The 9th International Conference on Virtual Learning
VIRTUAL LEARNING – VIRTUAL REALITY

Phase II - Period 2010-2020: e-Skills for the 21st Century
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ISSN: 1844-8933 - ISI Proceedings,
accessed via Web of Science, since year 2006

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The printing of Proceedings was sponsored by the Romanian Ministry of Education-Scientific Research, Technological Development and Innovation, ROMANIA

Proceedings of the 9th International Conference On Virtual Learning

OCTOBER 24-25, 2014

MODELS & METHODOLOGIES, TECHNOLOGIES, SOFTWARE SOLUTIONS
Phase II - Period 2010-2020: e-Skills for the 21st Century

ICVL 2014
INTERNATIONAL CONFERENCE ON VIRTUAL LEARNING

editura universității din bucurești, 2014

ICVL and CNIV Partners:
Grigore Albeanu, Mircea Popovici, Radu Jugureanu, Adrian Adăscăliței
www.icvl.eu **www.cniv.ro**

ISSN: 1844-8933 – ISI Proceedings,
accessed via Web of Science, since year 2006

THOMSON REUTERS

Şos. Panduri, nr. 90-92, BUCUREŞTI – 050663; Tel.Fax: 021 410.23.84
E-mail: editura@unibuc.ro, Web: www.editura.unibuc.ro

Desktop publishing: Meri Pogonariu

MOTTO

“The informatics/computer science re-establishes not only the unity between the pure and the applied mathematical sciences, the concrete technique and the concrete mathematics, but also that between the natural sciences, the human being and the society. It restores the concepts of the abstract and the formal and makes peace between arts and science not only in the scientist' conscience, but in their philosophy as well.”

Gr. C. Moisil (1906-1973)
Professor at the Faculty of Mathematics, University of Bucharest,
Member of the Romanian Academy,
Computer Pioneer Award of IEEE, 1996
http://www.icvl.eu/2006/grcmoisil

“Learning is evolution of knowledge over time”

Roger E. Bohn
Professor of Management and expert on technology management,
University of California, San Diego, USA,
Graduate School of International Relations and Pacific Studies
http://irps.ucsd.edu/faculty/faculty-directory/roger-e-bohn.htm

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ICVL Project – www.icvl.eu

2010 – TOWARDS A LEARNING AND KNOWLEDGE SOCIETY – 2030
VIRTUAL ENVIRONMENTS FOR EDUCATION AND RESEARCH

C^{3}VIP: "Consistency-Competence-Clarity-Vision-Innovation-Performance"

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Partners: Ph. D. Prof. Grigore Albeanu, Ph. D. Mircea Dorin Popovici,
Prof. Radu Jugureanu, Ph. D. Adrian Adăscăliței

Institutions: The Romanian Ministry of Education, University of Bucharest, Intel Company, SIVECO Romania

October 24 – 25, 2014 – BUCHAREST, ROMANIA

Location: University of Bucharest, Faculty of Psychology and Educational Sciences, ROMANIA

Organizers: University of Bucharest, Faculty of Psychology and Educational Sciences, Siveco Romania

Participate

The Conference is structured such that it will:

- provide a vision of European e-Learning and e-Training policies;
- take stock of the situation existing today;
- work towards developing a forward looking approach.

The Conference will consider the perspectives and vision of the i-2010 programme and how this will stimulate the promotion, and development of e-Learning content, products and services and the contribution of these to lifelong learning.

Participation is invited from researches, teachers, trainers, educational authorities, learners, practitioners, employers, trade unions, and private sector actors and IT industry.

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Research papers – Major Topics

The papers describing advances in the theory and practice of Virtual Environments for Education and Training (VEL&T), Virtual Reality (VR), Information and Knowledge Processing (I&KP), as well as practical results and original applications. The education category includes both the use of Web Technologies, Computer Graphics and Virtual Reality Applications, New tools, methods, pedagogy and psychology, Case studies of Web Technologies and Streaming Multimedia Applications in Education, experience in preparation of courseware.

Thematic Areas / Sections

- **MODELS & METHODOLOGIES (M&M)**
- **TECHNOLOGIES (TECH)**
- **SOFTWARE SOLUTIONS (SOFT)**
- **"Intel® Education" – Innovation in Education and Research (IntelEdu)**

Objectives

2010 – Towards a Learning and Knowledge Society – 2030

Relevant topics include but are not restricted to:

- National Policies and Strategies on Virtual Learning
- National Projects on Virtual Universities
- International Projects and International Collaboration on Web-based Education
- Dot-com Educational Institutions and their Impact on Traditional Universities
- Educational Portals for education and training
- Reusable Learning Objects for e-Learning and e-Training
- Testing and Assessment Issues of Web-based Education
- Academia/Industry Collaboration on Web-based Training

- Faculty Development on Web-based Education
- Funding Opportunities for Projects in Web-based Education

Learning and the use of Information and Communication Technologies (I&CT) will be examined from a number of complementary perspectives:

- **Education** – supporting the development of key life skills and competences
- **Research** – emerging technologies and new paradigms for learning
- **Social** – improving social inclusion and addressing special learning needs
- **Enterprise –** for growth, employment and meeting the needs of industry
- **Employment –** lifelong learning and improving the quality of jobs
- **Policy** – the link between e-Learning and European / National policy imperatives
- **Institutional** – the reform of Europe's education and training systems and how I&CT can act as catalyst for change
- **Industry** – the changing nature of the market for learning services and the new forms of partnership that are emerging

General Objectives

The implementation of the Information Society Technologies (IST) according to the European Union Framework-Programme (FP7)

- The development of a Romanian Framework supporting the professional and management initiatives of the educational community.
- The organization of the activities concerning the cooperation between the educational system and the economical companies to find out an adequate distribution of the human resources over the job market.
- To promote and implement the modern ideas for both the initial and continuing education, to promote the team based working, to attract and integrate the young graduates in the Research and Development projects, to promote and implement IT&C for initial and adult education activities.

Particular objectives

The development of Research, projects, and software for E-Learning, Software and Educational Management fields

- To promote and develop scientific research for e-Learning, Educational Software and Virtual Reality
- To create a framework for a large scale introduction of the e-Learning approaches in teaching activity.

- To assist the teaching staff and IT&C professionals in the usage of the modern technologies for teaching both in the initial and adult education.
- To improve the cooperation among students, teachers, pedagogues, psychologists and IT professionals in specification, design, coding, and testing of the educational software.
- To increase the teachers' role and responsibility to design, develop and use of the traditional technologies and IT&C approaches in a complementary fashion, both for initial and adult education.
- To promote and develop information technologies for the teaching, management and training activities.
- To promote and use Educational Software Packages for the initial and adult education.

Thematic Areas/Sections

Models & Methodologies (M&M):

- Innovative Teaching and Learning Technologies
- Web-based Methods and Tools in Traditional, Online Education and Training
- Collaborative E-Learning, E-Pedagogy,
- Design and Development of Online Courseware
- Information and Knowledge Processing
- Knowledge Representation and Ontologism
- Cognitive Modelling and Intelligent systems
- Algorithms and Programming for Modelling

Technologies (TECH):

- Innovative Web-based Teaching and Learning Technologies
- Advanced Distributed Learning (ADL) technologies
- Web, Virtual Reality/AR and mixed technologies
- Web-based Education (WBE), Web-based Training (WBT)
- New technologies for e-Learning, e-Training and e-Skills
- Educational Technology, Web-Lecturing Technology
- Mobile E-Learning, Communication Technology Applications
- Computer Graphics and Computational Geometry
- Intelligent Virtual Environment

Software Solutions (SOFT):

- New software environments for education & training
- Software and management for education
- Virtual Reality Applications in Web-based Education
- Computer Graphics, Web, VR/AR and mixed-based applications for education & training, business, medicine, industry and other sciences
- Multi-agent Technology Applications in WBE and WBT
- Streaming Multimedia Applications in Learning
- Scientific Web-based Laboratories and Virtual Labs

- Software Computing in Virtual Reality and Artificial Intelligence
- Avatars and Intelligent Agents

Topics of interest include but are not limited to:

Virtual Environments for Learning (VEL):

- New technologies for e-Learning, e-Training and e-Skills
- New software environments for education & training
- Web & Virtual Reality technologies
- Educational Technology and Web-Lecturing Technology
- Advanced Distributed Learning (ADL) technologies
- Innovative Web-based Teaching and Learning Technologies
- Software and Management for Education
- Intelligent Virtual Environment

Virtual Reality (VR):

- Computer Graphics and Computational Geometry
- Algorithms and Programming for Modeling
- Web & Virtual Reality-based applications
- Graphics applications for education & training, business, medicine, industry and other sciences
- Scientific Web-based Laboratories and Virtual Labs
- Software Computing in Virtual Reality

Knowledge Processing (KP):

- Information and Knowledge Processing
- Knowledge Representation and Ontologism
- Multi-agent Technology Applications in WBE and WBT
- Streaming Multimedia Applications in Learning
- Mobile E-Learning, Communication Technology Applications
- Cognitive Modelling, Intelligent systems
- New Software Technologies, Avatars and Intelligent Agents
- Software Computing in Artificial Intelligence

Education solution towards 21st Century challenges (IntelEDU):

- Digital Curriculum, collaborative rich-media applications, student software, teacher software
- Improved Learning Methods, interactive and collaborative methods to help teachers incorporate technology into their lesson plans and enable students to learn anytime, anywhere
- Professional Development, readily available training to help teachers acquire the necessary ICT skills
- Connectivity and Technology, group projects and improve communication among teachers, students, parents and administrators

Section

MODELS & METHODOLOGIES

Models and Methodologies (M&M):

- Innovative Teaching and Learning Technologies
- Web-based Methods and Tools in Traditional, Online Education and Training
- Collaborative E-Learning, E-Pedagogy,
- Design and Development of Online Courseware
- Information and Knowledge Processing
- Knowledge Representation and Ontologism
- Cognitive Modelling and Intelligent systems
- Algorithms and Programming for Modelling

Computing Center of the University of Bucharest, an Important Step in the History of Computer Science in Romania

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Abstract

This article presents a history of Computing Center of the University of Bucharest (CCUB) and its role in the founding of informatics in Romania.

Keywords: Computing machines, Computing Center, Informatics

1 The beginning

During the first half of the fifties decade, *Acad. Grigore C. Moisil,* as a true pioneer, visualized the future of computers in society [5]. Even then, he realized the importance of mathematical logic and theory of automata for designing computers.

In 1959, inspired by the *International Congress of Romanian Mathematicians* held in *Bucharest* (in 1956), Acad. Grigore C. Moisil (1906-1973), Professor of Algebra at the Faculty of Mathematics and Physics, founded, for the first time in the country, the *Specialization of Computing Machines* in the Department of Mathematics of the faculty [5,7]. The program of this specialization was extended for the last two years (from five!) of studies. At the beginning, the curriculum was mostly *theoretical* but in time the staff used the experience of the Institute of Nuclear Physics (IFA), which had built-up the first computing machines CIFA[2] (of the first to two generation). Teachers were Prof. Paul Constantinescu and Constantin P. Popovici and the first generation of the about 10 graduates of the specialization in Computer Science were *enrolled* mainly in Bucharest, in the IFA or in some research institutes specialized in electronics or automation.

Apart from the University of Bucharest, some other academic or research bodies of Romania, such as Institute of Computing in Cluj, Polytechnic Institutes of Timisoara and Bucharest, Institute of Nuclear Physics at Magurele and later Academy of Economic Studies (ASE) in Bucharest or the Central Institute of Informatics, were also the pioneering units which started the development of Computer Science in Romania.

In order to stimulate the development of research in Computer Science, in February 1962, Acad. Moisil founded *the Computing Center of the University of Bucharest (CCUB)* [1,2,4,6,7], the first one in the country. The initial *petition* written by hand by Moisil, was approved during a short visit of his, by the Secretary of Education Prof. Eng. Stefan Balan, a former colleague while

[1] Professor Emeritus, University of Bucharest
[2] CIFA means Computer of the Institute of "Atomic" Physics. The first CIFA1 was built-up in 1956

he was teaching in the Polytechnics of Bucharest. As a formal body, the CCUB was a *Laboratory* of the chair of Algebra, lead by Moisil; of course, he was also the *Director of the Center.*

The initial location of the Center was in the *Negustori Street 9,* in a small building where a small *Library,* used by the students who were living in a student hostel from the neighborhood, also existed. The staff of CCUB was numerically small at the beginning; a few graduates from the specialization *Computing Machines* and two engineers (in total 5 researchers and 2 technicians) were the first members of CCUB. Prof. Paul Constantinescu was *Deputy Director.* At that time the only computing devices were two small analog machines of the type *HEATHKT,* brought by Prof. Mircea Malița from the United States, while he was in a diplomatic mission at the United Nations in New York, by the end of the fifties (See [6]). Of course these equipments became museum objects. In 1963, the location of the Computing Center was moved to Mircea Vulcănescu Street 125 (former Ștefan Furtuna 125). Here the amount of staff increased up to 15 (including 3 technicians) until 1968. In 1963 were installed here, an analog computer MEDA-20 and during the next two years, two other analog computers MEDA-40TA and MEDA-41TC, all these equipments beeing produced in Chechoslovakia. A progress was achieved by the end of 1964, when the Center received the digital CIFA-3 computer, produced in the mentioned IFA.

2 Starting Activities of CCUB

In 1966, two important events increased the quality of work in CCUB. First we mention the *International Colloquium "Computing Techniques and Computers"* organized by the University of Bucharest, Academy of Economic Studies and Polytechnics of Bucharest, with the financial support of the Romanian Government. To the succes of this meeting, highly contributed the young staff of the Center. (During that time I was a researcher in the *Center of Mathematical Statistics-CSM of the Academy of science,* and by request of *Acad. Moisil* and Acad. *Nicolae Teodorescu* I helped the organization of this Colloquium, having a good cooperation with the team of CCUB). This Colloquium brought in Bucharest new experience in computer science from about 50 participants from both eastern and western countries.

A second event which contributed to increasing scientific information in the Center, was the *six weeks exhibition of the computer ODRA,* brought from Poland, which that at time was the prototype of *two generation computer* met by the staff of the Center.

With the equipments of CCUB, at the beginning, it was not possible to achieve high performance. However, stimulated by Moisil, interesting problems related to *natural language translation, programming languages like "Algol 60", musical composition by computer and of course fundamental problems related to the theory of automata, were studied. The latter topic situated the University of Bucharest on the third place in the world after the Soviet Union and Czechoslovakia.* (See [3]). As concerns solving practical problems the staff tried to use CIFA-3 in this respect; when trying to solve a real *linear programming problem* which was custom at that time, after a half an hour of work, the computer stopped because the frequency of the electric power *was not stable.* (The computer was very sensitive with respect to frequency). Nevertheless, these computer equipments played a great role in improving experience in computer programming. (During that time the programming of computers was done in *low level languages,* i. e. languages closed to *machine code).*

A big qualitative step in the evolution of the Center was taken in January 1968, when the *Eastern Europe Branch of IBM Company,* located at that time in Vienna, organized an exhibition in Romania. Due the prestige of Acad. Moisil**,** *the IBM 360/30 computer,* then a very performing third generation computer, was installed in a specially designed building of CCUB, in Mircea Vulcanescu 125, near by the old building of the staff offices. During more than six months time, the IBM Company organized courses of two or three weeks to initiate the staff in computer programming (FORTRAN, COBOL and Assembler languages) and in using the DOS operating system (short from Disk Operating System) based on using *magnetic disks,* which was and still is fashionable. In opposition with the TOS=Tape Operated System, based on *magnetic tapes,* developed in the sixties by the British Company *ICT= International Computers and Tabulators.* Such a computer, also of the third generation, was bought by the Romanian Government in 1966, *to process the census* performed in that year. This ICT computer *was not open to a large public* as was the IBM 360/30 from CCUB.

Apart from the staff of the Center several other people from Bucharest or from other cities participated in these courses, such that the experience (and of course the advantage) of using a third generation computer was distributed in the family of computer science workers. IBM Company brought a large amount of computer documentation with the exhibition. Professor Moisil encouraged this kind of open training (called by him *free courses).*

Sometime in the third quarter of 1968 the Romanian Government bought the IBM Computer which was assigned to *three owners:*

1. *CCUB (e.g Minister of Education),*
2. *Government Commission of Informatics (e.g. the high body for supervising Computer Science in the Country) and*
3. *Minister of Agriculture.*

The cost of the whole installation was 638.000 USD. This was a high price because *computers* were considered high technology, prohibited for countries *over the iron cur tine,* as was Romania in that time!. Let us underline that *Government Commission* played 2/3 from the cost, the Minister of Education 1/3 of the cost, while the Minister of Agriculture played nothing at that moment, being obliged to provide later the money for extending the hardware configuration (e.g. magnetic disks, printers, punching cards machines and so on). The administration of the IBM Computer was allocated to CCUB . A detailed report on the initial activity of the Center is found in the papers [1, 2]. Note that the Center organized in one year many *free courses* to propagate computer programming among various potential users. Note also that in 1969 Moisil founded in the Faculty of Mathematics the *Chair of Informatics,* the first one in the country.

In 1968, the Romanian Government started to develop its own computer industry. At the beginning of 1969, some computers *IRIS 50* together with corresponding technology, were bought from the French Company *CII=Companies Internationale d'Informatique* with the aim to produce these computers in Romania. Many new computing centers were founded and an extensive activity to train users of modern computers was developed. CCUB did not have enough staff, but nevertheless, many training courses were organized. During the summer of 1969, the Government Commission of Informatics (in fact a political body!) organized an extended meeting with all leaders of existing centers in the country. Maybe, due to some unknown reason, Moisil he was strongly criticized *for not using efficiently the IBM computer.* As Moisil was very proud, he announced his resignation. Perhaps, he thought that the Dean of the Faculty, his lifetime friend, Acad. Nicolae Theodorescu, will not approve his resignation. But by a political demand, Teodorescu approved it. As the resigned, Moisil was very angry. The management of the Center was then done honorifically by Theodorescu, until the 1-st of February 1970, when the Government Commission asked me to be the Deputy Director of CCUB. In fact, I was obliged to do this, because I was a scholar of the Government in 1968-1969 at Manchester University (U.K.) where I got a *M.Sc. Degree in Automatic Computation.* Before I was proposed for this job, the Government Commission tried to appoint at CCUB an engineer as Deputy Director, but the Council of the Faculty did not accept, preferring a mathematician.

Fig. 1. Grigore C. Moisil - IBM 360 computer room at CCUB (archive TVR [8])

In the picture above (IBM/360 computer room in Street Stefan Furtuna 125, the CCUB-Computing Centre of the University of Bucharest) left to right*: Maria Lovin, Constantin Popovici Nicolae Popoviciu, Petre Preoteasa, Stelian Niculescu, Acad. Grigore C. Moisil.*

The first thing I did being nominated at CCUB, was an appointment with Acad. Moisil. During an interesting talk late one evening at his home (Moisil used to work mainly during the night and the last half of a day), I got a warm advice on how to act as a good research manager of the Center.

In February 1970, the staff of the Center consisted of 16 programmers and analysts and 6 technicians or junior operators and programmers. I must underline that, among auxiliary programmers, two were produced by a *postsecondary school* organized in Bucharest by Moisil (during 1968/69) and they proved to be *the best auxiliary staff in computer activity*. Unfortunately, by unknown reason, that school was *stopped* after one year.

In 1972 Prof. Dragos Vaida and myself designed (at the request of the Minister of Education Prof. Mircea Malita and of Prof. Moisil) a curriculum for the *Section of Informatics* which was created in all five Faculties of Mathematics of Romania, staring October 1972. This curriculum, which consisted among others, in *Basic knowledge on computers, Programming and formal languages, Operating systems, Data bases, Compiling techniques,* is still the main frame for the informatics section even today. The staff of CCUB has continuously given lectures for students in many topics, but mainly in computer programming.

Nevertheless, the staff was totally insufficient for an efficient computer use. The first thing I have done was to organize the computer activity in three shifts, combining our staff with Minister of Agriculture staff. The Minister of Agriculture bought further auxiliary equipments as punching machines, printers, terminals and some other devices. I tried to increase the staff, but as CCUB was a *Laboratory,* the first step was *to create a legal framework* for selecting new qualified staff. Therefore, with the help of Government Commission, I initiated *the Government Law 1948/31.12. 1970,* which was approved, in this manner *increasing the legal level of CCUB,* with the possibility of extending the number of staff up to 125 persons of different qualifications.

Even in the autumn of 1970, with the help of some experienced colleagues, I organized *weekly seminars,* asking all qualified staff to give talks about the news they learned and about their work results. These seminars were a tradition learned from Moisil and from my Ph.D. supervisors Octav Onicescu and Gh. Mihoc. After some time the seminars were divided in two weekly sections: *Stochastic modeling and simulation* (coordinated by myself) and *Theoretical problems of Computer Programming* (coordinated by the regretted fellow Liviu Sofonea).

One priority was to facilitate the access of students to use the computer, taking into account that preparation of programs (on punch cards) was not possible in the narrow environment of the Center. Therefore, two offices were organized, one in *Soseaua Panduri* and one in the Faculty of Mathematics.

In 1976 the Center received a Romanian computer FELIX C-256 which made more attractive our activity for cooperation with various Romanian users. The staff increased by selection of graduates from the faculty but, unfortunately, the Government did not allow us to enrollee too many graduates. (Priority was to enrollee graduates in industry!) Anyway, the staff has grown little by little, such as in 1975 CCUB had more than 50 employees and by the middle of '80's the staff number was 78! In 1972-1974, some fellows of CCUB undertook specialization stages in USA, Switzerland, Austria and France and when coming back they were basic leaders in research activity, such as: Liviu Sofonea, Nicolae Popoviciu, Maria Lovin, Dorin Panaite, Matei Bogdan, Ioan Rosca and so on. I, myself, for several months in 1974 and 1976, was a *visiting researcher at GMD Bonn*[3].

3 Research and Teaching Activitis, Cooperations

As the expenses of managing a Computing Center were increasing at that time, in 1973 CCUB started to perform research activity and services under contracts. I must say that expenses of activities in the Center were covered by funds from contracts at least from 1973 up to 1991; the services for students became free.

The research topics were various (see [6]). I mention some from the period of the seventies: simulation of mining transportation to achieve an efficient flow; simulation of flight of an airplane to achieve a given job; *design of the simulation language SIMUB* during 1976-1980 coordinated by me; (SIMUB=Simulation Language of the University of Bucharest); *design of computer product PLUB* during 1976-1980, coordinated by Liviu Sofonea; (PLUB=Programming Language of the University of Bucharest, used for generating compilers). The latter two languages were designed for the Romanian computer FELIX. They were worked in cooperation with some staff of the Chair of informatics (Professors A. Atanasiu and Horia Georgescu and regretted O.Basca and N. Tandareanu); some performing students were also used. Starting 1974, the computer usage was highly increased due to new staff enrolled and due to good work done by colleague Dumitru Draghici.

After 1970, the Center also organized *free courses* for people from Bucharest and the Minister of Education recognized the document which attested the graduation of these courses. Some of these graduates became later teachers in computing for Secondary Schools. Starting 1971, some staff from the Center (as Matei Bogdan and Petre Preoteasa) worked under the frame of Minister of Education for teaching *special classes of computer science* in some secondary schools of

[3]GMD means Geselschaft fur Mathematik and Datenverarbeitung

economics; graduates of these classes were very well appreciated as computer operators or programmers.

CCUB also developed some significant activities in *cooperation with UNESCO.* Thus, in 1971, due to the contribution of Acad. Teodorescu, an *International Summer Scholl of Informatics* was organized at Mamaia-Constantza. Specialists or audients from Romania and from France, Italy, Germany and others, participated. The lectures were printed, being used afterwards as references. In the summer 1972 a *UNESCO Round table on "Computer Assisted Instruction"= CAI* was organized. It was the first event of this kind in the country. (On this opportunity was tested for the first time an air conditioning system!).

By far the most important cooperation with UNESCO was *The International Postgraduate Course "Informatics and Applied Mathematics for Research".* There were nine annual editions of this course between 1973-1982. The UNESCO delivered each year 10.000 USD and Romanian Government offered 10 scholarships for participants from *Developing Countries.* The lessens were given (and written) in English and the teachers consisted of fellows from the Center or from the Faculty of Mathematics. The first semester was intending to bring *up-to-date the students* and the second semester consisted of two modules: *Informatics* and *Applied Mathematics.* There were participants selected from various countries such as: Syria, Iraq, Iran, Jordan, Egipt, India, Pakistan, China, Greece, Bulgaria, Poland, Bangladesh, Columbia, Brasil, Venezuela, Thailanda, Philipines, Costa Rica and so on. The course was also attended each year by at least 10 Romanian specialists. Among these, I mention some young assistants from the University of Civil Engineering (in 1982 was Calin Popescu Tariceanu), from Brasov, Pitesti and from Bucharest. Many of graduates of this course continued Ph.D. programs under coordination of staff of the Faculty, including myself, or in other Institutes from Bucharest. Even if the course was appreciated by UNESCO and by the participants, it was stopped due to economic difficulties of Romania during the 80's.

Unfortunately, Acad. Moisil died in 1973 (in Canada) and he was not able to enjoy the new results of CCUB, created by him.

During the seventies, the Center was also involved in some cooperation activities between the so-called *Socialist Countries.* Thus, the *Commission of Informatics of the Romanian Academy (lead by Acad. Tiberiu Popovici from Cluj, after the disease of Moisil)* asked for the cooperation of CCUB for organizing the meeting between representatives of socialist countries which was held in Bucharest in the summer of 1976. I, myself, participated also, as a Russian speaker.

The Minister of Education asked CCUB and the Computing Center of ASE to work in the Group of cooperation of Socialist Countries in the field of Education in Computer Science. The responsibility of this cooperation was for the Hungarian colleagues. Therefore, Dr. *Bilciu C.*, from ASE (which now lives in USA) and myself, participated in annual meetings of the group in 1977-1979 in Szeged and Budapest, where interesting problems of the curricula in computer science were discussed. Unfortunately, we were obliged by our authorities *not to agree with any of the interesting ideas,* even they assumed no pledge. As the leader of the Romanian side, I was highly ashamed!

During the years, the Center has done computer service and applied research for many units in the country such as: Factory "Electronica" and Factory IOR (which accomplished computerized management); some mining companies for which we performed research on using *Geostati tics* in estimating geological reserves (various appreciated applications regarding estimation of the various reserves of the country were obtained by *Mircea Adam* and *Emil Perjeriu*); optimization work for the huge project of sculptor exploitation in *Caliman Mountains* (which at the end the project was stopped by unknown reasons); an important statistical package for *new drug testing* (successfully designed by my PhD fellow *Denis Enachescu*). In the 80's, to an interesting project to manage the *traffic flow of autos* in Bucharest, participated successfully my Ph. D. fellow Gh.Petrescu.

In 1976 the Minister of Education asked the Computing Centers of Universities to develop a *program called SICAB* for ensuring an efficient management of the education system. In this respect, an *Informatics System for the personal used in education units of the country* was designed. This system illustrated many discrepancies in the balance of academic staff (for instance, in the fields of Economics and Geography, the percentage of professors and readers was very high compared to the fields of medicine and mathematics). Because the admission in higher education was done at that time by means of strong competition (and in the case of faculties of economics and law, defalcations were discovered) we developed a *computerized methodology for a safe processing of admission examination data* which is applied even now as a rule. Many other SICAB applications were analyzed an applied over time, related to management of equipment and material in universities, computerized salary calculation and so an. One application was done in collaboration with the Romanian state TV; a weekly poll data was processed in order to determine the optimum TV time table. As it is known, at that time, the TV schedule consisted of only some hours in the evening and half the time was allocated to the *Ceausescu family.* But once, the result of processing showed that audience for *the family* was null, therefore the project was stopped until 1990 when Ceausescu's regime failed.

4 Difficulties, Disappearance of CCUB

In 1986, CCUB had to change its address. In the eighties, Ceausescu decided to build the *huge Parliament House* in a space close to *Military Museum,* an unit of national importance. This museum had to be moved. As the buildings in the neighborhood of the Center belonged to the Minister of Defense before 1956 (when they were temporarily borrowed by the Minister of Education), it was decided that we must be moved, for bringing Military Museum instead. There was a big problem to select the best space in the University, where to move the Center which, by that time, had two big computers, many terminals and quite enough staff. The best location for equipments should have been in the main central building of the university, where a big room was suitable for the computers. But this room belonged to the *Institute of South-East European Studies.* Some official from the University suggested that such a solution will bring some protest from *Radio Free Europe,* which at that time led a strong propaganda against Ceausescu's regime. Thus, the only location selected by the administration of the university was in the building of the Faculty of Mathematics from 14 Academiei Street, the rooms of the Dean's and Secretary Offices, and the big Council Room. This was an unfortunate situation for me: for many years I was criticized by the colleagues in the faculty *that I damaged the tradition of the Faculty,* because the administrative bodies were transferred in non usual locations.

It is important to say that this action of moving the Center was very costly, but all expenses (including manpower) were ensured by the Minister of Defense. A problem was to move from Mircea Vulcanescu Street, *the cooling fans,* which had to be placed in the inner court of the building, very far from the air conditioning installation of computer room. The length of the copper pipes necessary for the flow of cooling liquid, was five times larger than in the old location. With the help of a lady programmer of the Center, whose husband was an influent person, we obtained the necessary copper pipelines for the cooling installation. (At that time copper was a metal as expensive as gold). As computers were installed at the ground floor, the offices of the staff were located at the top (i.e fourth) floor. One problem was also to connect terminals from the ground floor to the top floor, but with the help of a military specialist the problem was solved. At the top floor, there were previously some classrooms owned by the faculty of Physics, which moved already in 1971 at the Campus Magurele, so, we became the owners and the big rooms were divided in smaller rooms in order to be suitable for our staff.

After 1986, *the cooperation with the colleagues of the Chair of Informatics* was improved. It was really an improved integration of the staff of the Computing Center with the practical activity of teaching students. But at that time, more effort had to be made in order to ensure the funding for the necessary expenses. (By the end of eighties, the economic crisis was effective in Romania!). During this period of time, two minicomputers CORAL and INDEPENDENT were installed, they increasing the research and teaching activity.

After the *Events of December 1989* the Center continued its activity and by request of the regretted colleague Dr. Emil Perjeriu, *a former political detainee,* I still remand the Director. In the mean time, the faculty and the Center received modern PC computers (bought with the currency from UNESCO) allowing further improvement of our activity. But as the most part of our partners for research activity disappeared, the Center could no longer have enough contracts to finance its activity.

With some help (contracts) from some friends, including Calin Popescu Tariceanu, the boss of an auto company, we could survive for two years. In this bad situation, the staff, which in majority had Ph. D. degrees, *left CCUB as teachers in different faculties: Tudor Balanescu, Gheorghe Marian, Denis Enachescu, Stefan Stefanescu, Florentina Hristea, Emil Perjeriu, Andrei Baranga, Mircea Adam, Rodica Niculescu, Victorina Panaite* at our faculty; *Gheorghe Petrescu, David Dumitru and Paul Radovici* in University of Pitesti; *Marin Vlada, Liviu Sofonea and Cornel Stanescu* at the Faculty of Chemistry; *Grigore Albeanu* at "Spiru Haret University"; *Nicolae Popoviciu* (which makes me pleasure as being my first Ph.D. Student) at Military Academy and Hyperion University; Maria Tudor at ASE; Petroniu Doina at Polytechnic-Bucharest; Matei Bogdan in the faculty of political sciences. The most part of the staff had obtained Ph.D. degrees under the supervision of *Acad. Solomon Marcus, Prof. Leon Livovschi, Prof. Constantin Popovici* and myself. Some of the former fellows from CCUB are working in Universities abroad such as: *Radu Nicolescu* in Aukland, (New Zeeland); *Gheorghe Marian* and *Gheorghe Doina* in Sheffield University (UK); *Serban Gavrila*-a programmer in USA. During the years, more those 50 fellows working in other universities of the country and more than 20 from abroad, prepared their Ph. D. theses in the Chair of informatics or in CCUB.

In august 1993, while I was a researcher at TH-Darmstadt[4], by a statement of the Chancellor of the University, Emil Constantinescu, *CCUB was abolished* and even *quashed* retrieving of computer equipments being close to nothing. (Hardware contained more than five tones of metal among which at least 150 kg copper, 2 kg silver and one kg gold!). I asked myself sometime whether the abolishment of CCUB is connected to my refuse to join the Parti of Constantinescu, *Solidaritatea Universitara* in 1991. Anyway, by *abolishment, the Faculty recovered its tradition!* In any other universities from the country, computing centers were preserved as research units.

When I came back in October 1993, I created within the Chair of Informatics a *Research Center in Informatics* which carried out contract- based research, using academic staff, until 2007 when I retired. This research center still survives but does not have too much activity. The scientific seminar *Stochastic Modeling and Simulation,* opened in 1972, was active monthly until 2011, when the last of my Ph.D. Student defended the thesis.

A part of the auxiliary staff of former CCUB remained in the faculty to assist the activity of computer laboratories.

I dare to think, that CCUB, which survived for 31 years (quite a long life in Computer Science), has given enough benefit to our society and that efforts of the staff was really useful.

[4]TH-Darmstadt means Technische Hochschule Darmstadt,

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Apps Service for Business, Education, Government - Creating forms and questionnaires using Google Drive[5]

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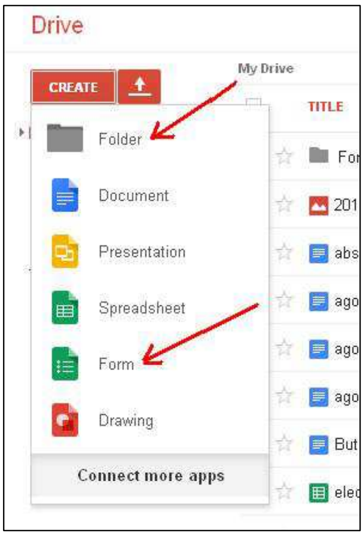
Abstract

This article provides you with detailed guidelines for creation, storage and use of various documents: Word (doc), presentations (ppt), spreadsheets (xls), newsletters, forms and questionnaires, etc. This article describes the steps to create the forms using Google Drive. The Google Drive is available for PC / Mac, Chrome OS, iPhone / iPad, and devices under operating system Android OS. Google Drive is a file storage and synchronization service provided by Google which enables user cloud storage, file sharing and collaborative editing.

Keywords: Storage, Forms, Questionnaires, Google Drive, Documents

1 Introduction



Google Drive, which has taken over the functionality for Google Docs, offers the option to create a form, which works well as a questionnaire and is available for free. Surveys created with Google Drive are recorded to a spreadsheet automatically, making it easy to view responses and manage your data. The help center is your online resource for learning about everything Google Drive has to offer. Help center articles will get you up to speed on a large variety of topics related to: Google Drive on the web; Google Drive for Mac/PC; The Google Drive app for smartphones and tablets. Google Drive provides five avenues for your questions: Help Center; Troubleshoot & Known Issues; Product Forum; and User Feedback.

If the user has created a Google account, you can access all the facilities and services offered by Google. Examples: Gmail (email service), create a Blog (Blogger), creating a website (Sites), creating and storing documents (Docs and Drive), creating forms and questionnaires (Drive), etc. It takes a single Google account for all Google services.

About Google products & Apps Service: Gmail, Search, Drive, Docs, Sheets, Slides, Drawings, Sites, Blogger, Chrome, Calendar, Books, Google+, Maps, YouTube, Google Play, Talk, Chat, Groups, News, Translate, Scholar, Mobile, Android OS, etc.

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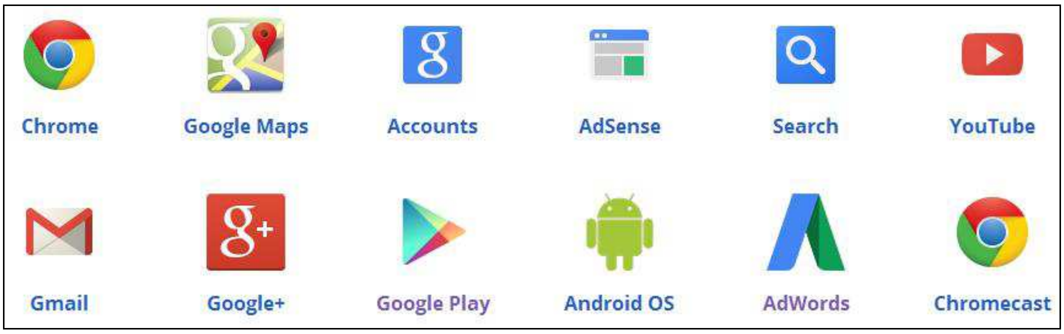

Figure 1. Service categories: Consumer, Business, Developer (Google)

Checking the status of these applications (Apps Status Dashboard):

- http://www.google.com/appsstatus#hl=en&v=status

Solutions:

- for Business - http://www.google.com/enterprise/apps/business/
- for Education - http://www.google.com/enterprise/apps/education/
- for Government - http://www.google.com/enterprise/apps/government/
- for Nonprofit - http://www.google.com/nonprofits/products/

2 Creating forms and questionnaires using Google Drive[6]

Before developing a forms and questionnaires the user must have the necessary knowledge of the role and structure, as well as some examples from various fields. In the words of Google, a form has a title (Title) that formed a Theme (Theme), and structure a set of questions (Questions) Items considered. Questions can be of the following types: Text, Paragraph text, Multiple choice, Checkboxes, Choose from the list, Scale, Grid, Date, Time. There are simple forms (e.g. Contact form). There are very complex forms and questionnaires that require different processing of stored information. Some of these treatments are provided automatically by Google Drive.

Steps to create forms and questionnaires (7 steps)

1. **Step 1**: Create a Google Account using the Google Chrome or Mozilla Firefox browser: accessing Gmail and then the "*Create an account*" to enter the information required to register as a user of all Google services. If the user has a Google account to access Google through user account;
2. **Step 2**: Accessing Google Drive, then the "*Create*" that provides submenus "*Folder*", "*Document*", "*Presentation*", "*Spreadsheet*", "*Form*", "*Drawing*". It is recommended to create a folder in which to save files for forms, then choose the menu item "*Form*".
3. **Step 3**: We will create a simple example of form before type Contact. Choose the menu item "*Form*" to create a new form. Appropriate window opens a new form which must indicate Title, eventually Theme (*Choose title and theme*) by subject means a model / template (*background*). Execute click the OK button. Name of Form title will appear in the upper left of the document page. This name can be changed (*Rename*) by accessing it. A guide (*Forms Help*) for information on accessing the Help menu is "*Help*" in the menu bar located at the top.

[6] Online registration forms for ICVL is done with Google Drive: http://www.c3.icvl.eu

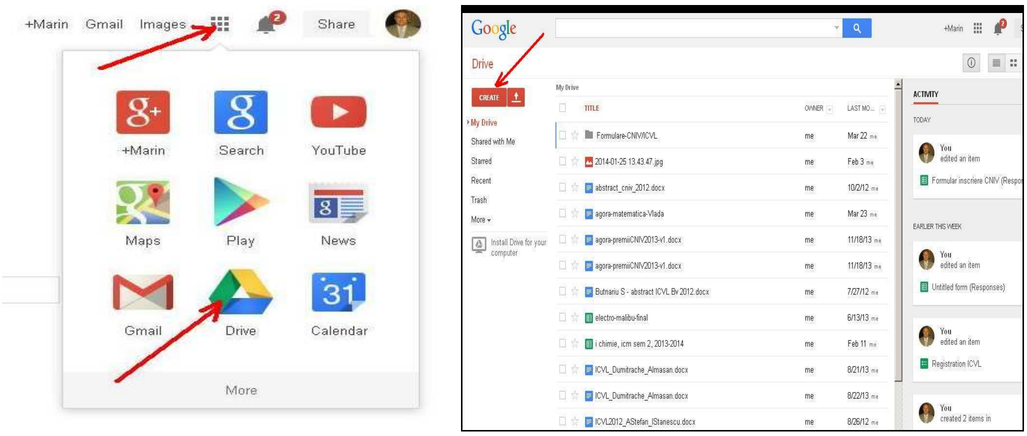

Figure 2. Apps service and Google Drive

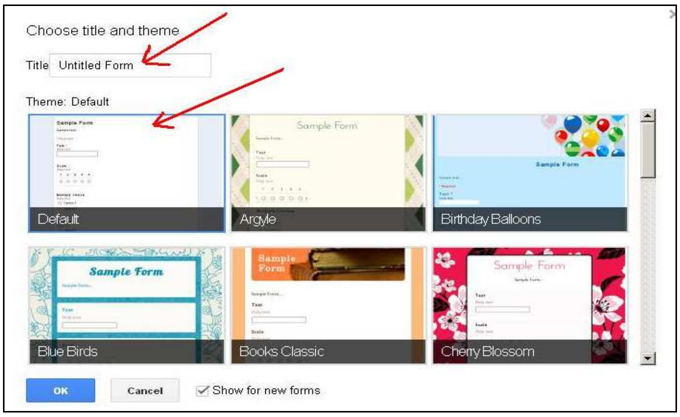

Figure 3. Choose title and theme

4. **Step 4**: Indicate elements for first Item (first Question): *Question Title*, *Help Text*, *Question Type*, and *Required question* (question, Done-validated or not). These elements will indicate each time you add a new item (new question), then accessing *Done*. Ensure that the type of question (*Question Type*) to choose from the list: *Text*, *Paragraph text Multiple choice*, *Checkboxes*, *Choose from the list*, *Scale*, *Grid*, *Date*, *Time*. For entries in each question can opt for their validation through "*Data Validation*". Observation: Using the three buttons in the top right, each mesh item (question) can be processed through *editing*, *duplication* or *deletion*. Also, after adding item (*question*) can be viewed final content of the form (*View live form*) by clicking *View live form* are in tool bar functions the top right.

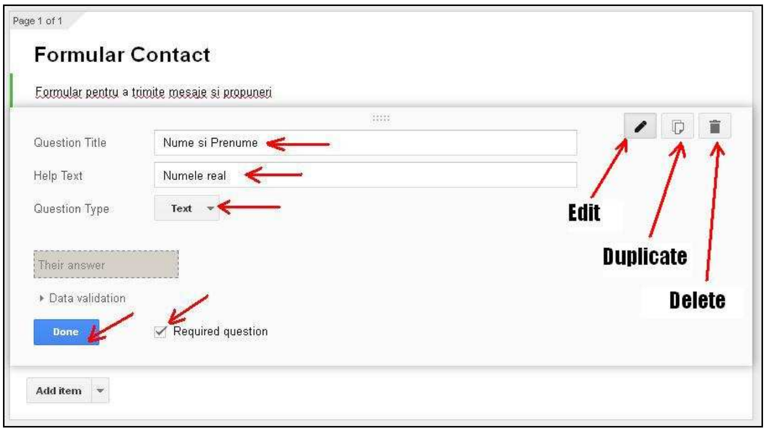

Figure 4. Indicate elements for first Question

5. **Step 5**: If the first question (first item) was created partially viewable final form as indicated in the previous step. Using the "*Add item*" will add two more questions (items), namely *e-mail* and *message*, type "*Text*" and "*Paragraph Text*". These types can be selected from the table displayed when accessing arrow on the "*Add item*". In this table are shown the three categories of types: BASIC (*Text*, *Paragraph text*, *Multiple choice*, *Checkboxes*, *Choose from a list*), ADVANCED (*Scale*, *Grid*, *Date*, *Time*), LAYOUT (*Section header*, *Page break*, *Image*, *Video*). Therefore, a more complex form can insert images, video, jump to page or new sections. These categories can be accessed from the "*Insert*" in the menu bar provided at the top.

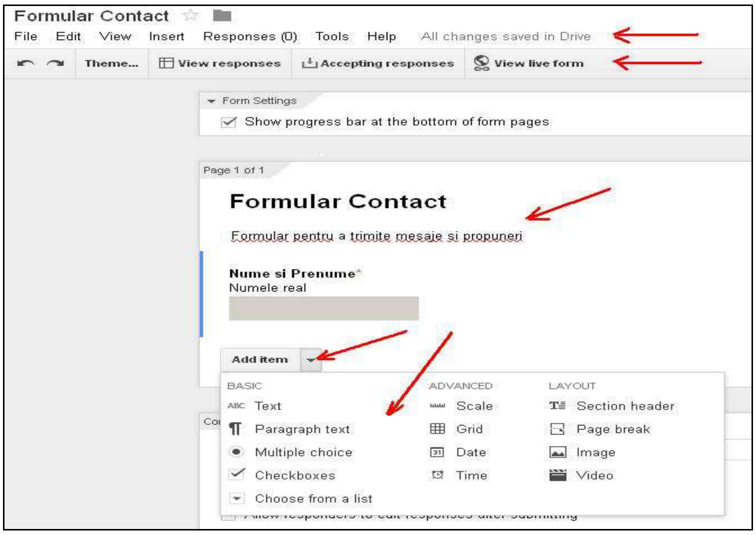

Figure 5. First question and "*Add item*" (following questions)

6. **Step 6**: Now the form is fog and can be viewed using the final "*View live form*". It is located in the top right toolbar. Next using the form that can be achieved by two ways:

insertion into a web page (blog, website, etc.) via a link or code (*Embed: Paste HTML to embed in website*) or submitting (*Send form via email*) to a number of e-mail; To use the form to access the "*Send Form*" located at the bottom of the form and cause the appearance of a window where you can choose two ways. These actions can also access the "*File*" menu that is located on the top left of the menu bar.

- In the first case insert a link share, for example: https://docs.google.com/forms/d/1vz9E_f1DnquVijwAFxKZfknfdNBXb7cwDXi6yNft1ws/viewform or insert or dusk HTML code (Embed: Paste HTML to embed in website), for example by changing *Custom size Width (*in pixels): , *Height* (in pixels):

<iframe src="https://docs.google.com/forms/d/1vz9E_f1DnquVijwAFxKZfknfdNBXb7cwDXi6yNft1ws/viewform?embedded=true" width="760" height="500" frameborder="0" marginheight="0" marginwidth="0">Loading...</iframe>

- in the latter form is sent by email to a number of e-mail; content of the message will contain a link to share online form and content of the form can be completed by those who received the message.

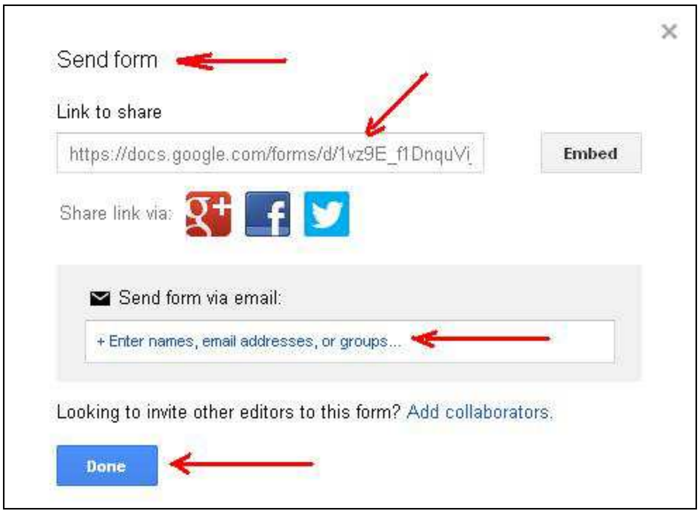

Figure 6. Send form via email

7. **Step 7**: Completing the form, receiving responses (*Responses*) and processing of information received (*Summary of Responses*). Filling in the form of a respondent (the person answering the questions of the form) will determine (by accessing the "*Submit*" button) storing information by Google Driver in https://docs.google.com by creating a spreadsheet, for example , which automatically creates *Form Contact* name (*Responses*), and a *Summary of Responses*). Therefore, in step 2 was recommended to create a folder in which to find documents related to this activity. Initially, after the form is created in the top menu *Responses (0)*. Who created the form (user with Google account) is able to store choice answers from respondents:
   - storing information in a spreadsheet (Responses Store in a spreadsheet), in this case a file named automatically creates *Contact Form* (*Responses*), the contents

of which can be viewed by accessing function *View Responses* in *Responses menu* or toolbar function (second bar above); using the / button "*Choose destination response*" can change the destination answers (*Change your destination response*) into a new spreadsheet; using the "*Unlink form*" any time you can choose the information is no longer presented in the spreadsheet and the information received is not lost, because they are automatically stored in the *Summary of Responses*; Also, any time you can use the "*Delete all Responses*" to delete the responses;

- default storing information from respondents (*Keep only in Response Forms*) in docs (*Form*) will automatically even if you do not want to store them in a spreadsheet. To access accessing recommended responses *File → Download as → Comma Separated Values*. Using the "*Summary of Responses*" to view all the information received from respondents with appropriate processing; if it accesses "*View all Responses*" to view all the information in a spreadsheet, and if access" Publish analytics "can opt for all respondents (people who have filled out) to have access to the results form (*Summary of Responses*).

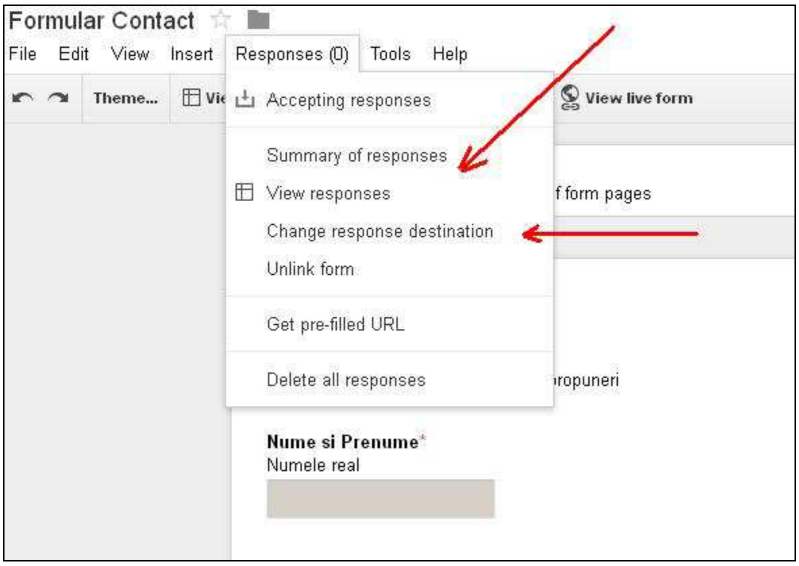

Figure 7. View all Responses and Summary of Responses

3 Complexity of forms and questionnaires

Questions to creating forms / questionnaires with Google Drive can be of the following types: : *Text, Paragraph text, Multiple choice, Checkboxes, Choose from a list, Scale, Grid, Date, Time.*

Types of complex questions:

- *Multiple choice* – Multiple choice single answer, **choose one option from** a set of two or more options, check the graphic sign is a small circle; for example, questions with answers YES or NO to the question for Sex: Male or Female, for the question "*Average of Baccalaureate*", there may be a number of four options to choose from one option: 6 to 6.9; 7 to 7.9; 8 to 8.9; 9-10;
- *Checkboxes* – check boxes for one or more answers, **choose one option or more** of a set of two or more options, check the graphic sign is a small rectangle; for example, one or

more answers to the question "*Where did you last buy a book?*" one or more answers to the question "*Where do you spend your free time?*";

- *Choose from a lis* – choosing from a list to a single answer, **choose one item** from a list of two or more elements; for example, choose an item from the list of the question "*Country of origin?*", choose an item from the list of universities in Romania the question "*University?*";
- *Scale* – scale of values of the evaluation criterion score (*notes, points, etc.*) represented by numbers from 0 to 10, indicating a name for the lower limit and upper limit (for example: "*very poor*" or "*very good* ");
- *Grid* – Grid /Network, a matrix defined by the names of the lines (*Row label*) and names of columns (*Column label*), the lines representing entities and columns representing criteria, so that when, fill out the form, the line must be a single answer.

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Methodological issues for university teaching ontologies development

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Abstract

Web-based education requires efficient software support tools. Among these, educational ontologies provide the solution for knowledge representation. The paper proposes a set of methodological guidelines for the development of university teaching ontologies starting from the EduOntoFrame educational ontology framework. An example of using the guidelines for a university course teaching ontology is presented.

Keywords: Teaching ontology, Web-based education, Ontology development

Introduction

The development of efficient educational ontologies became a real challenge for education, in general, and for a web-based education, in particular. Ontologies allow knowledge sharing. They offer a solution to the problem of knowledge representation and systems interoperability [5]. An university educational ontology is an ontology specific to the university didactical processes (i.e. teaching, learning, examination) that provide the support of knowledge sharing between teachers and students. Several educational ontologies were reported in the literature (see e.g. [1], [2], [3], [4], [6], [7]), each of them using particular development frameworks or methodologies. An educational ontology includes general concepts and terms that are specific to any course, and particular concepts and terms, that are specific to a certain course, i.e. domain of expertise. We have proposed in [8] a general framework, named EduOntoFrame, for educational ontologies development. Starting from this general framework, we have designed a methodology sketch for university teaching ontology development.

The paper is structured as follows. A set of methodological guidelines for university teaching ontology development is proposed in section 2. An example of using the guidelines for developing the teaching ontology for the course of Computer Programming Languages is presented in section 4. The final section concludes the paper.

Methodological guidelines for the development of teaching ontologies

Figure 1 shows a general view of the teaching activity. During the teaching activity for a specific course, the teacher uses a set of educational resources (books, textbooks, scientific papers, software, hardware, presentations, multimedia resources), and a teaching ontology. This ontology can be developed starting from the EduOntoFrame general framework proposed in [8]. The framework generates eight ontologies: four teaching ontologies (Course Basic Subject Ontology - CBS, Course Advanced Subject Ontology - CAS, Course Prerequisite Subject Ontology - CPS, and Course Basic Teaching Ontology - CBT), two learning ontologies (Course Practical Activities Ontology – CPA, and Course Basic Learning Ontology - CBL), and two examination ontologies

(Course Examination Ontology - CE and Course Basic Examination Ontology - CBE). They are presented in Figure 2.

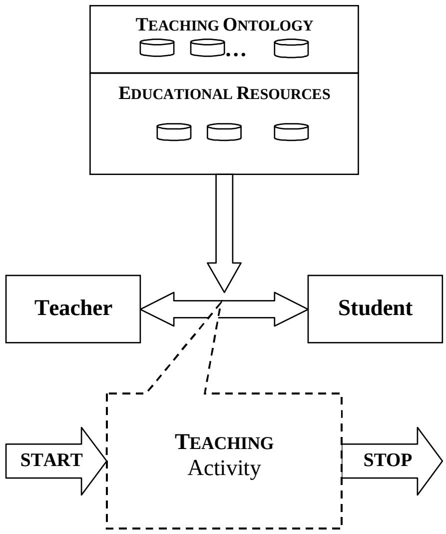

Figure 1. A general view of the teaching activity.

From these ontologies, five are course dependent ontologies (CBS, CAS, CPS, CPA, CE), and three are course independent ontologies (CBT, CBL and CBE), including concepts from the used educational, pedagogical, methodological and psychological didactical models.

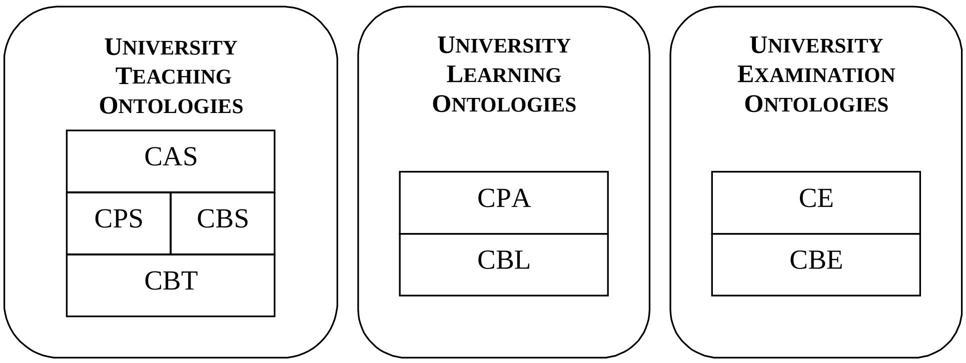

Figure 2. The educational ontologies generated by the EduOntoFrame general framework.

We propose a union of the four teaching ontologies generated by EduOntoFrame into one teaching ontology, named TeachOnto. From the viewpoint of the ontology vocabulary, we can formally represent it as a set.

Thus, TeachOnto = { CBT, CPS, CBS, CAS };

CBT – includes the basic terms of any university teaching activity;

CPS – includes the concepts from prerequisite courses, needed by the current course;

CBS – includes the basic concepts of the course, i.e. fundamental concepts needed to solve regular problems;

CAS – includes the advanced concepts of the course, needed to solve complex problems.

The structure of the TeachOnto ontology is given in Figure 3.

The teaching ontology is generated by using the following set of methodological guidelines.

****

Methodological Guidelines Set

Input: Course, Prerequisite Courses;
Output: TeachOnto

1. identify or take (from existing ontologies) the basic concepts of the teaching activity of any course;
2. initialize the teaching ontology with these basic teaching concepts;
3. identify or take (from existing ontologies) the course prerequisite concepts;
4. add to the current teaching ontology the course prerequisite concepts;
5. identify the course basic concepts;
6. add to the current teaching ontology the course basic concepts;
7. identify the course advanced concepts;
8. add to the current teaching ontology the course advanced concepts and provide the TeachOnto teaching ontology;

****

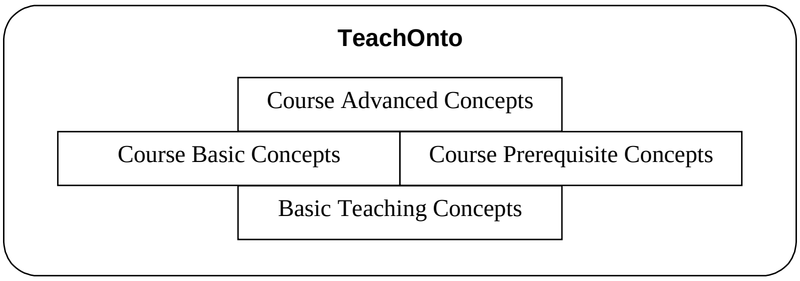

Figure 3. The structure of the teaching ontology (TeachOnto).

The teaching activity helps students to reach some educational and cognitive goals. Various teaching tools can be used by teachers: traditional ones (e.g. the blackboard, the overhead projector), modern ones (e.g. interactive PowerPoint presentations and different multimedia technologies) or a combination of them. The basic concepts of this activiy can be extracted from a careful analysis of university teaching.

Examples of basic teaching concepts are: pedagogical resource, knowledge resource, teaching model, teacher-directed model, student-directed model (or student-centered model), adaptive teaching, teacher competences, teaching method, teaching style, teaching feedback, teaching tools, teaching goals, educational goals, cognitive goals, course description, course content, course resource.

For each concept are given: a definition, a set of attributes that characterize the concept, and some related constraints, if necessary.

Figure 4 shows a part of the teaching ontology tree with some basic teaching concepts.

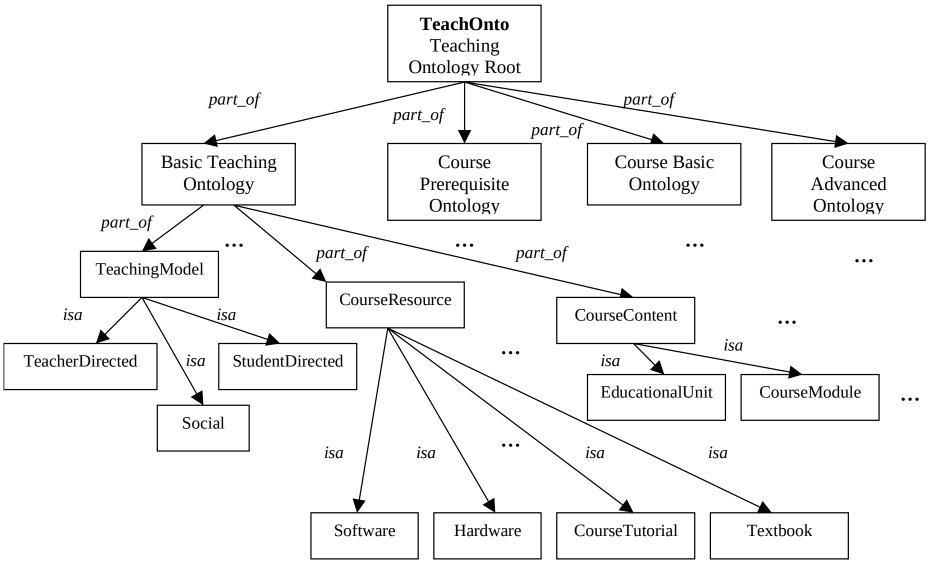

Figure 4. A part of the teaching ontology (TeachOnto) with some basic teaching concepts.

The definition of the teaching ontology involves apart from concepts identification and definition (i.e. vocabulary representation), the specification of the relationships between the concepts (such as *is_a*, *has*, *part_of*), and of the axioms stating the rules of using the terms correctly. In figure 4 the relationships are labels of the arcs between the nodes of the tree, representing the concepts.

All the concepts of TeachOnto, except the basic teaching concepts, are specific to the course that is teached and to the prerequisite courses needed by that course.

The above guidelines describe the sketch of a methodology for university course teaching ontology development. The teaching ontology is an important support tool for the university course teaching activity, and can be shared between different courses.

Example of university course teaching ontology

We have applied the methodological guidelines for the development of a university course teaching ontology in the domain of Computer Science, for Computer Programming subdomain. In this section, we briefly present the generated ontology (a prototype one, that can be extended with more concepts), and its implementation in Protégé [9], a Java-based ontology editor.

The teaching ontology named ProgrammingTeachOnto was developed for the course of Computer Programming Languages by following the guidelines given in the previous section. We have considered that the following programming languages are teached: Pascal, C, C++ and Java. The prerequisite courses are Fundamentals of Informatics and Computer Programming.

The application of the methodological guidelines for the generation of the ontology ProgrammingTechOnto was done as follows.

****
Generation of the ProgrammingTeachOnto Ontology
Input: *Course*: Computer Programming Languages;
Prerequisite Courses: Fundamentals of Informatics, Computer Programming;
Output:
Ontology: ProgrammingTeachOnto

During steps 1 and 2 we have generated the basic teaching concepts as specified in the previous section.

In steps 3 and 4 we have identified and added the concepts specific to the prerequisite courses of Fundamentals of Informatics and Computer Programming, i.e. concepts that are basic for the activity of programming. Examples of such concepts are: algorithm, program, data, input data, output data, instruction (or statement), sequence, decision, selection, iteration, identifier, variable, datatype, array, pointer, file, constant, function, procedure, parameter, formal parameter, actual parameter, function call, procedure call etc.

In steps 5 and 6 we have identified and added the basic concepts specific to the course of Computer Programming Languages. Examples of such concepts are: if instruction, switch instruction, case instruction, while instruction, for instruction, do while instruction, repeat instruction, composed instruction, Pascal procedure, Pascal function, C function, C++ class, C++ object, C++ constructor, C++ destructor, Java function, Java class. Some of the concepts are specific to a programming language, as e.g. switch instruction to C and C++, case instruction to Pascal, and so on.

In steps 7 and 8 the advanced concepts are identified and added to the teaching ontology. Examples of such concepts are polymorphism, try catch structure, exception, events, database connection, graphical interfaces.

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Figure 5 shows a part from the ProgrammingTeachOnto ontology tree.

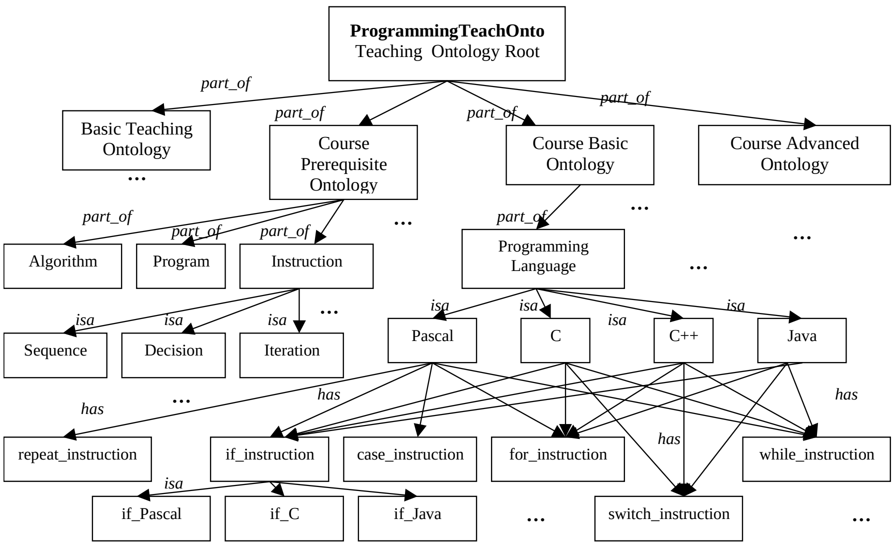

Figure 5. A part of the teaching ontology (ProgrammingTeachOnto).

We have implemented a prototype of the ProgrammingTechOnto ontology in Protégé 3.0 [9]. In Figure 6 it is shown a screenshot with some classes of this prototype.

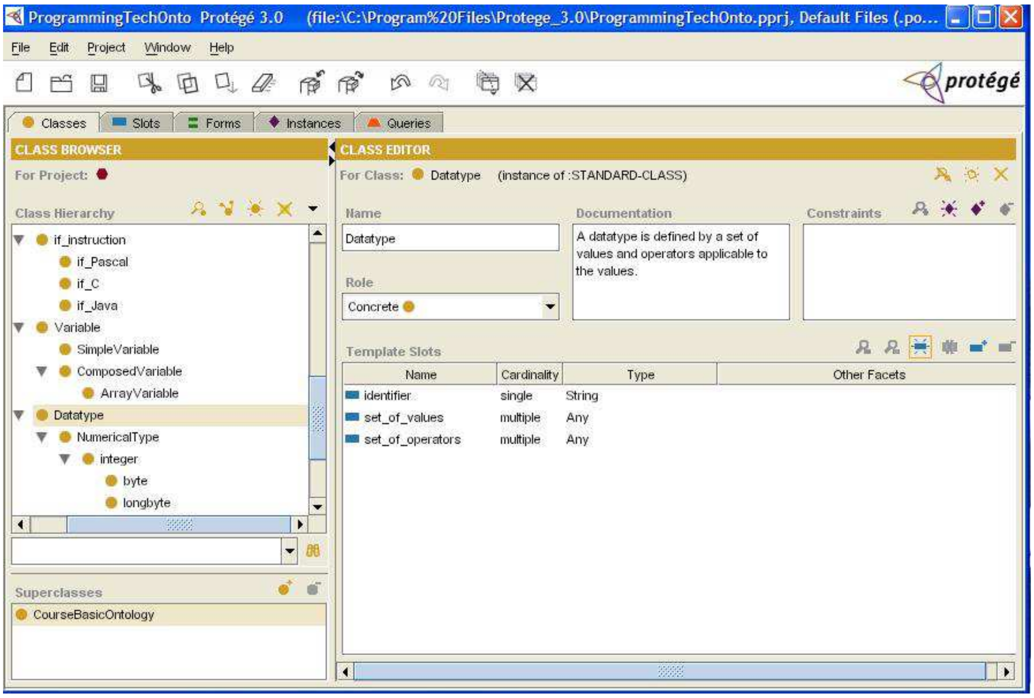

Figure 6. A screenshot with some classes of the teaching ontology, ProgrammingTeachOnto, in Protégé.

The teaching ontology can be used by teachers and students through various computer or network-based educational systems such as web-based educational systems, collaborative educational and research networks, virtual educational environments (as e.g. a virtual reality learning environment under innovative technology education as proposed by the InnoTek Project and described in [10]), or e-learning platforms.

Conclusion

The paper proposed a set of methodological guidelines for the development of a university course teaching ontology, TeachOnto, based on the EduOntoFrame educational ontology development framework. An example of using the guidelines for the domain of Computer Programming Languages was presented.

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On the use of artificial intelligence techniques for students evaluation

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Abstract

Artificial intelligence provides a set of techniques that can be applied to students evaluation, as for example, rule based expert systems, and artificial neural networks. The paper presents an overview of such techniques, and discusses the role of a student examination ontology under the university educational ontologies.

Keywords: Students evaluation, Artificial intelligence, Educational ontologies

Introduction

An educational process includes three main activities of teaching, learning and evaluation, in which are involved the principal actors, teacher and students. The automatization of this process is realized in computer-based education or computer-assisted education or, more general, IT technologies-based and assisted education. In this context, artificial intelligence (AI) provide various methods, techniques and technologies that can be integrated in the educational systems. For example, intelligent agents can be used as pedagogical or tutoring agents that assist students during learning activities [3]. The students evaluation activity can have an intelligent software support tool, based on different methods and techniques of AI: knowledge-based systems, rule-based expert systems, fuzzy systems, artificial neural networks, case based reasoning, data mining, machine learning or other computational intelligence techniques (such as genetic algorithms and swarm intelligence). Apart from the default requirement of knowledge representation in any educational system, provided by educational ontologies, the application of artificial intelligence is, usually, based on such ontologies. Starting from the general educational ontology for university didactical activities introduced in [9], an examination ontology can be developed for specific courses. In this paper it is presented an overview of some AI techniques that can be applied to student evaluation. Also, the role of a student examination ontology under the university educational ontologies is discussed,

The paper is structured as follows. In section 2 it is presented the overview of some AI techniques applicable to student evaluation. A discussion on university educational ontologies and the role of an examination ontology is made in section 3. The final section concludes the paper.

Artificial intelligence techniques for student evaluation

Artificial intelligence can be used in educational systems in order to improve their efficiency. Various methods, techniques and technologies are available for such purposes [12]. Among the traditional ones, we can mention knowledge based systems, expert systems, machine learning (as e.g. inductive learning), pattern recognition, case based reasoning. Other types include artificial neural networks, fuzzy inference systems, adaptive neuro-fuzzy systems (ANFIS), genetic algorithms, genetic programming, swarm intelligence, data mining, intelligent agents and multi-agent systems. From this variety, we have selected two techniques that are applicable to student evaluation: rule-based expert systems and artificial neural networks.

Rule-based expert systems

An expert system is composed by a knowledge base, that includes expert knowledge (heuristic) and an inference engine that makes reasoning (deductive, inductive) by chaining the knowledge. A rule-based expert system uses as knowledge representation method the production rules, i.e. IF-THEN rules (IF <conditions> THEN <conclusion>). Figure 1 shows the block schema of a rule-based expert system. The types of applications for which we can use a rule-based expert system are: analysis, diagnosis, monitoring and control, evaluation, training etc. In the case of students evaluation, we can use a rule-based expert system that apply general rules specific to students evaluation in universities and rules specific to the course that was teached. The rule-based expert system makes a symbolic reasoning and the response is usually, a symbolic one, with a linguistic value (fuzzy value).

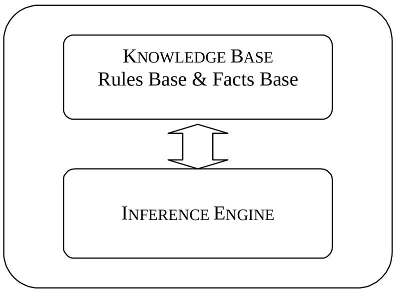

Figure 1. The block schema of a rule-based expert system.

Examples of general rules for a university course that has laboratory activity with periodical examinations (during semester), and the final examination:

RULE R15 (Heuristic Rule)
IF Student_lab_activity = Very_Good AND Lab_AverageMark >=9.00
AND Final_ExaminationMark >= 8.50
THEN
    StudentEvaluationResult = Very_Good;

RULE R2
IF Student_lab_activity = Poor AND Lab_AverageMark < 5
THEN
    Final_Examination = StudentNotAdmitted;

RULE R28
IF Student_lab_activity = None
THEN
Final_Examination = StudentNotAdmitted;

Examples of rules specific to the course of Object Oriented Programming (OOP):

RULE R_OOP_3
IF Lab_AverageMark >= 5.00 AND BasicOOP_KnowledgeMark >= 5
THEN
    Student_FinalExamination = PassedExam;

RULE R_OOP_5
IF Lab_AverageMark >= 5.00 AND BasicOOP_KnowledgeMark < 5
THEN
    Student_FinalExamination = NotPassedExam
BECAUSE “Minimum requirements for basic OOP knowledge are not fulfilled”;

The previous rule has an explanation text added by the BECAUSE clause at the end of the rule. The text explains the conclusion of the rule.
Other rules from the knowledge base can be particular to the type of examination or assessment method: essay (i.e. written essay), questionnaire test (as e.g. with simple choice, multiple choice, true false questions), project report etc, and to the corresponding learning objectives.
The parameters that are analyzed have numerical, symbolical or logical values. The symbolical values of some parameters are established by the interval in which their numerical values are included. Other symbolical values are qualitative evaluations, as for example, the evaluation of the student activity at course laboratories. The names of the parameters that appear in the rules can be taken from the educational ontology of the course.

Artificial neural networks
An artificial neural network (ANN) is composed by a set of nonlinear processing units, named artificial neurons, distributed and linked according to a specific topology. An ANN need to be trained, tested and validated on a specific dataset. Figure 2 shows the block schema of an ANN. Several ANN types are available: feed-forward ANN (Multi-Layer Perceptron – MLP), Hopfield ANN, Boltzmann ANN, Hamming ANN, Kohonen ANN etc. Each type of ANN has a specific architecture.
The ANN presented in figure 2 is a feed-forward ANN (FFANN) with an input layer with *m* artificial neurons, *r* hidden layers, and an output layer with *n* artificial neurons.

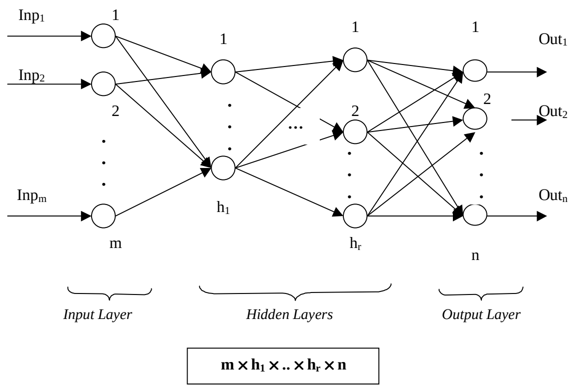

Figure 2. The block schema of an artificial neural network (FFANN).

In a FFANN each layer is connected with the next layer, except the output layer. Each artificial neuron has an activation function and the link between two artificial neurons has a certain weight

with the value in the interval [0, 1]. The ANN is trained with a training algorithm (e.g. a backpropagation algorithm). At the end of the ANN training, the weights values are found. The ANN validation and the testing phases uses these weights in order to provide the output values.
Formally, we can express the computation of the ANN outputs by equation (1)

$$Output(\mathrm{OPL}) = FFANN(Input(\mathrm{IPL}), Weights(\mathrm{WL}), ANNTraining(\mathrm{TPL})) \quad (1)$$

where, OPL is the list of output parameters, IPL is the list of input parameters, WL is the weights list, TPL is the training parameters list (e.g. the learning rate, the momentum parameter).

In the case of students evaluation, a FFANN can be used for various types of applications, as for example, students performance forecasting, based on historical data with past students evaluation results; students performance evaluation and teacher feedback for a certain course based on a set of parameters (e.g. student cognitive style, partial examinations results, student interest for the course – viewed by student presence and activity at courses, and laboratories, final examination results). The dataset can be generated from historical data obtained by the teacher during her/his past didactical activity. The names of the parameters (ANN input and output) can be taken from the educational ontology of the course.

AI-based students evaluation systems
Different student evaluations systems were developed so far, some of them based on AI. One of the earliest system described in the literature is introduced in [2], a model-driven question-answering system that uses sequencing as intelligent technology. An online evaluation system for web-based courseware, named QUIZIT, is proposed in [14]. More recently systems are based on ontologies (see e.g. [1], [6], [7]). For example, a question generation engine for educational assessment is presented in [1]. The engine named OntoQue is based on domain ontologies and can be used for questionnaires tests generation. Another evaluation system is introduced in [5] for online multiple-choice questions. An example of using fuzzy logic for students performance evaluation is shown in [13]. Another type of AI technique that can be used in students evaluation systems is data mining. In [8] it is described a web-based tutoring tool with mining facilities for the improvement of learning and teaching.
Usually, AI-based students evaluation systems and, in general, educational systems need ontologies as basic support tool. Thus, a students examination ontology need to be included in the educational ontologies of university courses. Such an ontology is based on the course content concepts from the university teaching ontology.

University educational ontologies
Educational ontologies can model a course for all didactical activities: teaching / tutoring, learning and students examination / performance evaluation [9]. They facilitates knowledge representation and sharing in educational systems [4]. University educational ontologies can be defined as ontologies specific to the instructional processes that take place in an university. An educational ontology has general concepts / terms for any course, and specific concepts / terms for the knowledge domain of a certain course. A term is a concept, a property or a relationship. Examples of terms used for university examination are: student knowledge level, examination method, examination feedback, exercises, questions, theoretical problems, practical problems. Examples of relationships used by the ontology are: *is_a*, *ako* (a kind of), *has*, *part_of* etc.

A general educational ontology for university didactical activities was presented in [9]. In this ontology, all terms that are course domain independent were grouped in a general educational ontology. The general ontology is composed by three course independent ontologies generated with the EduOntoFrame general framework [10]: Basic Teaching Ontology, Basic Learning Ontology and Basic Examination Ontology. Figure 3 shows the structure of this general educational ontology.

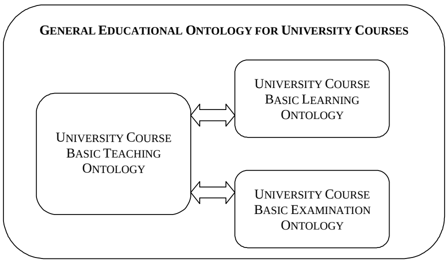

Figure 3. The structure of the general educational ontology.

Starting from the Basic Examination Ontology that we proposed in [9], we have implemented in Protégé 3.0 [11] a prototype basic university student examination ontology. In Figure 4 it is shown a screenshot with some classes from this ontology.

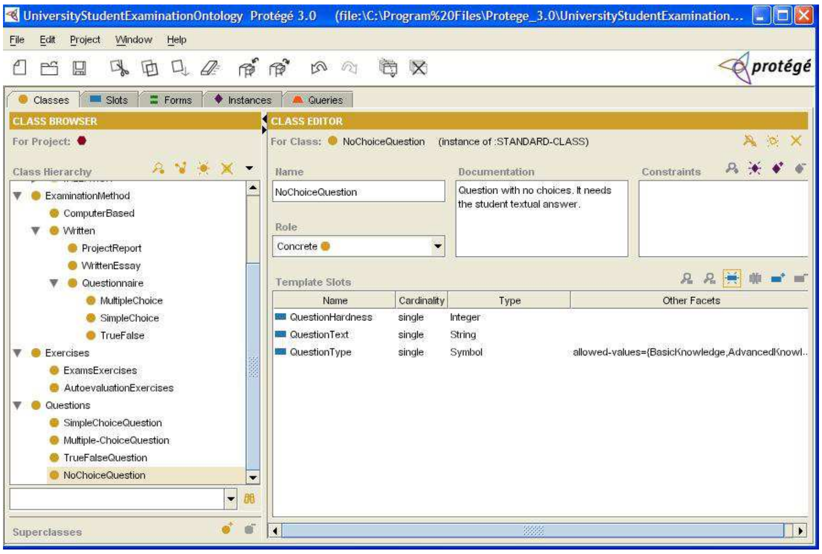

Figure 4. A screenshot with some classes of an examination ontology (in Protégé 3.0)

A students examination ontology provide the support tool for the university evaluation systems that analyze the student progress in a certain course. Such an ontology has the role to facilitate the development of full web-based educational systems that integrates all three main phases of any didactical activity: teaching, learning and examination.

Conclusion

The paper presented two artificial intelligence techniques that are applicable to student evaluation, rule-based expert systems and feed forward artificial neural networks. The use of these techniques in student evaluation systems that are integrated in full web-based systems, needs ontologies as support tools. Starting from the general educational ontology that we proposed in [9], we have implemented a prototype examination ontology in Protégé, and we have discussed the role of such ontology in an university educational system.

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The Use of Geographic Thematic Maps in E-Learning. Exemplification: Bobota Village, Romania

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Abstract

This study was prompted by the fact that students have difficulties in using thematic maps and finding out the relationships existing between various environmental components represented on maps. The paper presents an instructional method for virtual environment through which learners are guided in doing systematic analysis of thematic geographic maps. To exemplify how this method can be applied, an analysis of two thematic maps: of Bobota Village (in the county of Sãlaj, Romania) is presented. The two thematic maps used were for land elevation gradients and vegetation. We also exemplify the e-learning method through which the user performs a comparative analysis of these maps and establishes the relationships existing between environmental components represented on the maps. A number of ten Geography faculty members and two informaticians were interviewed on the use of the method in current instructional practices. The experimental part of our research was conducted with 44 university students at the Faculty of Geography within the "Babeş-Bolyai" University, Cluj-Napoca, Romania. The results obtained by participating students in the assessment of their assignments at various times during the experiment demonstrate they made progress in successfully completing their tasks, which encourages us to further employ this method in the analysis of other thematic maps with other students.

Keywords: Research, teachers' skills, online surveys, higher education

1. Introduction

Maps are very important sources of geographical knowledge (Bugdayci et al, 2011). Maps have an essential role in activating the thinking process of the user. Pupils will be able to transfer and process data on maps, to find location, to distinguish different types of maps, to perceive spatial distribution, to interpret maps correctly (Bugdayci, 2010).

Bugdayci et al (2011) states that every teacher encounters methodical problems when using maps to try and impart geographical knowledge to their students. Turkish teachers questioned on the types of maps that are difficult to understand by pupils selected all the seven options for thematic maps and suggested that "digital maps can be useful".

Specialist literature authors claim the Web has allowed maps to be created, disseminated, and used in ways that are vastly different from those in the past (Fu and Sun, 2010). Buckley and Frye (2011) mention that online maps can play several roles by communicating an increasing number of types of information. They underline that maps can portray much larger geographic extents than a typical computer screen, they can be multi-scale, they can be real-time, and they can be communal (are produced by a collective organizations).

Researchers emphasize the idea that "maps on the Web are assumed be fast, free, public, and eternally available. They are often interactive, intelligent (in that they can be linked to external data and other information sources), purposeful, and dynamic". On the other hand, not all maps posted on the web are accurate, as some are created by non-specialists in geography or cartography (Borruso, 2013, p. 11), even if they use advanced software (Bord, 2013, p. 54). There is a potentially dangerous, uncontrolled use made of such inaccurate maps by students (Osaci-Costache, 2012, p. 126).

We started this study based on the fact that in Romania as well, mentors for pre-service teaching practice and university faculty members state that undergraduates have difficulties in analysing and interpreting maps (Dulamă, 2006). Their analysis is chaotic and incomplete; it does not follow a plan and results in identifying only certain aspects represented on maps. Students fail to notice some essential features, typical of the content of a particular map (Dulamă, 2011a).

Using the ideas circulated in specialist literature, we suggest a development in the analysis of thematic maps in a virtual learning environment. The objectives of the study were the following: 1) to describe and analyze the method of analysis of thematic maps in e-learning (e-AMT); 2) to analyze the context in which the method is used; 3) to analyze the outcomes of implementing the e-AMT method. To achieve our aims we carried on experimental study in the academic year 2014, in our position of didactician, researcher and assistant lecturer.

2. Material and method

2.1. Participants

The subjects of our experimental research were 44 students in the 2nd year at “Babeș-Bolyai” University in Cluj-Napoca, the Faculty of Geography. They did a course in Psychopedagogy to become teachers of Geography for secondary education. We did not select a sample of participants out of the whole number of students enrolled for this course; we thought it would be better for us to have as many of students as possible to obtain relevant results. Participating students differ in their level of initial formation, amount of knowledge of Geography acquired, degree of specialist competence attained (subject variable) at the time when the experiment was initiated. These factors influenced the quantitative data of the research and the generalization of the results obtained. Since our study was limited to the 2nd year Geography student population of a single university it is possible that the results may not be representative for any type of Geography student population or sample.

There were 10 Geography teachers involved in our experiment, cooperating as mentors for students’ pre-service teaching practice, who volunteered to participate. There were differences of teaching experience, professional development experience and computer literacy level of competence. We also asked for the opinions of two informaticians for the purposes of our experiment.

2.2. Research hypothesis and variables

The following hypothesis was verified: by using the method of analysis of thematic maps in e-learning (e-AMT) the level of students’ competence of to identify essential aspects and analyze a map systematically increases. The independent variable was represented by the instructional activity in which the e-AMT method was used by the subjects. The dependent variable was represented by two indicators: the number of essential aspects identified on a thematic map and systematic organization of thematic map analysis.

2.3 Procedure

To test the hypothesis an experiment was developed over three stages.

Stage 1. Intial testing. In the first week of March 2014, students were given the hypsometric and vegetation maps of Măieriște Village, in Sălaj. The task set was to write an analysis of the two maps individually. We collected the texts produced by the participants.

Stage 2. Formative intervention. We designed and implemented several elearning activities over the months of March and April in three sessions. In the second week of March we gave each student the software developed on the basis of two thematic maps: the *Hypsometric Map of Bobota Village; the Vegetation Map of Bobota Village* (Chircev *apud* Dulamă, 2011) (see Figures 1 and 2). Each map had been designed with hyperlink buttons assigned for its analysis. Each button represented a category of items defined by the content criterion. When the map was displayed and a button was clicked, the first item and possible answers were shown under it. If the student clicked the right choice, the map with the correct answer was displayed. If the solution selected was wrong, the map with the question item and the possible answers were shown again. We included two types of objective items with alternative answers provided: true/false items and multiple choice items (see Tables 1-3). Students were requested to solve all items referring to the two maps (34 items in all; for the hypsometric map – 15 items; the vegetation map – 13 items; questions referring to both maps – 6 items).

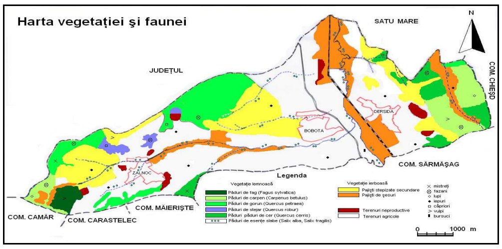

Figure 1. ***The Vegetation Map of Bobota Village*** **(Chircev *apud* Dulamă, 2011b)**

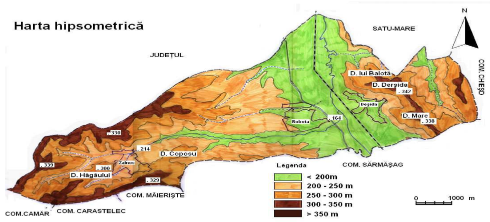

Figure 2. ***The Hypsometric map of Bobota Village*** **(Chircev *apud* Dulamă, 2011b)**

Table 1. ***Items referring to the thematic map "The Vegetation Map of Bobota Village"***

Buttons	Items
Types of vegetation associations	1. On the territory of Bobota Village there are forest of beech (*Fagus sylvatica*), hornbeam (*Carpenus betulus*), sessile oak (*Quercus petraea*), pedunculate oak (*Quercus robur*), cerris (*Quercus cerris*), soft wood tree species (*Salix alba, Salix fragillis*). True/False 2. On the territory of Bobota Village there are meadows and wood pastures. True/False
Location within the village	1. In which part of the village are the beech (*Fagus sylvatica*) forests located? a. to the north; b. to the east; c. to the south; d. to the west. 2. In which parts of the village are the hornbeam (*Carpenus betulus*) forests located? a. to the north; b. to the east and west; c. to the south; d. to the west. 3. In which part of the village are the pedunculate oak (*Quercus robur*) forests located? a. to the north; b.to the east; c. to the south; d. to the north-west. 4. In which part of the village are the sessile oak (*Quercus petraea*) forests located? a. to the north; b. to the east; c. to the south; d. to the north-west. 5. In which part of the village are the cerris (*Quercus cerris*) forests located? a. to the north; b.to the east and south-west; c. to the south; d. to the west.
Location by smaller villages making up village	1. The closest forests to the Bobota Village are those of sessile oak (*Quercus petraea*). True/False 2. The closest to the village of Zalnoc are the forests of sessile oak (*Quercus petraea*) and pedunculate oak (*Quercus robur*). True/False 3. There are extensive wood pastures: a. near the villages of Bobota, Derșida, Zalnoc. a. near the Bobota village; c. near the village of Derșida; d. near the village of Zalnoc.
Extensi-veness	1. The most extended type of forest on the territory of Bobota Village is that of sessile oak (*Quercus petraea*). True/False 2. The smallest wooded land area on the territory of Bobota Village is covered by cerris forests (*Quercus cerris*). True/False 3. The sessile oak (*Quercus petraea*) forest near the village of Bobota covers a large compact area. True/False 4. The sessile oak (*Quercus petraea*) forest near the village of Zalnoc covers a small sinuous area. True/False 5. Near Bobota village, the most extented area is that covered by: a. forests; b.arable land; c. wood pastures; d. meadows.

Table 2. ***Items referring to the thematic map "The Hypsometric map of Bobota Village"***

Buttons	Items
Land areas by elevation gradients	1. Land areas of Bobota Village coloured in green have an elevation of 200-250 m. True/False 2. Land areas of Bobota Village shown in dark brown have an eleveation higher than 350 m. True/False
Highest elevation point	1. The highest elevation point in Bobota Village is that of: a. High Hill; b.Hagăului Hill; c.Derşida Hill; Balotă Hill. 2. Highest elevation point in Bobota Village is located: a. in the eastern; b. in the western; c.souh-western; d.north-western part of the rural area. 3. The highest elevation point indicated on the hypsometric map of Bobota Village is of: a.339 m; b.342 m; c.330 m; d.351 m.
Lowest elevation	1. The lowest elevation point shown on the hypsometric map of Bobota Village is of: a.214 m; b.164 m; c.140 m. d. 210 m. 2. The lowest elevation point in Bobota Village is located: a. in the north, where the effluent small river exits the village limits; b.in the south, where the effluent small river exits the village limits; c. at the confluence of the effluent small river and its western tributary rivulet.
Elevations of localities	1. The village of Derşida is located at an elevation lower than 200 m. True/False 2. The village of Zalnoc is mostly located at an elevation of 200-250 m. True/False 3. The lowest elevation in the vicinity of the village of Zalnoc is of: a.214 m; b.164 m; c.140 m. d. 210 m. 4. The lowest elevation point near the village of Bobota is of: a.214 m; b.164 m; c.140 m. d. 210 m.
Elevations of other geographical features	1. The rivulet which flows through Zalnoc Village has its source at an elevation higher than 250 m. True/False 2. The effluent small river collecting the tibutary streams on the territory of Bobota Village has its lower course located at an elevation lower than 200 m. True/False

Table 3. ***Items referring to "The Hypsometric Map of Bobota Village" and "The Vegetation Map of Bobota Village"***

Buttons	Items
The relationship between elevation and vegetation associations	1. The beech (*Fagus sylvatica*) forest is located at an elevation of 250-300 m. True/False 3. The pedunculate oak (*Quercus robur*) forests are located at an elevation of 250-300 m. True/False 3. The cerris (*Quercus cerris*) forests are located at an elevation of 250-350 m. True/False 4. What is the elevation of the area occupied by hornbeam (*Carpenus betulus*) forests? a.250-350 m; b. a.250-300 m; c.300-350 m; d.200-250 m. 5. What altitude are the sessile oak (*Quercus petraea*) forests located? a. 200-350 m; b. a. 250-300 m; c. 300-350 m; d. 200-250 m. 6. What altitude are softwood forests located (*Salix alba, Salix fragillis*)? a. 200-350 m; b. a. 250-300 m; c. 300-350 m; d. 200-250 m.

2.4. Data collecting and research material

We collected four types of data: *experiment-focused instructional design* (the analysis method of thematic maps for e-learning instruction designed by the researcher); narrative data (analytical texts produced by students with reference to the contents of thematic maps); *three tests* (students' answers to the questions relative to the contents of thematic maps); *two questionnaires* (one applied to Geography mentor-teachers and one applied to informaticians).

We analyzed the e-AMT method and the conditions of its application from the points of view of: 1. the didactician and of the teacher who selects the teaching material and designs the instructional activities the learner is going to be involved in; 2. the informatician who designs the software-based instructional content and secures its operational readiness; 3. the user who learns as a university student (developing learners' motivation, ease of use and logical sequencing, effectiveness of instruction).

The texts of analyses produced by participating students in the initial test and in the final test as well were analyzed by the researcher with respect to the number of essential aspects correctly identified on a map and to the criterion of logical organisation of the analysis of a map. Students' answers to the dual and multiple choice questions based on the two thematic maps of Bobota Village were processed statistically. We analyzed the number of correct answers to the dual and multiple choice questions and the percentage it represents of the total number of answers. We selected and grouped the answers to the questionnaires accoding to our research objectives.

3. Results and discussion

3.1 Analysis of the e-AMT and its conditions of application

Several answers were given by the Geography mentor-teachers to the items of the questionnaire applied. To the question "What other thematic maps could the e-AMT method be applied to?", all respondents answered that it could be applied to any other thematic map. They enumerated several thematic maps: mean annual air temperature (90% of respondents), avearage annual rainfall/ precipitation (90%), climatic map (90%), natural resources (80%), population density (80%), synoptic weather map (70%), tourist map (70%), land declivity and slope exposure (50%), etc.

To the question "What are the conditions in which the method can be used?", with reference to *time*, the majority of participating teachers (97%) stated that the method could be used any time the teacher or the user choses to. The length of time for which the method should be used is variable, depending on the purposes, interest and time resources the user can employ or the teacher provides. With reference to the criterion of *place,* respondents mentioned that the method can be used anywhere the user wishes on condition that the application is available online, on an e-learning platform or on a website and that the user has access to it.

In as far as the size of a thematic map to be analyzed by a student is concerned, all mentor-teachers mentioned that, generally, the size of a map could be very large, but, to complete optimally an analysis of a thematic map, it would be recommendable that the map should be sized the area of a full-screen computer setting, without the need of zooming in or out any section of it.

To the question "What advantages do you think this method of analysis of thematic maps has in e-learning? " teachers stated that users can learn: to systematically analyze a thematic map (70%); to identify the essential and specific features of a thematic map (60%); to plan how to organize the analyis of the map (50%). This last mentioned aspect is highlighted in the specialist literature: to analyze a map involves to study it item by item (Dulamă, 2006). They specified that users could return several times to evaluate an item represented, which enhances knowledge consolidation (90%). An advantage may be represented by the fact that users receive all information visually and so they can establish a permanent relationship between the map, the question and the answer to be provided (30%). Dulamă (2011, p. 162) emphasizes that "map analysis focuses on the visible features represented on the map and on their specifics clearly distinguishable as well". An important advantage is that users can choose the place, the time and the length of the learning/instructional sequence (60%).

With reference to the disadvantages of using the e-AMT method in a virtual instructional setting, teachers mentioned mentor-teachers stated that users wh do not have intrinsic motivation for learning may randomly select the correct answer and after they identified it, they memorize it (50%), so they do not consciously analyze the map. Participating teachers also stated that to make a thorough analysis of a thematic map would involve to include a large number of questions referring to its content (60%) and that may lead to users' boredom during task solving (30%). The fact that only two types of objective items can be used to build up the questions on map datasets (70%) is another diadvantage of the method, especially because the answers are formulated by the course designer.

The informaticians answered the questionnaire items as follows. To the question "What level of computer literacy should users have in order to work on this application?" they mentioned that users could be either basic or more advanced computer skilled.

To the question "What is the human computer level of interaction for this product?" the respondents evaluted the product to be ranked level 2 of human –computer interaction on the six – level ranking scale designed by Schulmeister for multimedia components interactivity (Glava, 2005). At this level the user browses information and representations, which shows basic computer skills development and capacity of selecting information or graphic representation for a certain purpose.

The informaticians were questioned on the type of feedback offered by the product to the user. Their answer was that the software package offers explicit feedback throughout the instructional activity development.

Requested to state what design features this educational software has the informaticians mentioned that: the programme is *nonlinear*,since the user decides what information he should access, when and where to access it, without following a preset pathway; it is *reusable*, as it can be reassembled by the user in any variant suitable to him, to be used in several activities, to meet various specific instructional needs; is relatively *independent* of LMS or LCMS (Learning Content Management System), as it can be converted to several formats and distributed via several electronic means of communication (Internet, mobile phone, videoprojector etc.); it allows for adjustments to meet user's needs (Dulamă and Gurscă, 2006).

3.2 Participating students' results in thematic maps interpretation tests

In Figure 3 students' results in answering the questions of tests based on the two thematic maps are shown. 99% of students' answers to the 34 items referring to thematic maps contents were correct for each of the three elearning instructional sequences. We are aware that there was a possibility for some students to select the correct answer by chance and not because they mastered the necessary knowledge for data sets interpretation. However, we asked the subjects to carefully study the maps before clicking the alternative they thought to be the correct answer. We informed them that the scores in the test were not to be taken into account for their grade. The purpose of the activities they worked on was to enable them develop the necessary skills for systematic thematic map analysis. We urged them to memorize the labels of the buttons as those represented the essential aspects a map analysis should include for the types of thematic maps explored in the experiment.

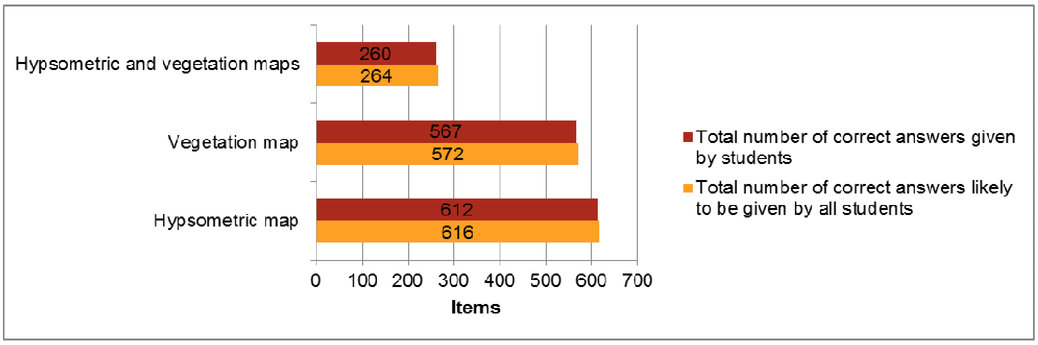

Figure 3 Students' results in the tests with items based on the two thematic maps

3.3 Participants' results in the initial and final tests

Most of the students gave correct answers to questions referring to the *vegetation map* of Bobota Village both in the initial and the final tests (316 and, respectively 421). Less correct answers were given by students to questions referring to the *hypsometric map* data sets. (290 and, respectively, 418) (Figure 4). We may explain this by the fact that legend of the vegetation map is more detailed than the one of the hypsometric map. As a result, more statements could be better evaluated based on the data sets given and thus more correct choices could be made to answer the questions. The fact that the smallest number of correct statements was produced for the correlated analysis of both thematic maps could be explained by the fact that this type of analysis is more challenging for students. Participants in the tests find it difficult to follow in parallel both maps on the screen and to infer the relationships existing between the visible elements on them. However, compared to the intial test, the better progress was recorded in the percentage of correct answers to the questions based on the hypsometric map in the final test: from 6.5 to 9.5 mean value. The mean value was calculated by dividing the total number of correct answers given in the tests to the number of participating students. For the questions based on *the vegetation map* the difference between the intial test and final test mean values was 2.4, whereas for the questions referring to both maps the difference between the mean values of the two tests was 2.9. In the final test the students organized and grouped the information for their written analysis into categories similar to those used as button labels for the electronic thematic maps.

Assessing and analyzing the texts produced by students from the point of view of the number of correct statements and level of organisation of the analytical text in both tests we may draw the conclusion that the students' level of competency of identifying the essential aspects and that of systematically analyzing a map have improved as a result of their learning experience with the e-AMT method of instruction.

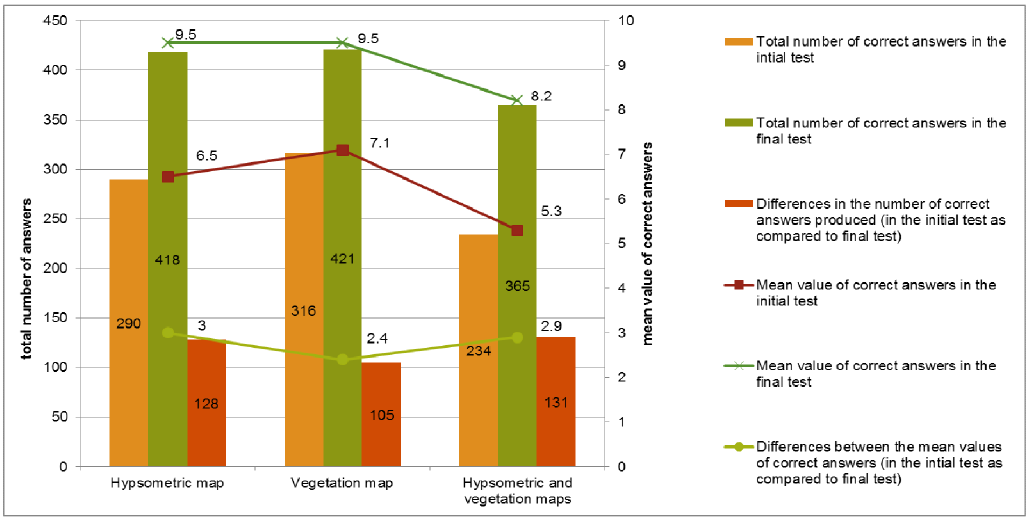

Figure 4. Participating students' results in the intial and final tests

4. Conclusions

From the analysis of students' results in the final test (as compared to those in the initial test) we infer that students made progress in completing a structured analysis of thematic maps as a result of their involvement in the three elearning activities in which the e-AMT method was employed. In this way the hypothesis of our sudy was confirmed. The outcomes motivate us to extend the use of this method in the analysis of other types of thematic maps, with other students as well.

The main advantages of the e-AMT method consist in the possibility to convert material to be worked on in various formats and distribute it via several communication means, independence of

LMS or LCMS system (the user decides what information, when, where and how many times to access it, without the limitations of following a preset itinerary, and availability of explicit visual feedback to the user. However, the method has some disadvantages as well: using teacher-designed answers in tests diminishes the quality of knowledge acquisition; there is a theoretical chance of students "guessing" the correct answer to one or more questions and simply memorize these for the analysis in text format; it requires writing a large number of questions referring to a map data sets; it may induce boredom in the task solving process.

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An Analysis of the Relevance of Some Online Information Sources for E-Learning. Case study: The Geomorphosite „Grădina zmeilor”, Romania

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Abstract

The study developed from the observation that students find it difficult to identify the components of micro-landforms and understand how they were formed whether they make a field trip in person or virtually visit the geomorphosite. Their knowledge is frequently limited to the images perceived and impressions they remember. To gather information about geomorphosites students frequently use photos or information published online. The question then arises as to whether photos, films, online written information about natural tourist attractions, geomorphosites included are reliable and appropriate for e-learning courses and instructional strategies or not. To answer this question we carried out a quantitative and qualitative analysis of materials available on websites. Pentru a răspunde la întrebare, am analizat calitativ și cantitativ materialele disponibile din surse web. The findings led us to the conclusion that these information resources are limited for an effective preparation about the micro-landform studied and, therefore, they cannot fully support studying. To illustrate our idea we selected and analyzed two web sources providing information on “Grădina zmeilor” (“Dragons’ Garden”) geomorphosite in Sălaj, Romania. In the final section of our study several suggestions are made relative to improving the quality of materials published online and solving the problem of relevance of online sources for e-learning.

Keywords: evaluation grid, evaluation criteria, natural monument, nature reserve, hypertext

1. Introduction

Geomorphosites are “*landforms that have acquired a scientific, cultural/historical, aesthetic and/or social/economic value due to human perception or exploitation”* (Panizza, 2001). Studies dedicated to the geomorphosites in Romania were carried out by: Comănescu (2008), Ielenicz (2009), Toma (2012), Irimia (2013) etc. Geographic studies on the „*Grădina Zmeilor”*geomorphosite have been carried out by Petcu (1985), Medve (2002), Abrudan and Medve (2008), Goidaci (2010) and others. A research study of geography didactics on this geomorphosite was conducted by Slevaș and Incze (2014).

Our research was motivated by Geography academic staff members’ observation that, while visiting various geomorphosites, undergraduate students generally noted the micro-landform units, but they were often unable to identify their components and demonstrate they understood how these were formed. They also noted that students search for web sources of information about a geomorphosite if they can access the internet on the spot. However, students’ knowledge about the site is frequently limited to memorization of visual perceptions and impressions made on them by the place. Under the circumstances, the question then arises: how relevant are the documents, pictures, videos or documentaries about geomorphosites as elearning sources of information?

2. Material and method

2.1.Research material. A qualitative and quantitative analysis of several information resources on “Grãdina Zmeilor” geomorphosite from Sãlaj county, Romania was made. The web resources available were identified using Google.ro search engine. Using the key words “Grãdina Zmeilor” our query returned 20600 results in 0.32 seconds (the search was done on 9th August2014). We analyzed in detail two of the sources identified: “Grădina Zmeilor – Wikipedia” **(**http://ro.wikipedia.org/wiki/Gr%C4%83dina_Zmeilor) and “Rezervația naturală Grădina Zmeilor – Sălaj – Ghid video”(The Natural Reserve Gradina Zmeilor –Sãlaj – a video guide) (available at: http://www.ghidvideoturistic.ro/ghid-turistic/Atractii-Turistice-Rezervatia-naturala-Gradina-Zmeilor-Salaj-62-p.html).

2.2.Participants. The participants involved were 10 undergraduate students in Geography at “Babeş-Bolyai” University from Cluj-Napoca, who volunteered to take part in the research. The students were of different levels of knowledge of Geography, which influenced the quantitative data of the study and the generalization of the findings.

2.3. Procedure. To achieve the aims of our study three stages were developed: *1. Qualitative analysis of text documents, photographs, videos and maps available from the two web sources*; *2.* Quantitative analysis of the materials provided by the two web sources using assessment tools (see Tables 1-6); *3. Conducting a product satisfaction survey among web resources users.* The survey carried out was aimed to identify users’ suggestions on how to improve learning resources available on websites.

3. Results and discussion

3.1.*Analysis of relevance of information in the article on “Grădina zmeilor” in Wikipedia <u>Encyclopedia</u>*

The information in the article is grouped (modularized) under ten headings (buttons): Location; Description; Biodiversity; Access Roads; Monuments and tourist attractions; See also; Bibliography; Notes; External links; Images. The information was evaluated from the perspective of relevance to elearning and grouped into four categories: relevant, somewhat relevant, only slightly relevant, non-relevant.

In what concerns *Location,* six items of relevant information about the geographic position of the geomorphosite could be identified. In order to convey scientific rigor to the text, we suggest that improvements could be made by an accurate employment of scientific terms. For example, “the geographical basin of the Almaş river” instead of “the basin of the Almaş river”, “the geographic position” instead of “position”. In the In a placeholder at the side of the article the geographic location of the geomorphosite is accurately described in brief: in Romania, Sălaj County, Bălan Village, Gâlgău Almașului Village. The cities near the place and the geographic coordinates are indicated: 47°12′14″N and 23°17′52″E. We suggest that the information in the placeholder should be completed for greater precision: “geographic coordinate system” instead of “coordinates”; “Latitude/Lat.: N <u>47°12′14″</u>” or “<u>47°12′14″</u> North latitude” instead of “N” and “Longitude/Long.: E 23°17′52″” or “23°17′52″ East longitude” instead of “E”.

In the section *Description,* there are 12 items of information out of which 9 are relevant. It is not clear whether “Grădina Zmeilor” is a natural monument, a protected area or a geological landscape nature reserve. Clicking the hyperlinks definitions of terms above mentioned can be obtained, but accurate information on what this location actually is cannot be inferred. Nor does *Law No. 5/2000 on the approval of the National Land Use Master Plan (PATN), Section III (Protected Areas)* - mentioned in the *Notes* section of the article with a hyperlink to the indexed entry – offer accurate information. “Grãdina zmeilor” is entered at number 682 in the list of natural areas and areas containing national interest heritage assets (http://www.cdep.ro/pls/legis/legis_pck.htp_act_text?idt=22636). In the “*List of nature reserves in*

Sãlaj County", "Grădina zmeilor" is classified in category III IUCN, natural geological geomorphological features, and, therefore, is a natural monument (http://ro.wikipedia.org/ wiki/Lista_rezerva%C8%9Biilor_naturale_din_jude%C8%9Bul_S%C4%83laj).

In the *Description* section it is mentioned that "Grădina zmeilor" is a "natural area in the Someșan Plateau". This item of information should have been included in the *"Location"* section. Further on, it is stated that the protected area "comprises a collection of rock formations and cliffs with irregular forms (*Fata Cătanii, Zmeul și Zmeoaica, Moșu, Călugării, Căpitanul, Acul Cleopatrei, Soldații, Eva, Dorobanțul, Degețelul, Sfinxul- English equivalent names:the Soldier's Girlfriend, the Dragon and Lady Dragon, the Old Man, the Monks, the Captain, Cleopatra's Needle, Soldiers, Eve, Infantry Soldier, the Pinkie, the Sphinx*), odd shapes (towers or spires, mushroom, needles, abrupt rock faces)". The article in the ecyclopedia is not accompanied by the necessary pictures which illustrate the microforms of landscape enumerated. In the last paragraph of the *Description* section information on the lithology and genesis of the geomorphosite is provided: "The geological formations (attributed to the Holocene period) composed of sandstones with microconglomerate deposits, were formed by repeated action of air (freezing-heating alteration, wind erosion, temperature variation), water (wash away, dripping) and gravitational processes (collapses, land slides) over time." In fact, the Sânmihaiu sandstone in the Dumbrava Hill is dated to the Lower Miocene epoch (Medve and Goja, 2012) and the specific landscape of "Grădina zmeilor" was formed in the Holocene epoch (Abrudan and Medve, 2008).

To identify the types of sandstone and microconglomerates on the location it is necessary to know what they are. Clicking on the words sandstone and microconglomerate and following the hyperlinks activated we are led to the definitions of these terms. The hyperlink for microconglomerate actually leads to a file on what the term conglomerate means. To find out a definition of microconglomerates other web pages must be visited (http://www.scritub.com/ geografie/geologie/Roci-Minerale-si-roci-sediment16110191210.php). In order to understand how microrelief is formed information on sandstone and conglomerate layering is needed. However, these information items are missing.

Under the heading *Biodiversity* the author(s) of the encyclopedia article provides 72 items of information (types of species which contribute to landscape composition; by the number of species of one type mentioned there are 5 of trees, 7 of shrubs, 21 of herbs, 3 of mammals, 5 of birds 1 of reptiles and 2 of amphibians. Of these, 7 are relevant. In the *Access Roads* section two road routes, useful for field trip planning, are indicated. In the *Monuments and tourist attractions* section seven tourist sights, irrelevant for the geomormphosite "Grãdina Zmeilor" are enumerated (4 wooden churches, the Botanical Garden in Jibou, Wesselenyi Castle in Jibou, and the archaeological site at Chendrea). In the *See also* part two useful links to the *List of nature reserves in Sãlaj County* and the *List of nature reserves in Romania* are included. In the *Bibliography* section two sources of general information are provided. These are only slightly relevant to the students and, therefore, it would be beneficial to expand the list with titles of scientific works and articles relevant to this topic. Under the heading *Notes* twelve hyperlinks to five sources of somewhat relevant information and seven sources only slightly relvant to the topic are provided. The External links part contains two hyperlinks to files which contain somewhat relevant information to the topic. Finally, in the section *Feature reports* three hyperlinks to feature articles published in newspapers indicate sources of somewhat relevant information to the topic.

To sum up, a positive aspect of this online reference article is that the hypertext provides 133 links to files on 16 scientific terms, 13 names of localities, 3 national road routes, 21 tourist attractions and several other topics of interest. Out of these online sources 38 are relevant or somewhat relevant to the topic discussed here. We identified some problems in the way the information is conveyed: inappropriate use of scientific terms (geographical/hydrologic basin, geographic location, geographic coordinates system etc.); omission of some terms (latitude North and longitude East); imprecision in classifying “Grădina zmeilor” into a category of protected areas (natural monument, protected area, nature reserve); incorrect dating of the epoch in which the landscape of “Grădina zmeilor” was formed; addition of some items of information irrelevant to the topic in the text of the article; providing some empirical explanations about how the microrelief was formed. Consequently, the text document provides little relevant information on “Grădina zmeilor” for elearning purposes.

3.2 ***Analysis of relevance of information in the text The Nature Reserve “Grădina Zmeilor”, Sălaj – of the Tourist Video Guide***

The information in the text is grouped under six headings/buttons: Description, Video, Images, Accommodation, Location, Comments. There is little information provided in the *Description* section and it is similar to the one in the article included in Wikipedia. New items of information are added: “Grădina zmeilor” is locally known as “The Soldier’s Girlfriend”, based on a legend about a girl who fell in love with a soldier and was turned into stone by her step mother. The size of the geomorphosite area is erroneously indicated (2 ha). In the *Accommodation* section a link to a tourist pension file is provided. Going to the *Location* section one can find no text but a Google Maps window is accessed. On the map, the location named “Grădina zmeilor” is marked, the road route can be visualized, but the microrelief land forms cannot be distinguished clearly. The *Comments* placeholder offer visitors of the site the opportunity to send email messages with their opinions about the place. To conclude, we reckon the text provides very little information, only slightly relevant to the topic of “Grãdina Zmeilor” from the point of view of effectiveness as an elearning resource.

3.3.*The comparative analysis of the information in the texts on “Grădina Zmeilor” in Wikipedia Encyclopedia and the Tourist Video Guide*

We assessed the two texts using an original evaluation instrument (Table 1). Appropriate criteria and indicators were selected to highlight the relevance of information content on this geomorphosite to elearners. Each indicator is awarded 1 point. The indicators related to geology and land forms could be awarded more points since the items of information on these aspects are the most important about this geomorphosite, a natural monument of geologic and landscape type. The text in Wikipedia Encyclopedia assessed against this evaluation grid totalled 14 points out of a maximum of 23, which means that 61.7% of the information content is the minimum of necessary relevance to a presentation of the geomorphosite. The text in the Tourist Video Guide scored 9 points (39.1% of necessary relevance). Similar grids can be used to evaluate texts on other geomorphosites.

Table 1 ***Analytical evaluation grid with a dichotomous scale for documents available online from the point of view of supporting e-learning***

Criterion	Indicator	Wikipedia	Tourist Video Guide
Name of protected area		x	x
Type of protected area		x	x
Location	county	x	x
	type of landform	x	-
	hydrographic basin	x	-
	administrative village	x	x
	village	x	x
	position relative to near (large) cities	x	x
Access	Road route	x	x
	Train route	-	-
Area	Size in hectares or square kilometers	x	x
Geology	Lithology (rocks, minerals)	x	-

	Structure (arrangement of layers)	-	-
	Paleographic evolution	-	-
Relief	Name of major landform	x	-
	Name of microrelief landform types	x	-
	Proper names of microrelief landforms	x	x
	Height of microrelief landforms	-	-
	Width of microrelief landforms	-	-
	Length of microrelief landforms	-	-
	Factors influencing the formation of microrelief landforms	-	-
	Scientific explanation of the formation process of microrelief landforms	-	-
	Geologic timeline of the formation process of microrelief lanforms	-	-
Total score: 23 points		14 points	9 points

In the evaluation tool presented in Table 2, to determine the extent to which a text material meets the generic criteria of suitability for elearning grades and points were used: VG (Very good) - 3 points; G (Good) - 2 points; S (Satisfactory) -1 point; U (Unsatisfactory) - 0 points. The maximum score is 27 points. To award an overall grade to a text reviewed we established score points ranges for each grade: VG- 22-27 p.; G - 15-21 p.; S - 7-14 p.; U – less than 7 p. The texts reviewed were both given the grade *Satisfactory*.

Table 2. ***The analytical evaluation grid with a non-descriptive scale for the assessment of suitabilty of texts for e-learning***

Criterion	Grade for the text in Wikipedia				Grade the text in the Video Guide			
	FB	B	S	I	FB	B	S	I
Accuracy of information		x				x		
Text organisation		x				x		
Concision		x				x		
Accessibility of language		x				x		
Use of scientific terms				x				x
Scientific terms explained				x				x
Information relevancy		x					x	
Integrality of essential content knowledge			x					x
Hyperlink insertion	x							x
Final grade awarded	Satisfactory (11 points)				Satisfactory 9 points			

3.4.The analysis of the photographs in Wikipedia Encyclopedia and the Tourist Video Guide

In the article in Wikipedia Encyclopedia five photographs of “Grădina zmeilor” are included: two of them are suggestive of the landscape and microrelief in the area whereas two are irrelevant to this topic. The captions of the pictures do not support learning: they do not offer accurate information but a rather literary description. In the Video Guide, in the section *Images* 80 photographs are displayed. The shape and massiveness of the rocks and the tilting of the microrelief forms are illustrated by thirty pictures. The monoclinal flexure of sandstone and microconglomerate layers, the results of differential erosion are highlighted by 4 pictures. Gullies and ditches are represented in two photographs. Microconglomerates are shown in two pictures. One picture illustrates a panoramic view of “Grădina zmeilor”.

To do a rigorous evaluation of the photographs included in the two information resources from the perspective of suitability to e-learning we designed three analytical evaluation grids with a non-descriptive scale: one for landscape composition (Table 3); one for landscape components included (Table 4); one for clarity of details (Table 5). We selected the evaluation criteria based on their suitability(relevance) to elearning. For the grid in Table 3, the maximum score is 9 points

(Very good/VG - 9 p.; Good/G - 6-8 p.; Satisfactory/S - 3-5 p.; Unsatisfactory/U – less than 3 p.). For the grids illustrated in Tables 4 and 5, the maximum score is 15 points (VG -13-15 p.; G - 9-12 p.; S - 4-8 p.; U – less than 4 p.). The six pictures selected for exemplification earned a *Good* grade point. (*see* Table 3, 4, 5). The pictures in the Tourist Video Guide earned grade points as follows: *VG*-14 pictures (5 – landscape composition, 4 - components, 5 – clarity of details), *G*- 39 pictures (9 – landscape composition, 27 – components, 3 – clarity of details), *S* – 7 pictures (3 – landscape composition, 3 – components, 1 – clarity of details), *U* – 20 pictures (irrelevant to the topic).

Table 3. ***The evaluation grid for the assessment of landscape composition suitability to e-learning***

Criterion	Grade for Photo1[1] Wikipedia Encyclopedia				Grade for Photo 2[2] Tourist Video Guide			
	VG	G	S	U	V G	B	S	U
Caption with name of landscape composition represented			x					x
Importance/Relevance of landscape composition represented	x				x			
Unity of landscape composition represented		x			x			
Final grade point	Good (6 points)				Good (6 points)			

Photograph 1: View of Grădinii Zmeilor (http://ro.wikipedia.org/wiki/Gr%C4%83dina_Zmeilor#mediaviewer/Fi%C8%99ier:Sarkanyokkertje.JPG)

Photograph 2: No 65 (http://www.ghidvideoturistic.ro/ghid-turistic/Atractii-Turistice-Rezervatia-naturala-Gradina-Zmeilor-Salaj-62-p.html#imagini)

Table 4. ***The evaluation grid for the assessment of suitability of photographs showing landscape components to e-learning***

Criteriu	Grade for Photo1[1] Wikipedia Encyclopedia				Grade for Photo 2[2] Tourist Video Guide			
	FB	B	S	I	F B	B	S	I
Caption with name of object represented		x						x
Relevance of object represented	x				x			
Object represented is the point of interest in the image		x			x			
Depth of field for object represented		x			x			
Unity of object represented in the composition		x			x			
Final grade point:	Good (11 points)				Good (12 points)			

Photograph 1: Rocks on the Dumbrava Hill (http://ro.wikipedia.org/wiki/Gr%C4%83dina_Zmeilor#mediaviewer/Fi%C8%99ier:RO_SJ_Natural_Reserve_Gradina_Zmeilor,_Galgau_Almasului.jpg)

Photograph 2: No 29 (http://www.ghidvideoturistic.ro/ghid-turistic/Atractii-Turistice-Rezervatia-naturala-Gradina-Zmeilor-Salaj-62-p.html#imagini)

Table 5 ***The evaluation grid for the assessment of clarity of detail in a landscape photograph from the point of view of suitability to e-learning***

Criterion	Grade for Photo1[1] Wikipedia Encyclopedia				Grade for Photo 2[2] Tourist Video Guide			
	FB	B	S	I	FB	B	S	I
Caption with name of the detail represented				x				x
Relevance of detail represented	x				x			
Image resolution (sharpness)	x				x			
Contrast ratio of the image	x				x			
Degree of chromatic aberration	x				x			
Final grade point:	Good (12 points)				Good (12 points)			

Photograph 1: No 8; Photograph 2: No 55 (http://www.ghidvideoturistic.ro/ghid-turistic/Atractii-Turistice-Rezervatia-naturala-Gradina-Zmeilor-Salaj-62-p.html#imagini)

3.5. The analysis of videos in the Tourist Video Guide

In the *Video* section of the article two short videos with a musical soundrack and no voice-overs are presented. The length of the first video is 1.53 minutes and for the second video is 2.19 minutes. The first video is a collage of randomly assembled clips of “Grădinii zmeilor”, with fading in and out transitions. The second video offers an aerial perspective, more spectacular, with an insufficiently ordered visual track of the geomorphosite “Grădina zmeilor” in terms of space continuity. We can distuinguish the overall composition of rock complex, the grouping of rock formations and shape of certain rock blocks, the geomorphologic structure of rock blocks made up of yellowish and white layers. However, the type of rocks in the texture of the blocks cannot be identified. The size of rock blocks can be estimated by contrast to the size of trees in the video.

To assess the suitability of the videos to elearning, an evalution grid based on 9 criteria was designed (Table 6). The maximum grade point score is 27 points (VG - 22-27 p.; G - 15-21 p.; S - 7-14 p.; U – less than 7 p.). The videos earned a Satisfactory degree grade point, therefore they have little relevance to elearning.

Table 6. ***The evalution grid for the assessment of suitability of videos to elearning***

Criterion	**Grade for Video 1**				**Grade for Video 2**			
	VG	G	S	U	VG	G	S	U
Title of the video				x				x
Relevance of video content			x			x		
Unity of rock complex highlighted by film footage				x		x		
Components of landscape shot are highlighted in the video				x		x		
Close-ups of details of subjects shot				x				x
Video resolution		x				x		
Brigtness-contrast balance of video footage				x		x		
Degree of chromatic aberration		x				x		
Video playback speed		x				x		
Final grade point	Satisfactory (7 points)				Satisfactory (14 points)			

4. Suggestions for increasing relevance to elearning content of web resources

Since this is a case study research, the suggestions collected from the users mostly refer to the geomorphosite considered as a topic of learning. To the question “ How can the relevance to learning be improved for the texts on “Grădina zmeilor” in Wikipedia Encyclopedia and the Tourist Video Guide?” we received various suggestions: texts should be reviewed by experts (70%); a proactive involvement of experts in writing the texts (in the case in view, geologists, geomorphologists) (60%); website admistrators should consult specialists on ensuring optimum relevance to information content (50%); each article posted should have author’s/contributor’s name and contact details provided for potential users who would like to warn on errors or to make additions to complete information provided (50%); the bibliographic list should include more scientific sources available in print or published online (40%); hypertexts should contain more links (30%). It is beneficial that “anyone can contribute to improve content” of articles in Wikipedia Encyclopedia, provided that experts get involved as contributors. The Tourist Video Guide also invites visitors of the site to add comments on each location presented and to contact the administrator via email or on the phone.

Students were also asked to give their opinions on the features of a text suitable to elearning. The opinions expressed were as follows: “to include accurate factual information” (90%); “to be written using an accessible language” (80%); “to be concise and logically systematized according to scientific rigour in geography and geology” (70%); “to include essential information on topic” (70%); “to use scientific terminology and style, not a narrative literary style” (60%); “scientific terms should be hyperlinked to specialised dictionaries” (60%); “to avoid repetition of the same item of information in a changed form” (50%).

To the question: “How can the content of photos and videos on “Grădina zmeilor” in Wikipedia Encyclopedia and the Tourist Video Guide be improved to optimize their relevance to learning?”, participating students suggested some solutions: “to have a caption which clearly specifies the aspect focused on” (90%); “to have a scientific explanation or description of the aspects represented provided” (80%); “the landscape element(s) represented should be captured from different angles so it could be easy to identified in reality” (70%); “selection of photos published should be made by specialists in the domain according to criteria of quality of image and content (60%); “grouping the landscape images by features captured (panoramic view, shots of the main rock block groups, details)” (40%). As for the videos, students stated that these should be made by joint teams of geology, geography and cinema specialists” in order to be relevant to elearning (30%).

The last questioned students were required to answer was: “What characteristics should pictures and videos have so that they can be suitable to you in elearning? The answers given mentioned that images should be “sharp” (70%); “the subject represented should be captured in its full size as close as possible – that is to cover as much of the photographic space” (60%); “object focused on should be well-lit, not in the shadow” (40%). Videos should be made in such a way that they: “capture the essential” (80%); “focus on topic area” (70%); “are short” (60%); “present the landscape shot in a systematic approach of scenes recorded, not chaotically” (60%); “to include a panoramic, even aerial view of the location, capturing the landcape components and details of these” (60%); “include voice-over scientific – not literary- explanations” (40%).

5. Conclusions

The analysis and assessment of the texts on “Grădina zmeilor” against the grid designed led us to the conclusion that the text in Wikipedia Encyclopedia offers 61.7% wheres the one in the Tourist Video Guide only 39.1% of essential relevant information to elearning in the presentation of the geomorphosite of the total amount each of them includes. It is beneficial that in the Wikipedia article there are 133 hyperlinks to various online sources (relative to scientific terms, localities, tourist attractions, etc.), out of which 38 are relevant or partially relevant to the topic. Less desirable and useful aspects of these texts as suitable support to elearning are: wrong use of scientific terminology, omission of some scientific terms, including irrelevant information in the text, providing incomplete, empirical explanations.

With reference to the images included in the two sources, the analytic assessment performed using tools designed by the author enabled us to evaluate their suitability of content to elearning likely audience. We determined that the three images in the encyclopedia article satisfy the criteria at a *Good* level; 17.5% of the images in the Tourist Video Guide were considered *Very Good*, 48.75% were evaluated as *Good*, 8.75% received a *Satisfactory* grade point degree and 25% were given an *Unsatisfactory* grade point degree. The videos assessed received an *Unsatisfactory* grade point degree, therefore they were found to be only slightly relevant to elearning.

The findings presented here emphasize the idea that the text documents, pictures and videos available online on the topic of the geomorphosite considered in our study are of little relevance to users of elearning resources. The positive aspect of the web resources analysed is that they offer the opportunity to be improved by other contributors interested in the consistency, accuracy, scientific rigour, systematic approach and completeness of the information presented on the topic in order to increase the degree of relevance of content to support elearning. This can be done by suggesting additional items of information to a text, warning on errors and provide accurate information, uploading photos and videos of related content. Nevertheless, the relevance of the materials published online to elearning target audience could only be increased if specialists in the domain of a topic create, select, organise the information included. Further investigation will take into account experimenting with being a contributor of elearning materials of relevant content to topics in our specialist domain for the articles published on the web sources considered in the present study and to determine their effectiveness in e-learning.

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Implementation Methods of Speech Recognition in e-Learning

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Abstract

E-learning is understood as the use of information and communication technologies in teaching and learning. In the last years, some of these technologies, such as speech recognition, were included in many fields. Speech recognition is known as the ability of a machine to convert a speech signal into a sequence of words. In this paper, the authoress insists on the advantages of incorporating speech recognition-based technologies in e-learning. The second goal of this research is development and testing two different speech recognition methods for isolated spoken words in Romanian language: temporal alignment (dynamic time warping) and artificial neural networks (multilayer perceptron). For this goal, cepstral analysis was used for processing the speech signal in order to obtain important characteristics (mel-cepstral coefficients). Finally, the results of the experiments are presented, together with a comparison between these two methods, when they are used for e-learning process.

Keywords: Automatic speech recognition, Dynamic time warping, Multilayer perceptron, Neural networks, e-Learning

1. Introduction

E-learning plays a major role, not only in formal learning processes, but also in society in general. In our contemporary society, the access to information and technologies used in learning can offer to the trained person many more advantages. In recent years, web community consists of users who have access to information using smart phones, tablets or PDAs. Thus the educational technologies tend to be more portable. Due to the rapid development of communication technology, the forms of learning have evolved from the classical learning to e-learning. Such technologies can include automatic speech recognition (ASR) methods as well.

Speech recognition is an interdisciplinary field, going upon a lot of research from linguistics, mathematics, computer science, electrical engineering, biology or psychology. Significant work is being done in signal processing, acoustics, artificial intelligence, computer algorithms, pattern recognition, and phonetics.

The advantages of speech recognition in real life are tremendous: speech recognition enables applications or complex embedded systems, from autonomous machines that have the ability to drive themselves, or robots, to intelligent digital agents acting on behalf of man, and all these technologies progress fast.

Such intelligent digital agents, or speech recognition systems can be developed and applied in e-learning also. In this field, ASR systems can be used especially for dictation (speech-to-text) and voice commands, mostly in the case of persons with physical disabilities (for example, persons with difficulties of manual dexterity), but not limited to them. In the first case, the dictation systems refer to the situation where the message (the speech signal) is converted into text and then it is sent to the discussion board. In the case of voice commands, it is possible user navigation by voice.

ASR systems are classified as discrete or continuous systems. Discrete speech recognition means that each word is treated as a separate acoustic model, while continuous speech recognition handles words, or combination of words uttered by the user in a specific order, but these words are linked together. Discrete speech recognition systems are referred to as isolated word speech recognition (IWSR) systems.

The paper aims to bring into focus an IWSR system for Romanian language, putting forward two of the main methods which are used for speech recognition.

The present paper is organized as follows. Section 2 describes dynamic time warping and neural network methods for ASR. Section 3 presented the IWSR system, together with the results obtained. Finally, the conclusions are summarized in Section 4.

2. Methods for IWSR

Speech recognition (or automatic speech recognition) is the identification (by a machine) of a message (uttered by a human), the purpose being the obtaining of a string of words, as ouput.

When the input message is split into separate different words, we referred to this as isolated word speech recognition (IWSR). IWSR can be used essentially for the case of command and control (voice commands) (Şchiopu, 2014).

Figure 1 shows a general representation of an IWSR system (used in Section 3). The main modules are:

- signal processing and feature extraction;
- the decoder (pattern recognition), which might have three components: acoustic model, phonetic model and language model.

Speech recognition process consists of two main parts:

- first, the speech signal is processed and then acoustical parameters are extracted from it;
- the recognition is realized based on the three models (acoustic, phonetic and language model).

Mel-frequency cepstral (MFCC) analysis is the most used feature extraction technique for speech recognition, because the spectral frequency characteristics of the signal correspond to the human auditory perception (Davis, 1980).

The acoustic model uses words or sub-lexical units, such as phonemes or senones (Hwang, 1992). In order to implement the acoustic model, there are used hidden Markov models, or other techniques, such as time alignment methods or neural networks.

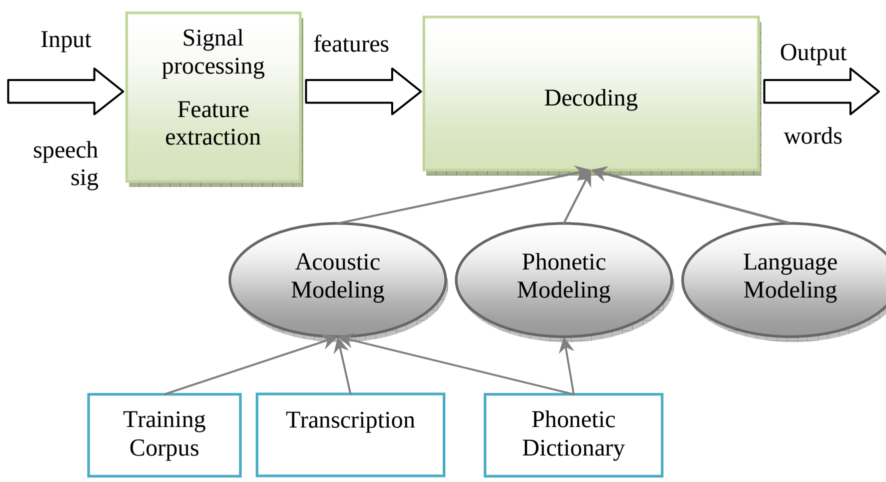

Figure 1. The general architecture of the IWSR system

The language model for IWSR consists of finite state grammars. The phonetic model might be a phonetic dictionary (pronunciation dictionary), that specifies how to pronounce every word from the vocabulary.

There are three different approaches for speech recognition (Anusuya, 2009):

- acoustic-phonetic approach (segmentation and labelling);
- pattern recognition approach (includes template methods and stochastic methods, statistical pattern recognition, dynamic time warping (DTW), vector quantization, and support vector machine);
- artificial intelligence approach (includes artificial neural networks (such as Multilayer Perceptron – MLP, Kohonen networks, recurrent neural networks), knowledge based systems.

2.1 Dynamic Time Warping

Dynamic Time Warping (DTW) is a simple method that seeks an optimal fit between two time series, where a time series can be “aligned” non-linearly, by bringing it on the time axis. This time alignment between the two series can be used to find the equivalent region for the two time series, or to find similarities between them. These similarities are given by calculating a minimum distance between the two time series (models or dynamic templates).

DTW consists of the following steps. Let’s assume that the two templates are $P = (p_1, p_2,\ldots, p_i, \ldots, p_n)$ (input speech signal) şi $Q = (q_1, q_2, \ldots, q_j, \ldots, q_m)$ (template reference) with length n, m, respectively. DTW calculate a matrix (n x m), where the element (i, j) is the distance between p_i and q_j. Then, using the Euclidian distance, the absolute distance between the two sequences is computed:

$$d(p_i, q_j) = (p_i - q_j)^2 \tag{1}$$

Each p_i and q_j is a feature vector (e.g. MFCC). The alignment is equivalent to the problem of finding the minimum distance between P and Q.

To obtain the optimal path from the start point (1, 1) till the end point, we need to calculate the optimal accumulated distance $D(n, m)$:

$$D(i, j) = \min[D(i-1, j-1), D(i-1, j), D(i, j-1)] + d(i, j) \tag{2}$$

The optimization process is performed by using dynamic programming, which reduces the number of calculations by avoiding the computing for the sequences which one cannot reach an optimum solution: once a sub-problem is solved, the result is retained and recalculation is no longer necessary.

Therefore, DTW has the following advantages: effectiveness for speech recognition systems with low vocabulary, especially for IWSR systems; also, this method is suitable to match sequences containing the missing information.

2.2 Neural Networks for IWSR

IWSR problem is basically a classification problem. And because of their ability to solve classification complex problems, artificial neural networks have a wide applicability, including speech recognition.

One of the problems of implementing neural networks for speech recognition is modelling the sequential nature of speech signal. For solving this problem, a solution would be forcing the number of input feature vectors to a fixed number. In this case, there are used multilayer perceptron (MLP) or time delay neural networks.

For a neural network to be suitable for speech recognition, it must have the following characteristics (Toderean, 1995):

- must contain enough nodes and weights in order to learn the diversity of the input feature vectors;

- able to retain the temporal relationship between events (spectral coefficients which model the speech signal);
- invariance to vectors' translation in time to achieve better recognition rate;
- training procedure should not be affected by time alignment.

3. Implementation of DTW and MLP for IWSR

In this section, we propose an IWSR system based on DTW and MLP methods, for several isolated Romanian words. The parameters used for these methods were MFCC and short-term Fourier analysis. In the last part of the section, experimental results are presented, together with a comparison of the two methods.

3.1 IWSR System

The system consists of two modules, one based on DTW, and MLP respectively.

The human speaker utters one of the following Romanian words: *start*, *stop*, *sus* (up), *jos* (down), *prinde* (catch), *lasă* (leave), *stânga* (left), *dreapta* (right). The speech signal is acquired with microphone and processed by the speech recognition module (decoder). The decoder will use neural or temporal alignment methods and will provide the class for the input word. The system was implemented in Matlab®.

For acoustic modeling, we used BDCVR database, which contains recorded audio files associated with textual transcription. The phonetic dictionary consists of the eight words.

For training, there were used (for both methods) data from 24 speakers recorded in a usual room, but without ambient noise and from 8 speakers recorded on-line, using a web platform.

We used mel-cepstral analysis for extracting the parameters from the speech signal. The mel-cepstrum with 12 mel-frequency cepstral coefficients (MFCC) was computed, together with delta and delta-delta coefficients.

The language model for this ISWR system is a finite state grammar. An example of this type of grammar has the following Chomsky form:

```
Action → <start> | <stop> | <sus> | <jos> |
<prinde> | <lasă> | <stânga> | <dreapta>
```

This grammar is deterministic, because the automaton that checks the language generated by the grammar is deterministic (it accepts or not the spoken word).

For neural network module, the algorithm was as following. First, features vectors were extracted by using short-term Fourier analysis, then these parameters were inputs to a feed forward neural network (MLP type). Specifically, they were trained and simulated three MLP, and output was given by the maximum score.

The configuration for each network topology was:

- the number of neurons in the hidden layer (100);
- equation type used to calculate the weights (sigmoid function).

The parameters of the neural network (for training) are:

- maximum number of epochs (20000);
- learning rate (0.001);
- sum of squares for error, SSE (0.01).

3.2 Experimental results

The system was trained using BDCVR speech database, containing 256 files (32 speakers uttering the 8 words). Voices were recorded from 11 female speakers and 21 male speakers.

For testing, we used 50 voices already recorded (29 female speakers and 21 male speakers), in order to provide accurate data (a speaker cannot utter identically the same word and for several time).

Table 1 summarizes the results obtained (recognition rate), relatively to the total number of female speakers (FS), and male speakers (MS) respectively, and an average of them for each implementation.

Table 1. Word recognition rate (WRR)

Method	**WRR**		
	FS	**MS**	**Total**
MLP	89.65%	76.19%	**84%**
DTW	82.76%	85.71%	**84%**
Average	**86.21%**	**80.95%**	**83.58%**

Word accuracy (a ratio of correctly recognized words to total number of words) is shown in Table 2.

Table 2. Word accuracy

Word	**Accuracy**	
	RNA	**DTW_MFCC**
dreapta	70%	80%
jos	100%	80%
lasă	83.33%	50%
prinde	100%	83.33%
stânga	75%	87.50%
start	100%	100%
stop	80%	100%
sus	100%	100%
Average/Total	**88.54%**	**85.10%**

Although the difference between the two obtained values (corresponding to DTW and MLP), for the word accuracy, are not high, however the obtained accuracy was higher for neural networks, demonstrating the effectiveness of this method even for IWSR, and not only for continuous speech recognition (Bourlard, 1993).

It is observed that the words “start” and “sus” were recognized 100%, regardless of the method chosen for recognition. Also, the word “lasă” had the lowest word accuracy (for the case of DTW) and the word “dreapta” (for the case of MLP method).

4. Conclusions

This paper evaluates how DTW and MLP can be used for developing IWSR systems. We have presented an IWSR system for Romanian language.

The results showed, on average, a higher word recognition rate for FS, although in the training phase, the number of FS was only one third of the total number of speakers.

In terms of the methods used in the implementation of the system, the module based on MLP provided better results for the case of FS and the module based on DTW had better results for MS.

However, according to the results, without taking into account the gender of the speakers, the two methods provided equal word recognition rates.

Consequently, these methods can be applied for speech recognition systems with good results (where words can be voice commands), both for automated systems, and for e-learning environment as well.

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Using evolutionary computation in air quality knowledge extraction

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Abstract

Evolutionary computation is inspired by biological mechanism of evolution and involves continuous and combinatorial optimization. This paper presents a genetic algorithm – based heuristic method designed to obtain an optimal solution for the proper selection of the atmospheric parameters that are most likely to influence the ozone concentration. It is known that tropospheric ozone is a secondary air pollutant being directly influenced by the primary parameters concentrations and chemical reaction among them. The aim of this study is to determine based on a genetic algorithm the optimal selection of the air parameters that influenced the Ploiesti air quality.

Keywords: evolutionary computation, genetic algorithm, air quality

1 Introduction

Evolutionary computation uses the process of the Darwinian survival of the fittest to create computer programs for a given problem, where candidate solutions correspond to the natural individuals. The best program is the fittest individual from a population in the natural selection process. The main advantages of evolutionary computation such as no presumption about problem space, provide many alternative solutions, intrinsic parallelism, easy to incorporate other methods, made these techniques useful in different domains (system modelling and identification, planning and control, engineering design, numerical or combinatorial optimization etc.).

According to (http://courses.cs.washington.edu/courses/ cse466/05sp/pdfs/lectures/ 10-EvolutionaryComputation.pdf, 2014) four main approaches have evolved throughout this domain: evolution strategies (ES), evolutionary programming (EP), genetic programming (GP) and genetic algorithms (GA) (Figure 1).

This paper focuses on the application of a genetic algorithm in order to determine an optimal subset of atmospheric parameters which are most likely to influence the ozone concentration.

Many studies made around the possibility of using GA in the environmental sciences have been reported in the literature. In (Wang et al., 2013) a genetic algorithm based approach is used in order to obtain an optimization for the selection of air pollution monitoring stations and in (Qin et al., 2010) is designed a genetic algorithm aided stochastic optimization model for regional air quality management. In (Kadiyala et al., 2013) is developed a model for the air quality inside public transportation using genetic algorithm, neural network and regression trees.

The evolutionary computation proved to be suitable also for the air quality parameters modelling optimization in (Lee and Wang, 2006) where a temperature prediction is aimed based on fuzzy logical relationships and genetic algorithms or in (Mechgoug et al., 2012) where the evolutionary algorithm is used in order to optimize a neural network for the prediction of ozone and carbon dioxide. In (Reyes and Sanchez, 2013) the air quality in Mexico City is modelled with genetic algorithms and clustering techniques. In (Kalapanidas and Avouris, 2002) it is presented an experiment in which the evolutionary computation approach is used to extract an optimal feature subset which feeds a nearest neightbor algorithm to predict the daily maximum concentration for two pollutants.

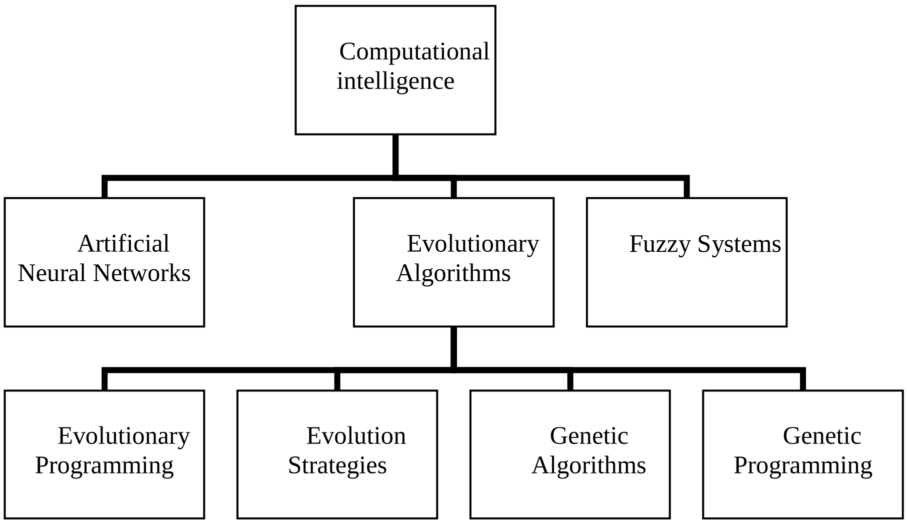

Figure 1. The taxonomy

Particularly to the ozone modelling and prediction problem there have been undertaken several evolutionary computation approaches. In (Loughlin et al., 2000) the scope of using genetic algorithm is in ozone control strategies, in (Yu et al., 2011) the aim is in the optimization a back propagation neural network and support vector machine for the ozone forecasting.

In this contribution it is proposed an efficient optimization genetic algorithm which incorporates specific operators that better tackle the ozone forecasting problem by alternating two types of selection operators: the elitist and the tournament methods. Then optimal input genetic parameters are search in order to obtain the best results.

The rest of the paper is structure as follows. In section 2 there are tackled the main characteristics of a genetic algorithm and in section 3 the ozone forecast problem definition. In section 4 there are synthesized the experimental results of application and the conclusions of this study are presented in section 5.

2 Genetic algorithms

Genetic algorithms have been continuous improved and successfully applied in various domains since their first designed in 1960s by the Holland and his team at the University of Michigan. They are biological inspired models which simulate the natural evolution of a population: the individuals store the DNA information; some of them are selected for the crossover, as in nature mutation of some genes occurs, the new individuals are integrated in population.

A GA starts with the initialisation of the first population. Then each individual is evaluated based on a fitness function which reflects how well this candidate can solve the problem. Using a stopping criterion new populations are generated based on some genetic operators: selection, crossover, mutation, and migration.

The genetic algorithm that is used follows the steps presented in figure 2.

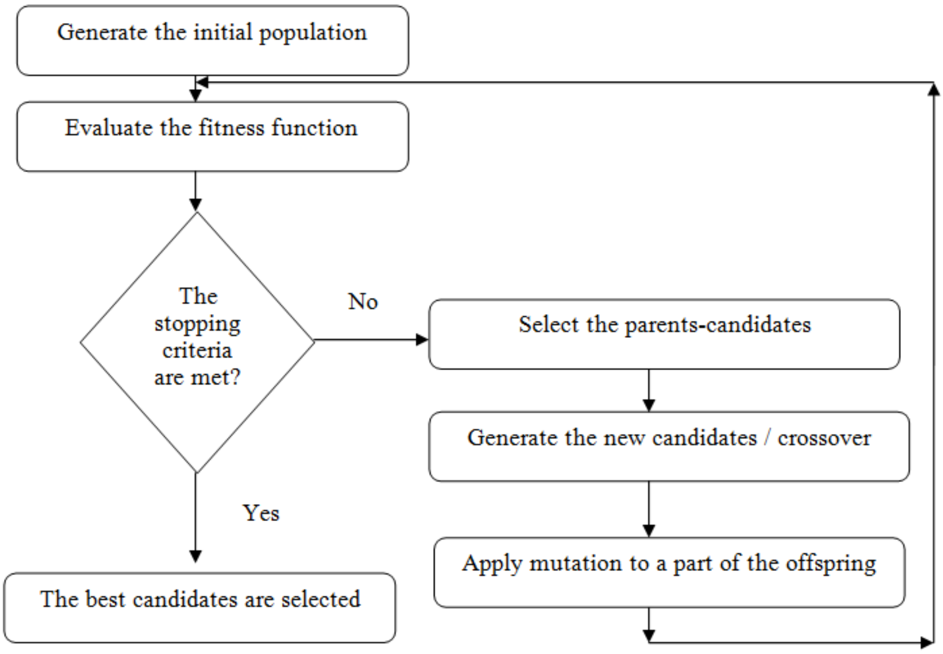

Figure 2. The basic genetic algorithm flowchart

3 The ozone forecasting problem definition

The development of effective prediction models of ozone concentrations in urban areas is important because the ozone is an anti-greenhouse gas particularly in the upper troposphere, thus playing a direct role in climate change. The ozone adversely impacts the human health hazard and also yields the agricultural crops and causes noticeable foliage damage (Hajek and Olej, 2012). There are many complex photochemical reactions and meteorological parameters involved in the ozone formation thus the development of these models is difficult.

The basic air pollution forecasting model for ozone is given by [1].

[1] $$y = f(x_1^t, x_2^t, x_3^t, \dots \dots, x_m^t)$$

where m is the number of parameters taken into consideration,

y is the ozone concentration level at time t+1 (i.e. the predicted value), and

x_i^t is the set of air pollutants concentrations and meteorological parameters values recorded at time t.

In our case study: m = 22,

x_1^t is the concentration of the carbon monoxide at time t,

x_2^t is the concentration of the sulphur dioxide at time t, etc.

All these air quality parameters are taken in consideration because it is demonstrated that the seasonal inputs, time of the day may be some useful predictors in urban environments where oxides of nitrogen, which are strongly related to the time of the day, could influence ozone concentrations (Derwent and Davies, 2012). The anthropogenic tropospheric ozone is a secondary pollutant, formed from oxides of nitrogen and volatile organic compounds which interact photochemically in the presence of sunlight.

Therefore, it is important to include these air pollutants as well as the meteorological parameters in order to have some accurate ozone predictions models.

Our research goal is to identify the best selection among the air pollutants and meteorological parameters that influence the ozone concentrations and therefore to reduce the number taken into consideration by the forecasting models.

4 Experiments and implementation details

The proposed genetic algorithm has been applied in order to select the most appropriate input atmospheric parameters that are most likely to influence the ozone concentrations.

It was implemented in C++ according to the flowchart presented in figure 2.

The chromosome structure is important because it maps the problem details into the GA coding. The chromosome coding scheme contains 20 genes, each one for an atmospheric parameter that may possible influence the ozone concentration, synthesised in table 1. The dataset used in this case study contains the monthly measurements made at air quality monitoring stations in Ploiesti, Romania in 2011. The monitored parameters for this area are legally established by Law 104/15.06.2011.

Table 1. The Chromosome Coding Scheme

Atmospheric parameter	Gene number coding		Atmospheric parameter	Gene number coding
SO_2	G1		m- xylem	G11
NO2	G2		Wind direction	G12
NOx	G3		Wind speed	G13
PM10	G4		Temperature	G14
Benzen	G5		Relative humidity	G15
CO	G6		Air pressure	G16
NO	G7		Solar radiation	G17
Toluene	G8		Precipitations	G18
o- xylem	G9		p-xylem	G19
Etylbenzene	G10		Ozone	G20

For the chromosome's genes the coding scheme includes values within [0, 100]. In order to determine the parameters' weights in the ozone forecasting it is used equation [2].

[2] $$w_{g_i} = \frac{v_{g_i}}{\sum_{j=1}^{m} v_{g_j}}$$

where w_{g_i} -represents the weight of gene *i*, $i = \overline{1,m}$;

v_{g_i} -is the value of gene *i*, $i = \overline{1,m}$.

The interpretation of the results follows the equation [3] (only those greater than 0.05 are taking into account) and the chemical and physical relations among the atmospheric parameters given by the domain specialists.

[3] $$w_{g_i} \geq 0.05$$

After preliminary experiments the fitness function selected is given by equation [4]. It reflexes the ratio of ozone and the total amount of atmospheric parameters.

$$fitness(individual_k) = \frac{v_{ozone_k} * \frac{\sum_{j=1}^{12} Rv_{ozone_j}}{12} * 10^2}{\sum_{i=1}^{m} v_{g_i} * \frac{\sum_{j=1}^{12} Rv_{g_{ij}}}{12}}$$

[4]

where v_{ozone_k} - represents the value of ozone gene in individual *k*, $k = \overline{1, dimPopulation}$;

Rv_{ozone_j} - is the recorded value for ozone in month *j*, $j = \overline{1,12}$;

v_{g_i} - is the value for gene *i*, $i = \overline{1,m}$;

$Rv_{g_{ij}}$- represents the recorded value in month j for air parameter in gene *i*, $i = \overline{1,m}$.

For the selection step of the genetic algorithm we have consider the tournament selection method of the possible parent- candidates for the even generation and the elitist methods for the odds generations because the composite selection algorithm time taken to build the model is considerable smaller than the other two methods and the best chromosome fitness is the highest. In table 2 there are synthesised the results obtain for the same genetic parameters (crossover probability- 0.7, mutation probability- 0.1, initial phenotypes in the first generation- 10, maximum number of generations- 10) but with different selection methods: first case study only with elitists operator, the second only with tournament method and the thirds one with a combination of the above mentioned.

Table 2. The Genetic Algorithm Selection Method Experiments

	The elitist selection algorithm	The tournament selection algorithm	The composite selection algorithm
Best fitness	15.0404	12.8896	15.6248
Best weights atmospheric parameters selected	SO_2, Benzene, CO, NO, Toluene, Wind speed, precipitations, relative humidity, ozone	SO_2, Benzene, NO, etylbenzene, wind direction, solar radiation, precipitations, p-xylem, ozone	SO_2, PM_{10}, benzene, CO, NO, toluene, precipitations, ozone
Time to build	31.387 s	30.857 s	23.135 s

The new phenotypes generation method used in these experiments was the 2-points crossover method, which combines the parents' code in order to obtain two descendents. To maintain the diversity in the population the mutation operator selected is the add method (a random gene of some chromosomes are modified adding a value to it).

We run the genetic algorithm aiming to determine the maximum influence between ozone and the other air parameters with different values for phenotypes in the first population, number of generations, crossover and mutation rates. In table 3 there can be observed the results obtained in different genetic conditions. For each experiment we have taken at least 5 runs with 10 phenotypes in initial generation, taking into consideration the random nature of the algorithm.

Scenarios S1 until S3 have in common the number of phenotypes in the initial generation and the number of generations, tournament dimension and the mutation probability. The crossover probability is tested with values between 60 % and 90%. The results show a better fitness as well as a smaller time to build the model for the crossover probability maximum value. The mutation rate is tested in scenarios S3 – S6 having the best results for 10%. In the last group of scenarios the number of generations is varying from 10 to 25 epochs. There can be seen that a long with the incremental of the generations there is an important growth of the time but also of the fitness value.

From the preliminary experiments undertaken in this case study the best fitness function is obtained in scenario S9. The atmospheric parameters' calculated weights are presented in table 4. There can be extracted the most influent air parameters for the ozone concentration: SO_2, PM_{10}, benzene, CO, toluene, etylbenzene, m-xilem, wind speed, temperature, and ozone. From this selection there can be drawn a shortcoming of this proposed model: the omitting of NO_x and solar radiation in the most influenced parameters, which is to be taken into consideration with further experiments.

Table 3. The Genetic Algorithm Experiments

Scenario number	Number of epochs	Crossover probability	Mutation probability	Tournament dimension	Best fitness	Time to build the model(s)
S1	10	60%	10%	6	15.6248	45.692
S2	10	80%	10%	6	14.183	40.591
S3	10	90%	10%	6	15.8077	40.652
S4	10	90%	5%	6	14.1337	54.210
S5	10	90%	15%	6	13.2701	42.387
S6	10	90%	20%	6	12.3934	58.157
S7	13	60%	10%	6	18.2356	39.437
S8	20	60%	10%	6	21.661	160.775
S9	23	60%	10%	6	24.0882	1714.73

Table 4. The Atmospheric Parameters' Weights for Scenario S9

Atmospheric parameter	Gene weight		Atmospheric parameter	Gene weight
SO_2	0.12085		m- xylem	0.061089
NO2	0.00531209		Wind direction	0.00664011
NOx	0.00265604		Wind speed	0.119522
PM10	0.0703851		Temperature	0.0504648
Benzene	0.063745		Relative humidity	0.0172643
CO	0.110226		Air pressure	0
NO	0.00265604		Solar radiation	0.0159363
Toluene	0.116866		Precipitations	0.0159363
o- xylem	0		p-xylem	0.0464807
etylbenzene	0.063745		Ozone	0.124834

The model validation is performed against the domain specialists' heuristic rules. Therefore knowing that ozone is directly influenced by the volatile organic compounds, nitrogen oxides, carbon monoxide, solar radiation, wind speed, from table 4 we can say that this model has a good accuracy in selecting the majority proper air parameters involved in the increasing of the tropospheric ozone concentration.

5 Conclusions

In this study there has been proposed a genetic algorithm – based heuristic method designed to obtain an optimal solution for the proper selection of the atmospheric parameters that are most likely to influence the ozone concentration. The preliminary experiments results indicate that the atmospheric parameters selection pre-processing using a genetic algorithm can be a useful tool for environmental problem solving.

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Functional aspects of educational software development's process from the perspective of teachers involvement

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Abstract

Starting from an idea that in the ideal version, XXI century teacher must be someone equipped not only by pronounced luggage of professional, methodical and scientific knowledge and skills, but also digital competences which can be applicable to the design and development of interactive learning materials in various electronic formats having a prospective of classes' implementation in teaching-learning-assessment with contingents of students.
There is proposed a descriptive analysis of the interaction between teachers of different school subjects in the collaborative activity of development of own design's educational software in this article.

Keywords: Interactive multimedia educational software, Reductional Model of Development and Implementation

1 Introduction

The transformation of didactical circumstances inside the actual system of education is a result of the evolution of modern high-performance technologies - digital and nanoelectronic - which has modified also our view, of teachers, on instructional design, in fact. Following the interpenetration of active social computerized life, the expansion of digital technologies' use area, continuous experimentations of ICT integration in educational approach, until recently, has been completely traditional, provokes some beneficial mutations on relationships, mechanisms and strategies on the instructional design in traditional and / or digital formats, all of these become more and more flexible relative to each other now.

2 General representations versus particular aspects of educational software development's process by own conception

Starting with the last decade of the twentieth century the field of educational software development scroll through an ascending trajectory towards a new CAL evolutionary stage, one of multiple development, determined by "the evolution of developing educational software concept" in which "trend towards transition from rigid teaching strategy, with low individualizing instructions, to one that considers an individual student who thinks, understands and has initiatives "(Crăciunaş S., 2013).

Into the subsequent period various authors tend to outline and define educational software's developing stages. In the opinion of good majority representatives of scientific community interested in the IT, digital educational finished product resulting from a dynamic design process divided into three main stages, which emphasizes "the specification of roles, activities, strategies, teaching methods, resources, hardware / software available" (Croitor-Chiriac T., 2013):

1. theme's establishing;
2. pedagogical design;
3. computer science's achievement (ibidem; Crăciunaş S., 2013; Niculescu C., 2012).

While a more precise approach to develop an educational software comprises the steps of: (1.) pedagogical design and selection of content, (2.) a model's realization, (3.) computer implementation of the program, (4.) program testing, (5.) program correction, (6.) dissemination and delivery of program.

By Istratii Olympus, 2013 "main guiding design operations of instruction work can be translated and applied in a computer assisted education program through the specification of the particularities training required". Succinctly, such operations are: (1) goals' setting; (2) preparing the final arrangements to evaluate the competence of pupils; (3) ordering per chapters of content material; (4) specification and detailing the sequences of study and auxiliary materials; (5) development program as text, iconic diagrams, symbolic or as audiovisual media; (6) implementation of the program; (7) assessment; (8) the reengineering of program (ibidem).

The analysis of flock savant views on the design and development processes and assembly of educational software (ES) essential factors for develop a proper of ES, previously exposed in detail in present paper, determined us to deduce the Reductional Model of Development and Implementation (RMDI) of interactive multimedia educational software (IMES) to the study of Romanian language and literature (see Figure 1). Particular case examined by us is the methodology development process of ES by own design concept: *"DIGITAL LABORATORY SPECIALIZED TO STUDY ROMANIAN LANGUAGE*" (Burlacu N., 2014).

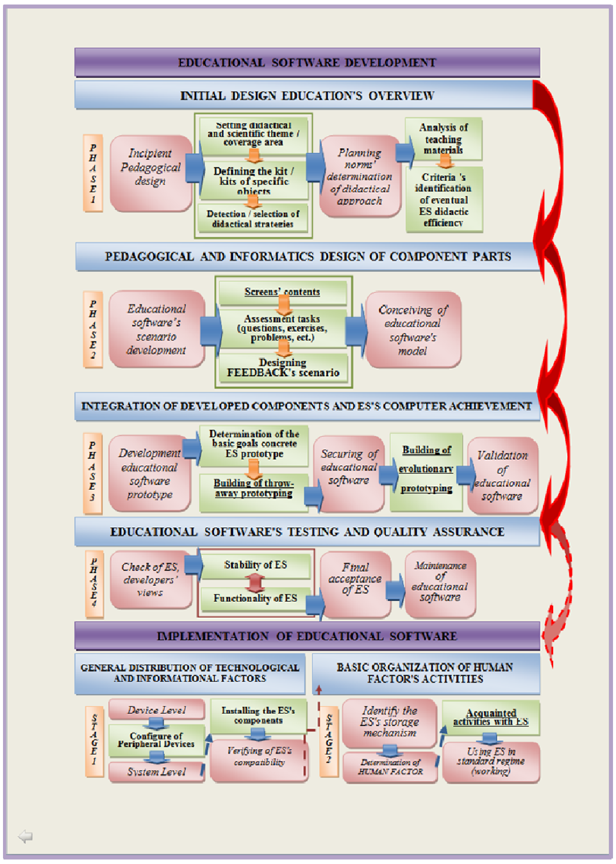

Figure 1. RMDI of IMES to the study of Romanian language and literature

In proposed by us version Reduction Model of Development and Implementation of interactive multimedia educational software (IMES) to the study of Romanian language and Romanian literature represents an ideatic container which is divided into two main processes:

I. EDUCATIONAL SOFTWARE DEVELOPMENT, what covers four phases of development and namely:

Phase 1 - INITIAL DESIGN EDUCATION'S OVERVIEW;

Phase 2 - PEDAGOGICAL AND INFORMATICS DESIGN OF COMPONENT PARTS;

Phase 3 - INTEGRATION OF DEVELOPED COMPONENTS AND ES'S COMPUTER ACHIEVEMENT;

Phase 4 - EDUCATIONAL SOFTWARE'S TESTING AND QUALITY ASSURANCE.

II. IMPLEMENTATION OF EDUCATIONAL SOFTWARE containing two stages which are reflected in previous scheme (see Figure 1):

Stage 1 - GENERAL DISTRIBUTION OF TECHNOLOGICAL AND INFORMATIONAL FACTORS;

Stage 2 - BASIC ORGANIZATION OF HUMAN FACTOR'S ACTIVITIES.

Interaction of the teaching staff is continuous and runs with diverse intensity throughout all steps of ES development.

As preconditions of development process launch of IMES to the study of Romanian language and literature according to our Reduction Model of Development and Implementation of IMES involved teachers have taken into account ratio of prior elements, as well (see Table 1):

Table 1. Preconditions of the launch IMES development process, according to Reduction Model (see Figure 1):

No. of row	Define precondition	Precondition's purpose
	TARGET GROUP ANALYSIS	
1.	To notice behavioral changes, the emergence some response reactions of learning outcomes at student's contingent, constituents of target group.	Supports: (1) evaluating the effectiveness of learning; (2) student motivation; (3) rationalization of content.
2.	To obtain information about target group representatives, whom it is addressed ES, just in order to adapt ES's characteristics to this kind of school population.	It helps determine target group representatives' personal factors such as: (1) cognitive structure; (2) the level of cognitive development; (3) intellectual capacity; (4) motivational factors; (5) attitudinal factors; (6) situational factors; (7) socio-psychological factors; (8) social factors.
	ANALYSIS OF RESOURCE CATEGORIES	
3.	To make decisions on potential **material resources** reserved and / or vacant: With what technical equipment it will work and which are availabilities of target group.	Allows you to set all of the technical equipment employed at various stages of ES development and availabilities of target group.
4.	To specified the set of **content resources** expressed in: whole concepts which have to be transmitted; forming the required behaviors in order to solve proposed objectives.	Aimed the hierarchical manner of concepts for facilitate the learning. Pedagogical research results help the designer to detect various techniques for structuring the content after which it will choose the most appropriate.

5.	To calculate a **student resource** in terms of the target group and the circumstances of ES use.	Supervises: the selection of activities offered to students with a view to achieve proposed finalities; the transposition of educational activities defined in digital format in a well-argued scenario.
6.	To delineate the **interaction resource** of ES-student at the level of overall conditioning reciprocal units of relationship's objects (ES-student), conducted in a special way through which the activity of target group's representatives will be monitored by the internal system of ES installed on the computer.	Assumes that the ES's authors possess thorough knowledge of theoretical and practical nature regarding: design, algorithmic and informatics transposition; exploitation of unit mechanism of interaction.

ANALYSIS OF RELEVANT PARTS IN ES's DESIGN		
7.	To examine **the nature and amount of information** to be transformed into digital format of ES.	Stimulates: (1) inclusion of pertinent and useful elements regard to the objective; (2) use only listed pre acquisitions; (3) adapting to difficulty level incurred by the concerned students; (4) compliance correctness of information operating within ES.
8.	To research **opportunities** mandatory and optional; real and operative presentation **of ES's content.**	Determine: (1) vocabulary related to the concrete level of school; (2) concise and accessible sentences; (3) relevance of graphic (* bmp, * .dib; *. *. Giff; * .tiff; * .tif, * jpg, * jpeg, * .jpe; * .jfif; * png etc.); audio (* mp3, * wav, * .midi;; * .aa; * .aac; * .amr; * .ape; * .cda; * .flac; * .mt9; * wma etc.) and / or visual (* avi, * swf, * .ani; * .bik; * .mkv; * mov, * .qt; * .smk etc.) information in relation to the themes and screen's context.
9.	To order **the didactical** involved **situations** in ES assisted learning.	Impose the following rules: from the known to the unknown; (2) from simple to complex; (3) from concrete to abstract; (4) from observation to reasoning; (5) from an overview to a detailed treatment; (6) from gradual ascendancy of difficulty's degree (the start being determined by simple exercises which provide to student the satisfaction of success); (7.) Design sequences of upgrading knowledge earlier assimilated; (8) achieving for overall synthesis of knowledge.

The compliance of recommended prerequisites for launching development process of IMES to study Romanian language and literature constitutes a lighter traverse platform for implementation of consistent educational ideas RMDI designed according to a real ES. Thus, during of I-II stages the ES's designer will adopt a more general deductive approach (from general to particular), and later during of III-IV stages, by ES's multiple path testing to go also through inductive approach (from particular in general), which will lead to more specifically ES's prototype development concerning the way traveled by the student. This is mainly relevant when the designing experiences overcoming some school subject’s educational materials, addressing the design to the finalities of education system and / or lifelong education. The coordination of such finalities must determine the ways in which learning is triggered. For example, by Burlacu N., 2012, if one of these finalities is to develop the creative potential through learning expressive reading, which is an art, then the work load included in ES can not miss one based on the divergent thinking.

3 Structure of educational software development's process from the perspective of teachers involvement

ES's development is a multidimensional process, dependent on numerous factors, including human factors of diverse didactic formation which is fundamental. ES's development process from the perspective of teachers involvement, representatives of various scientific fields (language, history, physics, chemistry, biology, mathematics, etc.), in fact, is a sequence of steps to the common participation's achievement in developing action of high performance educational products, communication stages oriented to: (1) interchange of information within the team, into the formed tandem of computer science teacher (CST) - non-computer science teacher (non-CST) and (2) constructive cooperation of these component units.

The act of working together concerned scrolling in school context has a distinctive touch difficult to identify under the aspect of analytical and observable events. This fact is due, on the one part, to nature of relationship's intersubjective communication, generally, and in particular, to one marked by collaborative actions a view ES's development, employing factors, processes and, even, psychological conditions, sometimes difficult or impossible to describe and explain, while - on other part - an extremely dynamic nature of the process, no more, no less, of creation which in no case should it be suppressed.

There are several formulas that express established relationship between stakeholders of pedagogical cooperation, included with the aim to developing educational software applicable in the school's reality, which emphasizes importance of interchangeability of meanings that is produced within the present interaction. Moreover, the most fundamental sense of the concept of "communication" is the sharing of meanings between interaction partners.

Educational software development process, running in terms of different school subject’s teacher’s inclusion, possess interpersonal communication features that can be found in whole educational communication by school type, certainly, some other features that customize it. These are primarily, those features without direct interaction act does not occur here. For example, we have developed the *Pedagagogic Model of Formative Units’s cooperation of computer science teacher (CST) – non-computer science teacher’s (non-CST) tandem in the ES's development process* (see Figure 2).

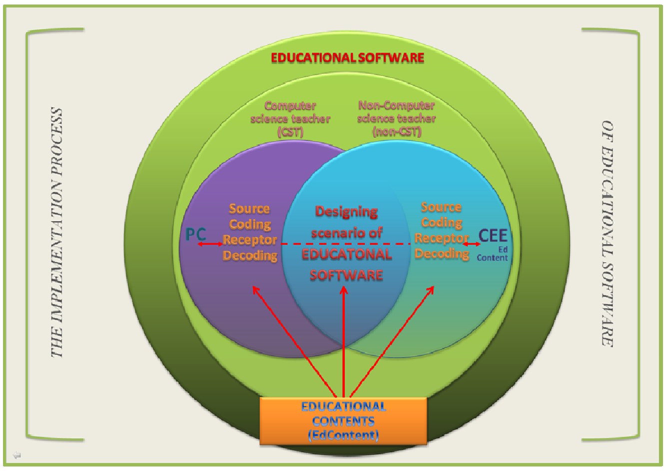

Figure 2. Pedagogic Model of Formative Units’s cooperation of CST - non-CST's tandem in the ES's development process

Proposed model (see Figure 2) is the synthesis of a pedagogical experimental cooperation between teachers in the interactive-multimedia ES's development process of own conception *"DIGITAL LABORATORY SPECIALIZED TO STUDY ROMANIAN LANGUAGE"* (Burlacu N., 2013, 2014) (see Figure 3).

Starting from the premise that communication processes always have a unique configuration, given the context and situation in which it is performed and, its guess an interpersonal exchange between at least two partners, above representation allows highlighting and analyzing formative role played by the various units of the ES's developed tandem. One of the two central figures of given tandem, always constant, is the IT and / or TIC (CST) teacher forming specialist.

CST comes with Programming Competence (PC), so has empowered to transpose digital educational content through the mediation of OOP languages. Based on Figure 2, the second actor is a teacher of any other forming, as IT and / or ICT specialist, here designated like a non-Computer teacher (non-CST) is endowed with the Competence to Expose Efficiency (CEE), in a correct methodologically manner the educational content (EdContent) and teaching-learning-evaluating strategies for integrating in an eventual ES's format.

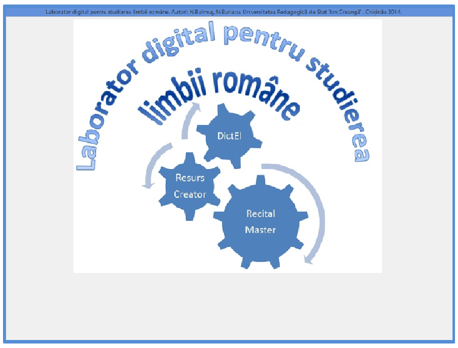

Figure 3. Print screen from ES "Digital Laboratory specialized in the study of Romanian Language"

The area of common concerns of Formative Units's cooperation of CST – non-CST's tandem is delimited by EdContent, educational scenario's designing in order to obtain an optimal ES in the settlement of some didactical situations.

Pedagogic Model of Formative Units's cooperation of CST – non-CST's tandem's *doublet source / encoding - receiver / decoder* (Figure 2) - make it clear that each of both partners of given tandem is succeeding to the position of the transmitter (encoder) and the receiver (decoder), manifesting itself - in the same time - as a transmitter and receiver of own message. This relationship foreseen that any of the participants in the interaction carries, first of all, dialogue with himself (there is an intrapsychic communication there) from where this is launching in an interpersonal circuit. Of course, in the creative process described at one time are interconnected also personal factors by affective nature, as: emotions, education and feelings, interpersonal issues, etc.

4 Conclusions

The especially of existence's character of such types of relationships can be distinguished by: the imperative presence to organize and sort materials for teaching, learning, assessment in a functional-structural agreement between the qualitative-quantitative flock of the totality information, needed to assimilate data in an object module, theme, etc. provided-received in the context of teacher-student relationship, computer science teacher versus teacher of other subjects. Positive result of collaboration described above, having a potential transposing in a programmable algorithmic format, has been demonstrated experimentally by auditoriums ES's issuing and implementing of "Digital Laboratory specialized in the study of Romanian Language".

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Agenția de Stat pentru Proprietatea Intelectuală a Republicii Moldova. Certificat de înregistrare a obiectelor drepturilor de autor şi drepturilor conexe. Seria PC Nr: 3854 din 14.01.2014. Nr. cererii: 55. Denumirea: LABORATOR DIGITAL SPECIALIZAT PENTRU STUDIEREA LIMBII ROMÂNE. Autori şi titulari a drepturilor patrimonial e: Burlacu Natalia, Balmuş Nicolae.

The complexity of interlanguage – a computer assisted analysis

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Abstract

The analysis of the interlanguage system is still a challenge as researchers admit they have to deal with a dynamic language. The interlanguage is considered to be a third language system developed by the learner, different from both the source and target languages. The paper aims at revealing a new methodology of interlanguage analysis which uses both manual and computer assisted techniques. Statistical and IT tools support these research methods and add to the refinement and liability of this study.

Keywords: interlanguage, balanced complexity, lexical and syntactic diversity, lexical and syntactic sophistication.

The analysis of interlanguage is still a challenge for researchers, given the dynamism of this type of language which is seen as third language system developed by a foreign language learner, different from the native language and the target language. In addition, the study of compliance of the interlanguage with the norm of the target language and the analysis of a second dimension are required, in order to get a more faithful image of the learner at a given moment of his/her evolution.

It is therefore essential to lean over the complexity of interlanguage, as many times these two dimensions of interlanguage do not go hand in hand, on the contrary, they enter a compensatory mechanism, namely: the more the compliance with the norm increases, the more the complexity decreases and vice-versa.

In this article, we intended to show step by step the methodology we have chosen, as it is about determining the complexity of interlanguage. This methodology was used and detailed in the final thesis *Interlanguage of Romanian learners of French as a foreign language at the crossroads of Roman languages (case study on Romanian learners also studying Italian and Spanish)* of Mariana-Diana Câşlaru, defended on the 05th of September 2013 at "Alexandru Ioan Cuza" University of Iași. Given that this work is very detailed, we have looked for software instruments to render more accurate and effective the analysis, at a time.

We would say straight away that in order to calculate the indices of complexity (diversity and sophistication), we used the formulas suggested by Mr. Schulze, Mr. Verspoor, P. Wood and B. Pokorny in the unpublished article *Towards automatic proficiency scoring in L2 writing: Balanced complexity*. We also mention that this article was provided to us by one of the authors, Mathias Schulze, from the University of Waterloo (Canada), who was kind enough to give us additional explanation with regard to these calculations.

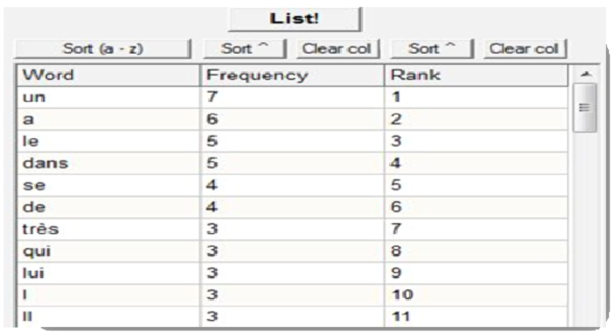
The specialty literature suggests numerous calculation formulas for the indices of lexical and syntactic complexity. The authors of the article mentioned above choose formulas that are not proved the most efficient and in use in practice in the last years. The novelty they suggest consists in the addition of four indices: lexical and syntactic diversity and lexical and syntactic complexity, in a single value. This one represents the balanced complexity of a given text. For the moment, we shall deal with these indices and we shall treat the balanced complexity in due time.

The determination of indices of lexical and syntactic diversity is based on the calculation of the *unique lexical units / total of lexical units* ratio and of the *unique syntactic units / total of syntactic units* ratio.

The *type/token* ratio (TTR) is a common instrument of measurement of the lexical diversity. It is well known that this TTR is negatively influenced by the length of the text, which means that the longer the text, the more the index decreases, because words tend to repeat as the length of the text increases. Numerous criticisms (Carroll, 1964, Arnaud, 1992, Wolf-Quintero *et alii*, 1998, Malvern *et alii*, 2004) were made with regard to the use of TTR as such. We tried to transform this formula in order to neutralize its accessible character. One of the new proposals is the CTTR (Corrected Type Token Ratio) suggested by Carroll (1964:54), which is “positively correlated with sample size” (Malvern, 2004:139).

However, Schulze suggests the measurement of lexical diversity by means of Guiraud’s *type/token* ratio, even if this one remains considerable on the length of the text. He argues his choice assuming that texts to be analyzed have more than several hundreds of words and in this case a compensatory law intervenes to neutralize the influence of the length of the text.

In our case, such as the length of texts written by learners of foreign language, situated between 50 and 300 words, we suggest the use of CTTR of Carroll, which Schulze used at the beginning of his research. This ratio is calculated dividing the number of types by the square root of the double of total number of words. Similarly, it is worth mentioning that all identical occurrences of a word are counted as a single type. For example: *table*, *table* = 1 type, and *table*, *tables* = 2 types. In order to count types, we suggest the use of the software Word List Expert, which provides us the frequency of words in a text:



Word	Frequency	Rank
un	7	1
a	6	2
le	5	3
dans	5	4
se	4	5
de	4	6
três	3	7
qui	3	8
lui	3	9
l	3	10
il	3	11

Figure 1. Example of type count

The formula that calculates lexical diversity is:

$$\text{CTTR} = \frac{T}{\sqrt{(2 \times W)}}$$

where T = number of types and W = number of words

Then, in order to determine lexical complexity (mean word length), the calculation of an additional index related to diversity is required. It is about the index of lexical sophistication, which reports to the complexity of forms of words, namely which indicates the mean word length. We obtain this index by dividing the number of letters (only alpha characters) of a text by the number of words:

$$\text{MWL} = L / W$$

where L is the number of letters and W is the number of words.

The third index, the syntactic diversity one, considers the frequency of bigrams, which represent a sequence of two words: [word1 word2] [word2 word3] [word3 word4] as in the following example. We do not have software to create and count bigrams of a text and consequently, we double the words of texts manually and therefore we count them by means of the software Microsoft Office Word.

Lesdeux deuxpersonnages personnagessont sontune unefille filleet etun ungarçon garçonles lesdeux deuxpersonnages personnagess sappellent appellentMarie Marieet etRobert Robertet etils ilsont ontla lanationalité nationalitéindienne indienneles lesdeux deuxpersonnages personnagesont ontdes desvetements vetementstrès trèscoleurés coleurésle legarçon garçonà

Figure 2. Examples of bigrams

Similar to the index of lexical diversity, the index of syntactic diversity is always determined by the intermediary of calculation of a ratio, the one of unique bigrams. We obtain this index by dividing the number of unique bigrams by the square root of the double of total number of bigrams of a text. Schulze *et alii* mention that this ratio shows the degree of predictability of words in a text. The less predictable they are, the higher is the complexity of the text. We also notice that several identical occurrences of a bigram shall be counted as a single bigram. After having manually doubled each word in order to obtain bigrams, we count their frequency by using again the software Word List Expert:

Sort (a - z) | Sort ^ | Clear col | Sort ^ | Clear col

Word	Frequency	Rank
lesdeux	4	1
deuxpersonnages	4	2
legarçon	3	3
veutse	2	4
trèscolorées	2	5
sontune	2	6
semarier	2	7
quil	2	8
personnagessont	2	9
marieravec	2	10

Figure 3. Example of bigram counts

Furthermore, we need to mention that the total number of bigrams of a text is always equal to the number of words of a text minus one. The formula which calculates the syntactic diversity (unique bigram ratio) is:

$$UBR = \frac{U}{\sqrt{(2 \times (W-1))}}$$

where U is the number of unique bigrams and W is the number of words

Finally, the index of syntactic sophistication (mean period unit length) is added to diversity and represents a second dimension of the syntactic complexity. It shall report to the mean length of syntactic units that end by a dot and we may obtain it by dividing the number of words of a given text by the number of syntactic units that end by a dot:

$$MPL = W / P$$

where W is the number of words and P is the number of syntactic units that end by a dot.

All these calculations are easy to make by means of online calculators suggested by easycalculation.com. The following table presents the results of calculations obtained for a certain subject that provided us 6 texts.

Subject x	L	M	T	B	U	P	CCTR	MWL	UBR	MPL
text 1	435	104	69	103	97	12	4.784	4.182	6.758	8.666
text 2	513	128	80	127	121	7	5	4	7.592	18.285
text 3	319	76	51	75	71	6	4.136	4.197	5.797	12.666
text 4	843	205	113	204	190	12	5.580	4.112	9.406	17.083
text 5	480	117	64	116	108	9	4.183	4.102	7.090	13
text 6	589	144	81	143	134	13	4.773	4.090	7.923	11.076

Table 1 – Calculations of indices – Subject x

It is worth mentioning that these indices do not represent values in themselves. They do not have usefulness in comparison with other indices. We also note that such an index may not be compared with another such index of the same nature. For example, we compare the index of lexical diversity with another index of lexical diversity and not with an index of syntactic diversity. However, in order to neutralize these differences and to be able to combine indices in a single formula meant to calculate the balanced complexity of a given text, Schulze suggests operations based on statistical elements.

Descriptive statistics provides basic procedures frequently used in the analysis of the corpus (see Mackey and Gass, 2005), as in linguistics, the obtained data is not immediately exploitable in their initial form. In this context, the researcher may use statistical procedures of organization and description of data so that they become informative. Schulze *et alii* suggest the use of the z-score in order to standardize the four indices based on different units (letters, words, bigrams, expressions). It shall allow, as we have already mentioned, the addition of indices of different types.

First of all, let's give the definition of this instrument. The z-score determines the position of a certain value compared to the mean, measured by standard deviations (Johnson et Kuby, 2008:99). The calculation formula of the z-score is:

$$z = \frac{x - \mu}{\sigma}$$

where x is the noticed value, μ is the mean of distribution values and σ is the standard deviation of distribution values. Consequently, the z-score of the x value (x being a part of a certain population/distribution) represent the relative position of this value in the distribution, measuring the number of standard deviations which situate it above or below the mean (Gosling, 2004: 36).

The standard deviation is defined as the measure of dispersion around the mean and it corresponds to the square root of the variance. The variance is the sum of squares of deviations compared to the mean, divided by the number of observations (Carricano *et alii*, 2010:34).

We need to note that the calculation formula of the variance changes according to the type of the data. If the data (values) we have represents a population, we shall use the following formula:

[sum of the squaring deviation] ÷ number of observations = variance(σ)

The standard variation related to a population is denoted by σ. If, on the contrary, the data represents a sample, in order to calculate the variance we divide the sum of the squaring deviation by the number of observations minus one. The standard deviation of a sample is denoted by *S*. (Dodge, 2004:157). We mention that in the study of interlanguage, we calculate the z-score using the standard deviation of the population (σ), as our subjects are the only ones we take into account, considering that results are not to be generalized, as interlanguage is always individual and unique.

After having calculated the indices of lexical and syntactic complexity and lexical and syntactic sophistication, the second stage is standardization. One distribution shall consist of indices of the same type corresponding to texts of the same subject. Let's say, for example, that we have 6 texts for a subject. In this case, in order to standardize the index of lexical diversity of text 1, the distribution shall include the indices of lexical diversity of texts 1, 2, 3, 4, 5 and 6.

Subject x	CCTR	MWL	UBR	MPL	CCTR+MWL+UBR+MPL	BC
	4.784	4.182	6.758	8.666	-0.9147	-0.4246
1	0.0840	1.0512	-0.6027	-1.4472		
	5	4	7.592	18.285	0.3707	0.1721
2	0.5232	-1.7553	0.1479	1.4549		
	4.136	4.197	5.797	12.666	-1.659	-0.7700
3	-1.2335	1.2825	-1.4676	-0.2404		
	5.580	4.112	9.406	17.083	4.5471	2.1105
4	1.7025	-0.0282	1.7805	1.0923		
	4.183	4.102	7.090	13	-1.7639	-0.8187
5	-1.1380	-0.1824	-0.3039	-0.1396		
	4.773	4.090	7.923	11.076	-0.5801	-0.2693
6	0.0617	-0.3675	0.4458	-0.7201		

Figure 4. Standardization. Stage 1

For example, in the table above, in order to calculate the z-score of $CTTR_{(text\ 1)}$ = 4.784, we take the distribution highlighted with red: 4.784, 5, 4.136, 5.580, 4.183 and 4.773. Each value of this distribution shall be standardized. The z-scores obtained are found in the pink boxes below the corresponding value. The same for all types of indices.

Then, in order to obtain the index of balanced complexity, we shall make the addition of the four standardized indices of each text: $CTTR_1 + MWL_1 + UBR_1 + MPL_1$

Subject x	CCTR	MWL	UBR	MPL	CCTR+MWL+UBR+MPL	BC
	4.784	4.182	6.758	8.666	-0.9147	-0.4246
1	0.0840	1.0512	-0.6027	-1.4472		
	5	4	7.592	18.285	0.3707	0.1721
2	0.5232	-1.7553	0.1479	1.4549		
	4.136	4.197	5.797	12.666	-1.659	-0.7700
3	-1.2335	1.2825	-1.4676	-0.2404		
	5.580	4.112	9.406	17.083	4.5471	2.1105
4	1.7025	-0.0282	1.7805	1.0923		
	4.183	4.102	7.090	13	-1.7639	-0.8187
5	-1.1380	-0.1824	-0.3039	-0.1396		
	4.773	4.090	7.923	11.076	-0.5801	-0.2693
6	0.0617	-0.3675	0.4458	-0.7201		

Figure 5. Standardization. Stage 2

The final step to carry out is to standardize the sum of indices, in order to render them comparable among them. Schulze *et alii* explain "Since the sum of z-scores is not a z-score anymore, it has to be standardized too, before carrying out the final step of the calculation". (unpublished article, authors' personal communication)

Subject x	CCTR	MWL	UBR	MPL	CCTR+MWL+UBR+MPL	BC
	4.784	4.182	6.758	8.666	-0.9147	-0.4246
1	0.0840	1.0512	-0.6027	-1.4472		
	5	4	7.592	18.285	0.3707	0.1721
2	0.5232	-1.7553	0.1479	1.4549		
	4.136	4.197	5.797	12.666	-1.659	-0.7700
3	-1.2335	1.2825	-1.4676	-0.2404		
	5.580	4.112	9.406	17.083	4.5471	2.1105
4	1.7025	-0.0282	1.7805	1.0923		
	4.183	4.102	7.090	13	-1.7639	-0.8187
5	-1.1380	-0.1824	-0.3039	-0.1396		
	4.773	4.090	7.923	11.076	-0.5801	-0.2693
6	0.0617	-0.3675	0.4458	-0.7201		

Figure 6. Standardization. Stage 3

Therefore we need to calculate the z-score of each sum of the distribution highlighted in red in the table above in order to obtain the comparable indices of balanced complexity (see the green boxes of the table). At this level of analysis, we suggest the automatic standardization of indices, by means of online computer instruments which calculate the standard deviation of the z-score.

For example, the site easycalculation.com makes available for users such instruments, such as the following:

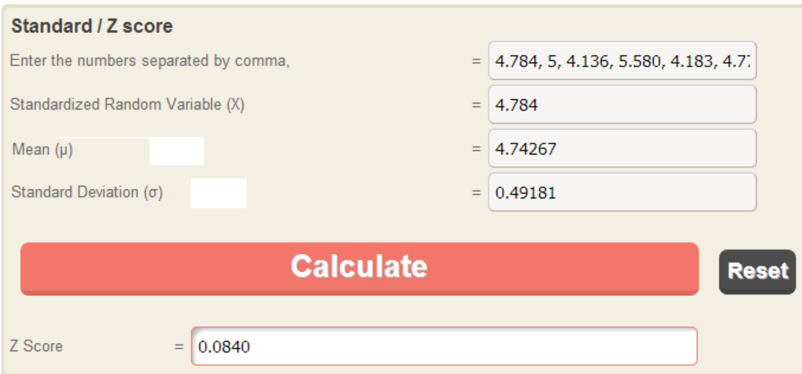


Figure 7. Calculation examples of z-score

At this point, the indices of complexity may be analyzed by comparison and represented in a single diagram, for a better description of the evolution of transitory systems that represent interlanguage.

This detailed study of interlanguage made possible by means of computer instruments allows us to give this concept, abstract at the first sight, a concrete value expressed in indices, numbers and formulas. We encourage the use of software in the study of non-native languages, while supporting the idea that we may only take advantage of computer-assisted analysis attached exemplarily to the manual treatment.

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Standard/z-score Calculator http://easycalculation.com/statistics/z-score-standard.php

A service-oriented perspective for enhancing a digital system design course

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Abstract

The traditional approach to digital system design uses Hardware Description Languages (like Verilog) for describing the functionality of the circuit and EDA (Electronic Design Automation) software for implementing the design into reconfigurable hardware. However this methodology raises challenges in the academic field where due to the various hardware platforms and multitude of software design tools specific for each vendor, it is often difficult to manage an on-site laboratory capable of providing the much-needed hands-on practical experience to students. This paper describes a service-oriented approach to solving this issue by providing the design and implementation flow using web services, remotely accessible to students. Simulation, compilation and implementation of a digital design are all accessible to the students via web services without them needing to install and manage the design software tools locally. Our approach makes the software and hardware resources involved in a digital system design course easily available for multi-student practice with improved flexibility and reduced costs.

Keywords: hardware design, SOA, HDL, System-on-Chip, FPGA, EDA

1 Introduction

In the traditional approach to teaching digital hardware design, Hardware Description Languages (HDL) like Verilog or VHDL are used for describing the functionality of the circuit which is then simulated, tested, synthesized and implemented into the specific desired technology using dedicated EDA (Electronic Design Automation) software tools. There are currently several companies that provide target boards based on FPGA (Field Programmable Gate Array) and SoC (System-on-Chip) reconfigurable devices for the implementation of digital hardware designs. This diversity of producers, software tools, and programming languages brings along an important challenge: dealing with such a multitude of hardware and software instruments and managing this variety of heterogeneous devices and software tools when setting up and running a hardware design laboratory – there are important costs involved, together with specialized personnel and a lot of work in maintaining the infrastructure.

These weak points have also been identified by recent research and summarized in two main reasons that hold back the widespread use of reconfigurable hardware devices (Vuletic et al., 2004): the lack of unified and standardized programming models for these resources and the difficulty in integrating them due to their diversity and heterogeneity. This is why we have considered using Web Services for abstracting away the complexity of hardware design and the low-level technical details regarding the management and use of the software design tools.

In this paper we describe the integration of the digital hardware design workflow using web services as an ideal approach for the academic field, where it can provide the much needed „hands-on" approach to students, thus providing an important enhancement especially in the situations where having an on-site dedicated laboratory is not possible.

In our approach we have analyzed each process of the hardware design flow and integrated it using web services for easy access and use; besides the common steps in the implementation of a digital design: simulation, synthesis, place & route and deployment, we have considered providing an enhancement for the students not familiar with HDL, so we have integrated an open-source C-to-Verilog synthesis tool allowing the description of the circuit in a high level programming language.

2 The Service-Oriented Architecture Solution

Having to cope with the integration of such a variety of hardware and software instruments, we focused on developing a web service-based middleware for abstracting away the heterogeneity of the resources involved. This way, the designers are offered a remote and standardized interface for the development of hardware applications and the academic institutions can save time, space, and money that were normally used in configuring and maintaining a dedicated laboratory (with tens of PCs, software tools, and other resources).

In our cloud-computing perspective, services are independent and autonomous applications (and not classes or components of a particular application) that are designed to be deployed onto a network (usually Internet) where they can be accessed and integrated into user applications when needed. They do not need any particular knowledge about the clients and can accept service requests from anywhere, as long as these requests comply with the security and protocol requirements.

Services can be installed and managed independently one from another and from any client applications, and the service owner can modify the service's interface and functionality at any time.

Service-oriented architectures (SOA) are being credited as ideal for building such a middleware since they offer inter-operability and can thus be used for integrating a variety of technologies (Josuttis, 2007).

A major advantage of a service-based integration is generated by the fact that SOA relies on standards (like XML, SOAP, WSDL, UDDI) that allow a unified approach to all resources (Fig.1), abstracting away their inherent particularities (Chappell and Jewell, 2002).

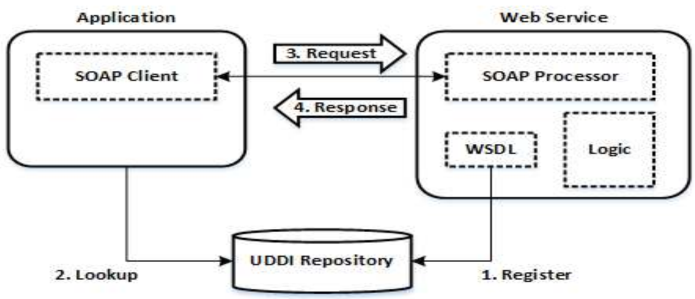

Fig. 1. Generic functionality of a Service-Oriented Architecture (SOA)

This way a service-based middleware (Fig. 2) has the potential of providing solutions to the two major issues stated above by easing the programmability (introducing hardware description services – like the C-to-Verilog conversion service that we have implemented) and by having a web-service based access to the design flow and to the deployment of the digital application to a target board (thus making the work of the design engineer or student much easier by offering a unified and standard interface to the flow, regardless of vendor, version or platform).

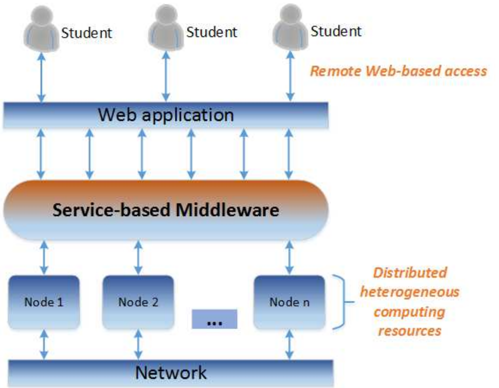

Fig. 2 Integrating hardware design resources using service-based middleware

3 Digital hardware design work-flow integration

3.1 Web-based user interface

The integration approach that we chose relies on web services, and more specifically it takes advantage of their standard interface in order to provide easy to use, scalable and remote-accessible web-based instruments for the design, simulation and implementation of digital hardware applications.

This way, the users – particularly students – can be granted hands-on experience any time, and from any location, given a computing device with an Internet connection, and the academic staff – professors, technicians, and other personnel – need to install and maintain only a server and a local network of FPGA target boards, instead of a laboratory composed of tens of PCs and other equipment.

In our implementation, we provide a web interface based on JSP (Java Server Pages) and a Java Servlet for the communication to the users who are thus being offered a standard, easy-to-use web access to the behind-the-scene web services running the actual design flow in the background, on a server. This solution uses SOAP (Simple Object Access Protocol) – a crucial building block of any SOA – for communicating between the Web Service and the JSP pages. The user interface (Fig. 3) has been implemented using JSP because this technology allows the generation of dynamic web content by combining HTML, XML and basic Java code. This functionality is needed since the response data from the Web Service (files, logs and other info) has to be dynamically generated on the web page and this would not be possible using plain HTML.

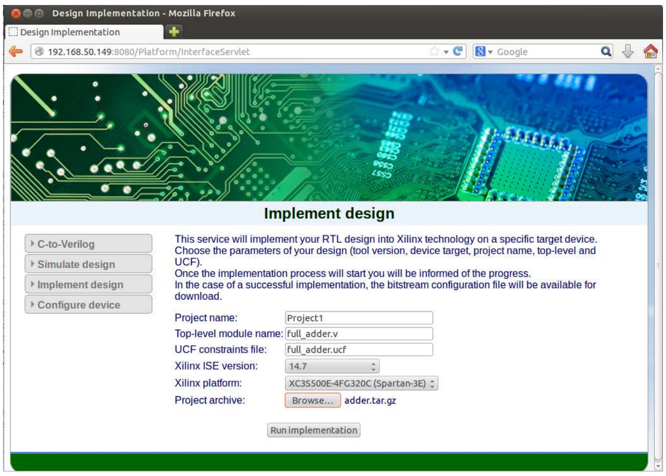

Fig. 3 Design implementation web page

Acting as an intermediary between the JSP web interface and the Web Service is a Java Servlet, which is basically an extension to the server used for enhancing its functionality (Perry, 2004). In our case, the servlet processes the HTML message flow to/from the JSP page and implements the SOAP communication with the Web Service. For example: it encapsulates the HTML data and files from the web page to a SOAP message that is then sent towards the Web Service where the request is processed and a reply SOAP message is then sent back. This message is de-capsulated and the content displayed on the JSP webpage.

3.2 Web server implementation

The Web Service is the core of our implementation. It was implemented in Java and runs on a Glassfish 4.0 Server instance.

It is composed of 4 methods that are implementing the main tasks involved in the design, testing, implementing and deploying a digital hardware design (Fig.4). This allows for a simple, scalable access to the EDA design flow by students; the computational tasks are provided remotely and can be used on demand, no dedicated hardware or software is needed from the students, beside their ordinary computing device – PC, notebook, tablet, etc.

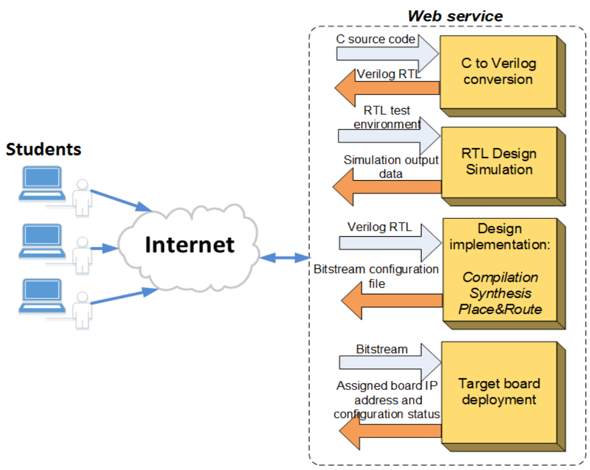

Fig. 4 The service-based hardware design methodology

Any digital hardware design course starts with the basics: the ways to describe the functionality of a digital system using dedicated hardware description languages (HDL) like Verilog or VHDL. These allow for a low-level description of the circuit capable of achieving high performances if done properly (and HDL description allows for a fine tuning of the circuit: eliminating redundant combinational logic, introducing pipelines to fulfill timing requirements, optimizing the use of registers and logic, etc.). However, it is something difficult to master for a beginner, and for this reason we considered that integrating an open-source high-level synthesis (HLS) tool that converts a program written in a higher level language to HDL would be welcomed, especially for educational purposes. Thus we added the LegUp framework for compiling C programs to Verilog synthesizable descriptions as a service method (Canis et al., 2011).

No hardware design will ever work if it is not properly tested and the inherent bugs discovered and removed. This is done by simulation, a resource and time consuming process that needs dedicated software. We chose to offer a simulation service based on the open source Icarus Verilog simulation and synthesis tool. This provides a thorough simulation of the HDL design and offers as outputs both a log file and a waveform.

The implementation of a design is a complex process including many major tasks: from the synthesis of the RTL design, to placing and routing the netlist physical components on the chip, performing the timing closure, formal verification, and bitstream generation.

Our implementation includes a method that performs all these processes by taking files and parameters as inputs from the web page. It provides support for the Xilinx technology (and the following boards that we currently work with at our university: Avnet Zedboard, Digilent Atlys and Spartan 3E Starter Board), but it can accommodate any vendor, if needed. The Xilinx development software suite has been installed on the server; the work environment, configuration and execution scripts are automatically generated by the web service that also handles the entire flow.

Last but not least we considered that providing the students with a web service based access to real target devices (FPGA and SoC boards) would significantly contribute to enhancing their practical experiences in the field of hardware design. This is why the Web Services provide a method for remote-configuring Avnet Zedboard platforms (zedboard.org) located in our campus LAN together with the processing Server. This approach has the potential of granting each student access to high-performance latest generation FPGA and SoC boards remotely; on one hand this can reduce maintenance costs since the possible physical damage to the boards is not an issue anymore, and on the other hand, by using a scheduling service, a large number of students can be granted time-multiplexed access to a small number of such devices, which also reduces costs).

4 Applications

Using SOA, the entire hardware design flow (RTL description from C code, RTL simulation, synthesis, placement and routing, timing closure and bitstream generation) has been made available for students and engineers in a remote, scalable and easy to use way, based on web services and instruments (Fig.5).

On the JSP webpage interface that we developed, the student has the possibility to choose a service that meets his needs, and to input the necessary information and files on a specific page for each task (C/Verilog source code, project information, parameters and other data) which are then uploaded by the Servlet to the web service. The service then runs on the server the respective computational processes (conversion, simulation, or implementation) using specific scripts that it generates and configuring an automated work environment. The results (files, logs, waveforms) are then sent back to the Java servlet and the student can view and download them from the web page.

Fig. 5 Digital hardware design services operation mode

This “modus operandi” brings along a series of key benefits in the field of virtual distance learning.

It is known that in the educational field of electrical engineering, the role of practical laboratory work is extremely important for a proper understanding of the concepts and notions involved (El Medany, 2008).

In the traditional approach, students were offered access to the software and hardware tools involved in the hardware design process only when attending the scheduled courses and laboratory hours at the university, or if they were able to install and configure them on their personal PC’s (however many are expensive and resource-consuming). This is an approach that limits the practical experience that is an invaluable part of learning hardware design. Also, installing and maintaining a laboratory with several (maybe tens) of workstations – each with its own operating system and software tools – is not only expensive but time consuming for the faculty staff.

By remotely exposing the hardware design flow using web services, technologies, software tools and hardware devices can be made available for multi-student practice in a flexible and scalable way, contributing to cost reduction and increasing the possibility for students to have real, practical experiences in designing and deploying digital hardware systems (Morgan and Cawley, 2011). Also, not having to bother with installing and running the software tools locally, the student can focus solely on the design and testing of the hardware system, and the faculty staff on improving the teaching material and not on managing the laboratory PC's, so precious time is saved and can be better used for both students and professors. Another important asset that the service-oriented approach brings is that it enhances the sharing of such hardware design services not only between students of a particular institution, but also on an inter-institutional level (Morgan and Cawley, 2011). This is a very actual and important research subject, especially given the joint efforts by academic partners in European projects like eDiViDe, which aims at creating a European wide online digital design lab (Vandorpe et al., 2013).

5 Conclusions

In our efforts of developing a service-oriented middleware for abstracting away the complexity of the traditional hardware design methodology, we propose using this approach for enhancing the academic field of electronic engineering, and more specifically the hardware design courses and laboratory work.

The work described in this paper proposes a service-oriented integration of the processes involved in the design of digital systems (circuit description, RTL simulation, implementation and deployment) so that it would become available remotely on the web, by the means of a standard, unified interface, that "hides" the diversity of software flows and hardware devices involved "in the background".

We consider this approach as bringing important benefits in easing access for students to hardware design flow instruments and FPGA target boards in a remote and scalable way that can contribute to a better understanding of the design methodology and can optimize the efforts from the faculty staff in organizing and maintaining the infrastructure needed for the practical applications of the hardware design courses.

Such a service-based perspective not only offers the students easy and safe access to high-performance and laborious software tools and hardware devices – in situations where normally due to cost and other resource requirements such an access would be limited or not available at all – but also can support inter-institutional cooperation and sharing of resources in a simple and quantifiable way, improving the learning process and other related academic activities.

Acknowledgement

This paper is supported by the Sectoral Operational Programme Human Resources Development (SOP HRD), ID134378 financed from the European Social Fund and by the Romanian Government.

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A Category-Based PageRank Algorithm on Finding Multi-Field Experts in Yahoo Answers

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Abstract

Nowadays, we are faced with numerous questions every day. Community-driven question-and-answer forums are websites where people are able to ask these questions or answer the ones asked by others. Today, a massive amount of knowledge and information is being shared in these websites. But the main problem regarding these online communities is, what percent of the information we obtain from them is valid, how many of the answers are correct, which users are more reliable and so on.

For this reason, we proposed a new approach on finding expert members in a popular forum, such as Yahoo! Answers, using PageRank and user activities. This way we know which answers and which users are countable. First, we use the questions and answers of members to create a graph. Then, after applying answers' rating parameters such as good and bad rating, we apply the PageRank algorithm in order to rate the members according to their activities in a specific category. Finally, we compute the overall score of a member, using these category-based scores and the relativeness between the categories, calculated by the proposed method.

Keywords: Expert Finding, User Model, Information Retrieval, Link-Analysis

1 Introduction

Due to growth of Internet and reachability of services provided through it, more people are starting to find help and answers to their questions and problems using online communities.

Questions and answers (Q & A) websites are one of the most famous groups of these communities. Forums are websites similar to chat rooms in which, people can communicate through messages. The difference between a forum and a chat room is that messages in a forum are posted in order to ask a question or answer a previously asked one (Omidvar et al, 2014).

Yahoo! Answers (YA) is a community-driven forum launched by Yahoo! on June 28, 2005. This forum gives members the chance to earn points as a way to encourage participation. People in this community can ask their questions, giving answer to others' questions and visit previously answered questions.

Moreover, people can rate the answers. This activity can be the start of the search for finding experts in a forum such as Yahoo! Answers. People participating in the activities of a forum may not have equal knowledge about topics and questions discussed. They may have different experiences or level of expertise in different categories. Therefore, ranking members according to their level of expertise in different categories is one of the most important objectives in social network analysis.

Using members' daily activities (such as answering questions, ranking other answers, etc.) have been the most common method to rank users and find their reputation in a Question and Answer community. The more points a user gains the higher his reputation will be. Although this is a good method for ranking users and it is used by many websites, but, it lacks analysis of user interactions. Analysis of user network gives us more accurate results. Therefore link analysis algorithms such as PageRank and Hits may be used in order to analyze user interactions.

For this reason, we proposed a new approach on finding expert members in a popular forum, such as Yahoo! Answers, using PageRank and user activities. Yahoo! Answers already has a reputation mechanism by which people can judge which user is more trustworthy than the others. But the current system lacks a user reputation model.

Currently Yahoo! Answers gives points to user's activities such as answering a question or choosing the best answer. This model appreciates users that are more active. Using the classic model and users' points, one may also infer if someone has been giving good answers or not, if they have been active and etc. Our goal is not only to show users' credits, but also to point out users with high community reputation.

For example one person may have a fair knowledge about computers but may not be a computer expert. His answers may get a good ranking but using our method, the chance that he will be characterized as an expert decreases. This way even if he answers 9 of 10 questions correct, people may know that they can't fully rely on his answers because he is not really an expert. In order to implement this method, we first use the questions and answers of members to create a graph. Then, after applying answers' rating parameters such as good and bad rating, we apply the PageRank algorithm in order to rate the members according to their activities in a specific category. Finally, we compute the overall score of a member, using these category-based scores and the relativeness between the categories, calculated by the proposed method.

2 Prior Work

Ranking graph based algorithms such as PageRank and HITS were used with content analysis techniques in order to define the level of expert's knowledge. This work had been carried out as a research project to rank transferred emails between IBM's employees based on emails' subject. They discovered using graph based algorithms can have better results in comparison with content analysis techniques. Anyway, their research had some drawbacks such as the size of their network was too small which could not show the characteristics of knowledge relations in real online communities (Campbell et al., 2003).

Social network analysis techniques were employed to study the structure of question and answer news systems. It was found that people's interactions patterns are affected by their interests. Visualization techniques were developed to study different interactions patterns in groups of Usenet. These visualization techniques are helpful to understand the whole picture of online interactions environments (Turner et al., 2005).

In another research, a new model was proposed to find the best answers in Yahoo Answers . YA is a largest English-language site with approximately 230 million resolved questions. YA is an active social world with a great diversity of knowledge and opinion being exchanged which can be used as a tool for knowledge sharing. Different categories of this forum were analyzed properly and then categorized based on content properties and interactions patterns which exist among people. While interactions in some categories resemble expertise sharing forums, others incorporate discussion, everyday advice, and support. With such a diversity of categories in which people can participate, they found that some users focus narrowly on specific topics while others participate across categories. The entropy of user's activities was illustrated in their research. They found that lower entropy correlates with higher rating answers. Also by combining user attributes with answer characteristics, they could predict which answer will be chosen as a best answer (Adamic et al., 2008).

SNPageRank was proposed using PageRank-like algorithm to find influential people on Friendfeed. Friendfeed is one of the most active social networks on the Internet, which has high volume of shared knowledge with variety of different subjects. (Kardan et al., 2011).

As mentioned in previous section, depending on selected context, people could have different level of knowledge. So SNPageRank algorithm along with other mentioned methods, could not distinguish expertise in terms of different contexts.

3 The Proposed Approach

One common method in finding experts in social networks is using Link-Rank algorithms. Link-based ranking methods such as PageRank emphasize on users' social reputation rather than their solid activities. Currently given points in YA does not point out if a specific user with a high score may be reliable to ask for help since it does not calculate different scores for every topic (category in Yahoo! Answers). In contrary, in our model the score is computed for different categories using the PageRank algorithm in the category itself and its top related categories. Therefore you ask for user's score in one or a mixture of topics altogether, which is fully explained in following.

PageRank algorithm is chosen as the basis of our approach. It is then improved through following steps and a new ranking algorithm is introduced in order to find experts and rank members in forum websites such as YA.

- Creating User-Graph as a substitution concept for Web-Graph in Page-Rank algorithm
- Applying member behaviors and feedbacks
- Creating Topic-Specific User-User Tables
- Computing Page-Rank of each User-User Table separately
- Computing the relationship between categories
- Designing a new method to rank members based on input categories

The main idea of our approach is to first compute the page rank for each category. These category-based PageRank results are computed by considering members' feedbacks such as Good-Rating and Bad-Rating on answers. We then obtain the relationship between categories a semantic ontology based method. In order to query the system we use members' ranks in all categories and calculate a total rank.

3.1 Creating User-Graph

PageRank uses Web-Graph and backlinks to assign a value to each web page. To be able to use the PageRank algorithm we create User-Graphs in which vertices are members of the forum website and edges are answers posted by them. Each answer of member A to a question of member B is an edge from member B to member A. Backlinks in the graph are links to every vertex which are answers posted by the member represented by that vertex.

3.2 Applying Members Behaviors and Feedbacks

The next step is to find out members, whom were rated the highest. There is an option in YA that gives us the ability to rate the answers given to a question. By finding the best answers we will be able to find members with good answers. For example if a member has answered twenty questions in the field of chemistry and sixteen of those were rated good, he is more probable to be an expert in chemistry than someone with the same number of answers (or more) but less number of best answers.

Answer's Good-Rating and Bad-Rating fields show members' ratings given to that answer. These fields are used to evaluate answers to one specific question and also, in order to give different portions of PageRank value from the source member to the answers. Moreover, the best answer to each question will get the highest portion. By applying the above method, we assign an answer value (AV) to each answer.

3.3 Creating Category-Based User-User Tables

Consider Portion of Help to User (PHU) as a portion of help a member has given to another. User-User tables are created based on three rules:

- Each row of the tables shows PHUs of member A to other members.
- Sum of the cells in each column will be equal to 1.
- Each table is made for one specific category, which means only questions and answers in the assigned category are counted.

PHU of a to b is calculated using the number of questions of b (assume the number of questions is q) and the number of answers posted on each question of member b by member a (assume P_0, P_1, …, P_q). Then, answers' ranking parameters are applied. Therefore instead of the number of answers on each question, the AV fields are used (assume AVP_0, AVP_1, …, AVP_q if AVP is the abbreviation of Answer Value Portion).

At last PHU is calculated using equation 1:

$$[1] \quad PHU_{(a,b)} = \sum_0^q AVP_{(a,q)}$$

In formula 1, *a* is the member who answered a question asked by member *b*. *q* is the number of questions asked by member *b*. Also AVP $_{(a,\ q)}$ is calculated using equation 2:

$$[2] \quad AVP_{(a,q)} = \sum_{i=0}^{i=Na} \frac{\sum AV_{(a,i)}}{\sum AV_i}$$

Consider Na as the number of answers to question q and $\sum AVi$ is the AV sum of all answers posted by all members to question q.

Table 1. Category-base user-user table

	U1	U2	U3	U4
U1	0	3	1	0.5
U2	0	0	3.2	2.2
U3	0.3	0.91	0	1.3
U4	3.7	5.09	2.8	0

In table 1, U_2 to U_1 is 0 meaning there are no questions of U_1 answered by U_2. Consider that in table 1, the sum of all PHUs in one column is an integer, equal to the number of questions asked by the member.

3.4 Computing PageRank of User-User Tables

In this section, PageRank (PR) algorithm is used to rank participation of members in differnet categories. The rank of members is presented by *u* in the category *c* as (*u*, *c*).

$$[3] \quad PR(U_i) = \frac{1-d}{N_u} + d\left(\sum_{i=0}^{i=Na} \frac{\sum AV_{(a,i)}}{\sum AV_i}\right)$$

In equation 3, N_u is the number of members and NQ_j is the number of questions asked by member j. Also *d* is the dumping factor and is equal to 0.85.

3.5 Computing Relationship of Categories

Some categories have a lot in common and people who are experts in one field could answer the questions in another field as well. For example, when somebody is an expert in Engineering, he might as well have a good level of knowledge in Programming. We decided to find the relationship and similarity between categories because a person who has answered a lot of questions in Engineering can also be an expert in Programming regardless of the number of questions he has answered.

The relation between categories is displayed by equation 4:

$$[4] \quad R(i,j) = \begin{cases} 1 & i = j \\ R(c_1, c_2) & i \neq j \end{cases}$$

Where R(i,i) identifies a relation between the category *i* and the category *j*. When *i*=*j*, the two categories are the same which means: $R(i,j) = 1$. It is evident that as two categories become more similar to each other, the value of $R(c_1, c_2)$ tends to 1.

Assume c_1 refers to category 1 and c_2 refers to category 2. $R(c_1, c_2)$ is obtained through several steps: at first, the distance between two categories is calculated according to the category tree. Second, the semantic similarity between two categories is measured using the WordNet dictionary and the Lin algorithm provided by WordNet.

Then the relationship between the two categories $R(c_1, c_2)$ is procured as following:

$$[5] \quad R(c_1, c_2) = \frac{S(c_1, c_2)}{D(c_1, c_2)}$$

Where S(c1, c2) is the similarity between category c1 and category c2 and D(c1, c2) is the distance between the two categories, equal to the number of nodes between them (counting both c1 and c2), since the two categories may have a high similarity, however, they may not be in the same parent categories. while these two categories are similart to each other in meaning of the word ($S(c_1, c_2)$ = 1 in this particular example) but they are in a so much different branches of the category tree.

For example, assume we want to calculate the relationship between the Engineering category and the Programming & Design category. According to the category tree in Figure. 1, the similarity between the two categories is calculated as explained before and we have: $S(P\&D, E) = 0.67$

And the distance is measured by the number of vertices between the two categories (including the categories, themselves). So we have: $S(P\&D, E) = 5$

Therefore the relationship between these two categories is:

$$R(P\&D, E) = \frac{S(P\&D,E)}{D(P\&D,E)} = \frac{0.67}{5} = 0.134$$

3.6 Finding Multi-Field Experts

One advantage of our method is that people who are experts in more than one field could be found. To achieve this goal we use both members' page rank in each category and the relationship between categories. Value of a member in the category *c* (C = {c_1, c_2, ..., c_n}) is calculated using the equation 6:

$$[6] \quad V_u = \sum_{i=0}^{NC} (N(c_i, C) \times PR(p, c_j))$$

In which:

$$[7] \quad N(c_i, C) = Max_{j=0}^{j=N} (R(c_j, c_j))$$

Assume that Nc is the number of all categories and N is number of categories in group *C*.

4 Experimental evaluation

In this section experiments on evaluating users are presented on a dataset of 1527817 questions and 10535161 answers by 577517 users. 65% of these questions have 3 or more answers and details of implementations and experiments are provided in following sections. In this experiment we implemented a ranking symbol similar to current Yahoo! Answers ranking system with some changes in order to make it more appropriate for ranking users' expertise.

Table 2. Yahoo! Answer's Ranking Parameters

Action	Points
Beginning participation in Yahoo! Answer	100
Ask a question	-5
Choose a best answer for your question	3
Answer a question	2
Have your answer selected as the best answer	10
Receive a "thumbs-up" rating on a best answer that you wrote (up to 50 thumbs-up are counted)	1

20 random users are ranked by three expert people in field of Computers and Internet and this human ranking system is compared with both classic YA method and the new approach proposed in this paper.

Sorting these 20 users by three scoring methods three sorted lists are obtained. We compared the sorted lists created using our scoring method and current YA's method to the list sorted considering human expert score in order to measure their performances. These evaluations are done using Spearman's rank correlation coefficient and Kendall tau rank correlation coefficient separately and presented in Table 3.

Table 3. Results of experiment one

Measure	Category Based PageRank	Yahoo! Answer
Kendall tau	0.705	0.442
Spearman (ρ)	0.876	0.633
Spearman error (1-ρ)/2	0.061	0.183

5 Conclusion

Expert finding in online communities such as forums has been one of the most important objectives in information retrieval. User scoring models based on users' activities have been the most widely used methods on ranking users and finding expert members of a forum. But they lack user networks and interactions analysis. Therefore, link analysis algorithms such as PageRank are used to produce accurate results.

In our approach we use both, user activities and user networks and interactions, in order to have more accurate results on ranking members reputation and finding expert members of an online community. We used PageRank to rank members in each category of Yahoo! Answers. Then in order to rank members in each category we used a weighted sum of user's scores in all categories and the relativeness of these categories. We believe our method will be more accurate because not only does it consider user daily activities, but also the way users have interacted with each other is taken into account.

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The application of Petri Nets in Flexible Manufacturing Systems

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Abstract

A Flexible Manufacturing System represents a production system that is able to adapt to different predicted or unpredicted changes that can appear during the production process and react to those changes in order to fulfill the proposed duties. Controlling, monitoring and optimizing the entire production process in a Flexible Manufacturing System is a challenging task that can be successfully solved using the advantages proposed by the Petri Nets method, a mathematical modeling language used for process analysis. The current paper proposes the application of Petri Nets used for modeling a real life situation: a flexible manufacturing system specialized on the margarine production.

Keywords: Flexible Manufacturing Systems, Petri Nets, modeling, production systems

1 Introduction

The current direction in all the production fields is focused on obtaining the best production results with a minimum of resources and costs. In this context the Flexible Manufacturing Systems (FMS) represents a viable option for all the production fields that needs to be able to adapt to different production demands regarding the quantity and the type of the products.

FMS are represents by a set of machines and resources interconnected by a complex transport system that are able to adapt to different predicted or unpredicted changes that appear during the production process in order to accomplish the current demands (Shivanand et al, 2006).

The flexibility of this type of systems refers to the fact that they are able to process different type of products in the same time without any changes in the system structure and the quantities of each type of products are adapted to the production demands.

In this context, controlling, monitoring and optimizing the production process is an important step that requires a special attention due to the association with the associated production costs that needs to be diminish.

The Petri Nets approach represents an appropriate approach of this problem because this method offers all the necessary tools for modeling and testing the production system.

In this paper is presented a Petri Nets application for modeling a real flexible manufacturing system that is used for the margarine production.

2 Petri Nets Theory

Petri Nets have been first introduced in 1962 by Carl Adam Petri and nowadays they have application in different fields such as real-time systems, network and protocol design, hardware structure, workflow, flexible manufacturing, scheduling systems, etc (Yeung, 1996).

In 1989 Murata defines the Petri Net as a a 5-tuple, PN=(P, T, F, W, M_0) where (Murata, 1989):

- P={p_1, p_2, …, p_n} symbolizes a finite sequence of places;
- T={t_1, t_2, …, t_n} symbolizes a finite sequence of transitions;

- $F \subseteq (P \text{ x } T) \cap (T \text{ x } P)$ symbolizes a sequence of arcs;
- $W : F \rightarrow \{1, 2, 3, ...\}$ symbolizes the associate weight function;
- $M_0 : P \rightarrow \{0, 1, 2, 3, ...\}$ represents the initial marking.

Shortly, the Petri Nets are a graphical tool for representing the system with all his characteristics. The places are graphically represented by a circle, the transitions with a rectangle and the tokens with a dot.

A transition *t* is considerate to be enabled if in every input place the number of available tokens is greater than or equal to the value of the weight function associate to the specific input arc (Pastravanu, 1997).

When an enable transition *t* is fired, the effects are [Giraul and Valk, 2003]:

- For each input place of the transition the number of token is decreased with a number equal with the weight function associate to the specific input arc.
- For each output place of the transition the number of token is increased with a number equal with the weight function associate to the specific output arc.

The Petri Nets utilization in manufacturing systems field is detailed in many research papers. Zimmermann and Hommel present a modeling and evaluation method based on dedicated Petri Nets in the manufacturing system area (Zimmermann and Hommel, 1999). The modeling and simulation of a complex manufacturing systems in order to evaluate the system performance is proposed by Coman et al in 2009 (Coman et all, 2009).

Kharman and Tuysuz presents an a hybrid modeling solution based on Petri Nets and fuzzy sets of rules for manufacturing systems (Kharman and Tuysuz, 2010).

The application of Petri Nets in the flexible manufacturing system fields is aldo widely presented in the scientific literature (Silva and Valette, 1990), (Gupta and Goyal, 1989), (David and Alla).

3 Flexible Manufacturing Systems

The flexibility in a manufacturing system can be divided in two large categories: machine flexibility or the routing flexibility. The machine flexibility refers to the fact that the manufacturing system is able to produce different types of product, with different order of operations.

The machine flexibility refers to the fact that the manufacturing system is able to adapt to different changes considering the production volume of capability.

The advantages of using FMS are represented by the low costs of products, increase of the productivity, optimize the machine and resources utilization, etc.

The disadvantage of using FMS refers to the high costs attached to the system implementation and the need to use qualified staff. So the modeling and simulation of FMS are binding and essential operations in order to test the systems properties and avoid the possible modeling errors.
In this paper the proposed problem refers to a flexible manufacturing system specialized in the margarine production composed of 4 machines. The system outputs are represented by 3 types of products (with different recipe, different packaging weight and shape, as presented in Table 1.
The problem constraints are represented by the fact that the technological machine succession for each product type and the processing time is different. The storage allocated to each machine is limited. At each moment of time a machine can process a single product.

Table 1. Technological Machine Succession

Product Name	Technological Machine Succession
M1	D→Prep1→PL
M 2	D→Prep2→PL
M 3	D→Prep1→PL

4 Modeling Production Process

The current study focuses on the production process in a real flexible manufacturing system specialized in the margarine production.

The studied production process is detailed in figure 1.

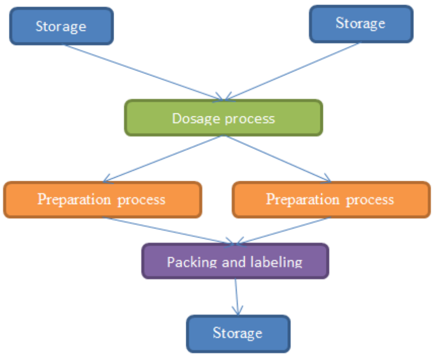
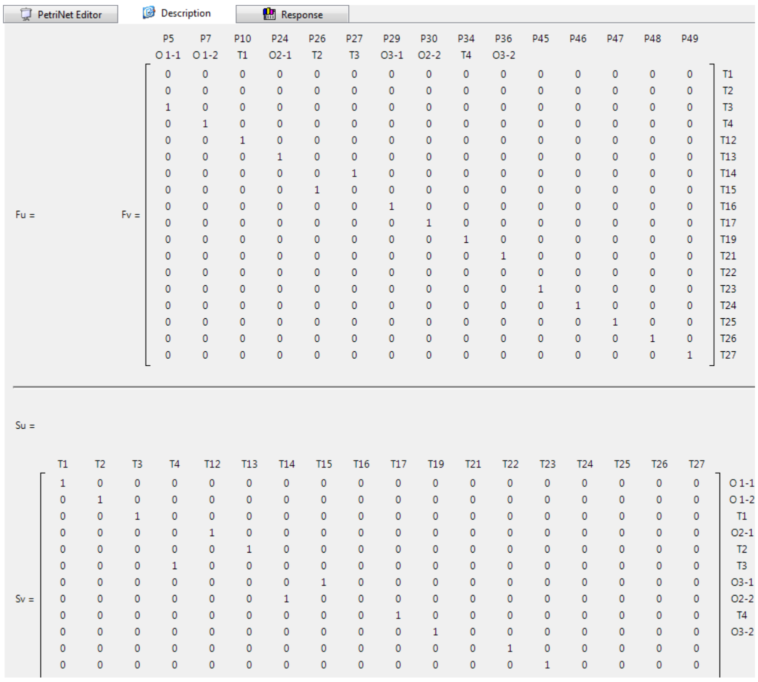


Figure 1. Production Process

The software tool used for modeling and analyzing the Petri Net for the proposed production process is represented by Petri .NET Simulator Version 2.0 designed by BIOGENERIC Goran Center in 2004.

Incidence matrix is presented in figure 2.



Fu =

Fv =

	P5 O 1-1	P7 O 1-2	P10 T1	P24 O2-1	P26 T2	P27 T3	P29 O3-1	P30 O2-2	P34 T4	P36 O3-2	P45	P46	P47	P48	P49
T1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
T12	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
T13	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
T14	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
T15	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
T16	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
T17	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
T19	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
T21	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
T22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T23	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
T24	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
T25	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
T26	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
T27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Su =

Sv =

	T1	T2	T3	T4	T12	T13	T14	T15	T16	T17	T19	T21	T22	T23	T24	T25	T26	T27
O 1-1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O 1-2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O2-1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
T2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
T3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O3-1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
O2-2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
T4	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
O3-2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

Figure 2. Incidence Matrix

The system response analysis considering the resource utilization is presented in figure 3. It should be noted the fact that almost all the resources usage is 100%, with one single exception: Prep2 utilization is 90%..

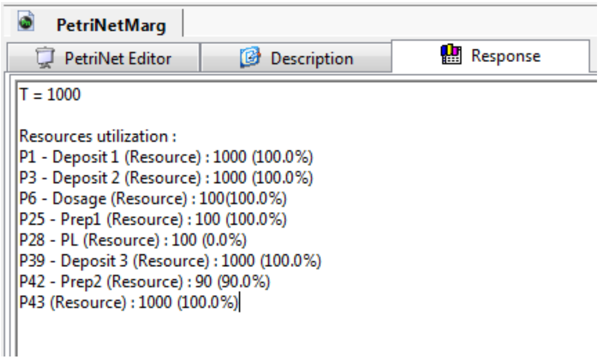


Figure 3. Resource Utilization

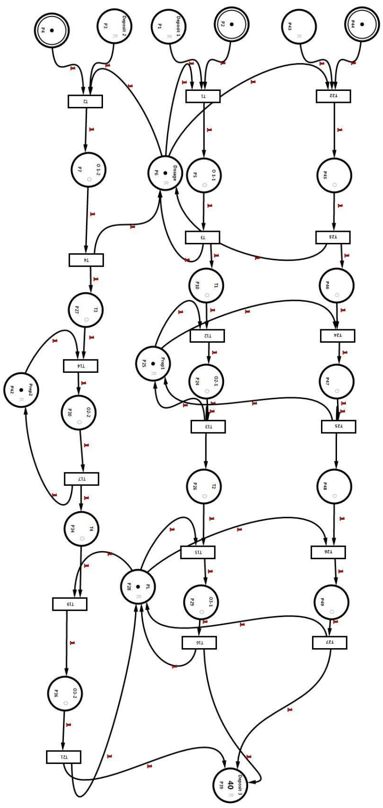


Figure 4. Petri Net Model

A series of test were made in order to identify the most suitable characteristics that lead to the best results for the proposed model, the main goal being to increase the system efficiency.

5 Conclusions

The manufacturing systems are usually composed of a set of computer controlled or numerical controlled machines and automated guided transport vehicles. In this situation it is easy to see why the costs associated to building and maintaining a system like this is very high. The importance of modeling and simulating the production process performance cannot be neglected because it can offer the possibility of tracking the system response to different changes in time. Improvement solution can be proposed to the current model and tested for different production demands and only if they are convenient and suitable for the entire production process optimization, they will be implemented in the real system.

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The Role of Simulation and Real Experiment in Teaching Photovoltaics

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Abstract

Alternative energy education must be an obligatory component of public education to improve the use of clean energy. We should teach one of the important energy sources which is solar energy as an alternative way to produce energy by direct conversion of the solar light into electricity. This process requires the usage of modern technologies and software which encourages students' understanding of photovoltaics. This paper discusses the role of interactive p-n junction simulation-based virtual labs for understanding the concept of photovoltaic. The primary audience for this p-n junction simulation is high school students who do not have a background in higher level science. This simulation encourages the chosen 11th grade students to understand characteristics of a p-n junction device by using energy bands. Virtual labs, which serve as an initial experiment and a first contact with the studied phenomena for the student, can be complemented with real hands-on experiments.The self-confidence of students is increased by their discovery of learning and curiosity in research during an interactive teaching and learning process.

Keywords: Simulation, Photovoltaics, P-N Junction, Dye-sensitized solar cell

1 Introduction

The sun releases a huge energy for generating clean and sustainable electricity without toxic waste which is effective solution to environmental problems.Students from high school should be familiarized with solar energy to increase uses of green energy. The basic principles with experiments behind solar cells understood by students would encourage them to choose their study fields. However students can't perform all types of solar cellexperiments at school due to expensive materials. Simulation based experiments can be solution to this problem.

Recently interactive simulation-based labs have highly been requested due to approval of many high school's computer assisted education programs. Conventional hands-on labs are supplemented by these interactive virtual labs. Moreover, difficult science concepts can be provided in an efficient and effective way via virtual labs (Cherneret all, 2008).

It is claimed that the usage of virtual experiments can assist to overcome some of the abstract or complicated science concepts. In addition, virtual labs lets the users modify system parameters and observe the outcomes without any harmful effects and failure. Moreover, it is cheap to use and equipment faults which affect outcomes can be eradicated (Chu, 1998).

The implementation of technologies via virtual labs is very beneficial because they supply instructional opportunities in different modes, at school as a visual interactive aid, at home for revision, tasks, or self-learning, or through distance learning. The physical processes from micro to macro can easily be observed by learners with the help of simulations. In addition to this, simulations let the students analyze the restraints between relevant parameters (Banky and Wong, 2007). Students can obtain the physical principles of an actual device via realistic-looking simulations.

The purpose of this paper is to compare the role of virtual labs and hands-on experiments on teaching solar cell.

1.1 Dye-sensitive solar cell

Light energy can be converted into electricity by photovoltaic systems which can be used to power small devices like calculatorsor for reduction of the energy cost at home.

The solar cells which can convert40 % of the incident light into electricity are very efficient but they are very expensive.Maintenance of delicate and costly solar cells is not competitive with inexpensive and accessible fossil fuels. Other devices using nanocrystalline dyes such as anthocyanin have efficiencies of only a few percent, but the cost is so low that it makes optimization of this type of device much more likely to be useful (Garabet and Neacsu, 2009).

Dye-sensitive solar cell is made with dye gained from plants like cherries, blackberries, and raspberries. These plants contain anthocyanin which absorbs light (Antohe et al, 2011). These dye-sensitive solar cells are cost effective solar cells which should be taught to the students. Students can do this by building their own organic solar cells and measuring the photovoltaic devices' performance based on power output.

The first step in introduction of the photovoltaics' study was made by the web-based lessons from the pveducation website as you can see from Figure 1.

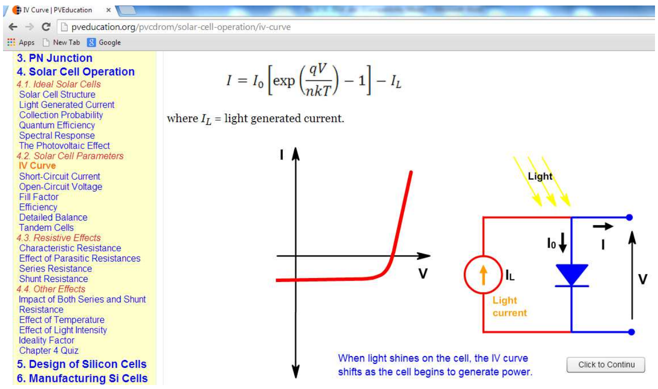

Figure1. PV-education screen

1.2 Experiment

Students prepared a dye-sensitive raspberry solar cell, which costs much less than silicon solar cells, due to less expensive manufacturing steps in the production process. The materials used in the production of our solar cell include: Conductive glass slides (SnO) sandwich, Titanium Dioxide, berry juice (Anthocyanin), iodine and carbon (Grätzel, 2003).

Before studentsstart to the experiment, they were exposed to the different steps involved in building the dye-sensitive solar cell.

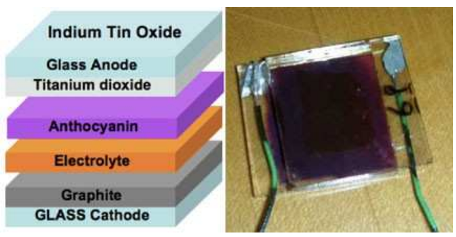

Figure 2.a) A schematic drawing of an organic solar cell b) a finished organic cell device

Students used two conducting slides, each having a face with a thin layer of Indium Tin Oxide (ITO.) On one of the glass slides, they placed a thin layer of Titanium Dioxide (TiO_2). TiO_2 is a powder and is found in almost every sunscreen because of its high refractive index and strong UV light absorbing capabilities (Antohe et al, 2011).

Figure 3. a) ITO glass slide,b) thin layer of TiO_2, c) raspberry on the conductive side

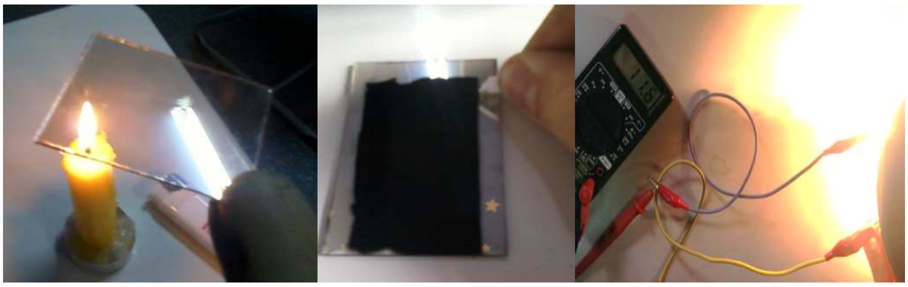

Figure 4. a) Soot generated from candle to deposit a thin film of carbon onto slide. b) Slide with carbon, c) Testing dye-sensitized solar cell

The students tested theirdye-sensitive solar cell sample by placing two alligator clips on opposite ends of the slide and held it beneatha lamp. They were able to draw 11.6 mV on one sample.

The class teacherobservedthe students' progress throughout the experiment by asking questions such as;what is the name of that piece?What is the purpose of (the raspberry, theITO, the TiO_2, etc.)? How does the device work if it is too hot outside?

After the dye-sensitive solar cell experiment, the students reported their results by answering the questions:

- ✓ What were your observations in this experiment?
- ✓ How did your device work compared to the other group?
- ✓ Can we power electronic devices with this solar cell?
- ✓ Why did / did not your device carry out well?
- ✓ What else could you do to improve your solar cell?

2 Simulator

P-N junction simulator does not require any knowledge of advance level of mathematics or physics. The program relies solely on visualization techniques to enable the students to learn the relationship between the energy bands of a semiconductor and the resulting electrical and spectral characteristics, with emphasis on qualitative reasoning and understanding. Moreover, it is completely interactive. Students can chose their own semiconductor device by appropriately doping each piece of semiconductor, and choosing the circuit in which they wish to use the device. Simulator is versatile and can be used by students as avirtual lab in all levels from high school to advanced undergraduates in solid state physics or electrical engineering.

Semiconductor device simulator simulates the working principle of three p-n junction devices - the LED, the solar cell, and the tunnel diode. With thissimulatorstudents canbuild the solar cell device starting with two pieces of semiconductor material, and doping them properly to create a p-n junction device. During the building process of the device, students canobserve both the changes in the energy bands and Fermi level as a response to doping. Having been built, this device can then be incorporated into a circuit where the students can observe the energy bands, the I-V graph, as well as the intensity spectrum of the device in response to the changes in applied voltage and/or incident light.

The program starts by displaying two cubes which represent two types of intrinsic semiconductor material. Student chooses dopant atoms to each of the semiconductor blocks. A p-type material is represented by addition of acceptors and an n-type material is represented by addition of donors (Rebelloet al, 1997).

Having doped the two sides of the blocks of semiconductor material appropriately, the student can then bring the two blocks in contact with one another, and make the Fermi levels coincide. The energy bands on either side would consequently be misaligned.The acceptor concentration on the left is 3x1022 m^{-3}, while the donor concentration on the right is 7x1022 m^{-3} as inFigure 5.

Students can observe easily the effects of different semiconductor materials on solar cell device by changing parameters.

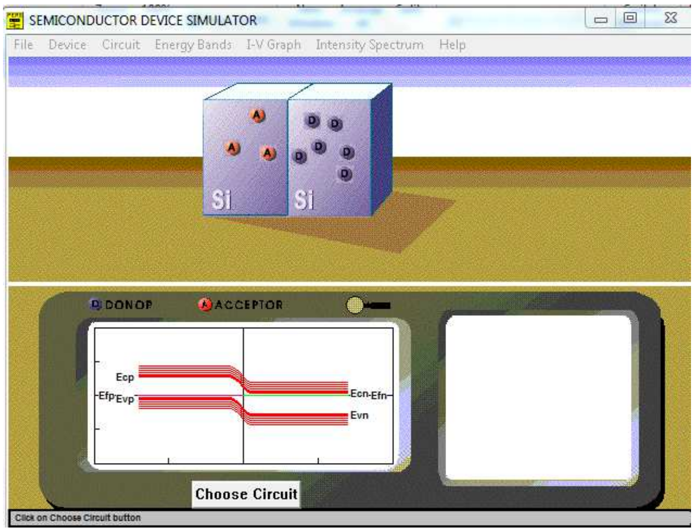

Figure 5: When Fermi levels are aligned, the energy bands are no longer aligned.

When this p-n junction simulator is used as a solar cell, in the output measurement mode, the studenthas an opportunity to observe either the open circuit voltage or the short circuit current generated by the solar cell when a user-defined spectrum of light is incident on it. Student can control the intensities of incident light with colors that are incident on the solar cell by clicking in the appropriate intensity spectrum that appears at the top right of the screen as in Figure 6 which is simulator in circuit mode for solar cell.

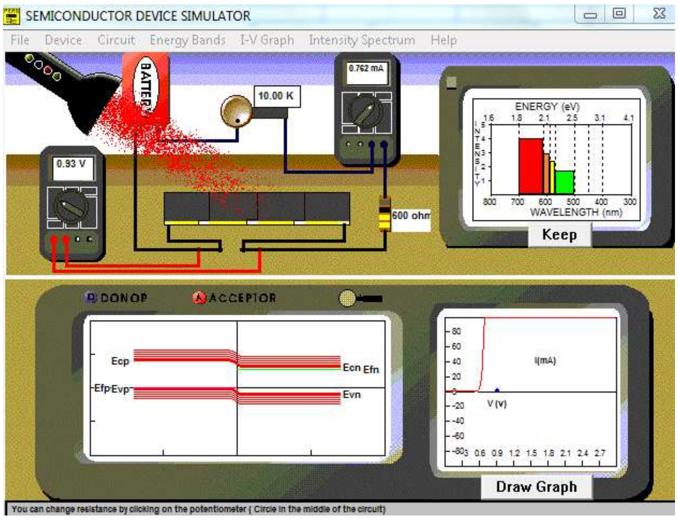

Figure 6: Solar Cell in Circuit mode screen.

Thissimulatorgives the user with full flexibility over the parameters. For example, the user can switch between any two solar cell midway through the simulation, while keeping other parameters the same. Alternatively, the user can study how the I-V graph or intensity spectrum would change if a different semiconductor were used instead or if the doping density, temperature or junction area were different.

3 Method

Some simple activitiesprepared that would be suitable for six 11thgrade gifted students at high school. Before using the p-n junction simulation, the students had worked firstly PV-education online education website with teacher then prepared areal hands-on dye-sensitive experiment to learn the basic concepts of the solar cell and to calculate characteristics of p-n junction.Finally students used semiconductor device simulator to discover properties of different p-n junctions. Data were collected form observations, interview with students and asked questions to understand effect of semiconductor device simulator on students' progress about solar energy concepts.

Steps of the activity on the p-n junction simulator

Firstly students selected the type of semiconductor to read off the various parameters associated with each of the semiconductors provided. This knowledge enabled students to choose a correct semiconductor that best matches the application desired. Students doped the semiconductors with acceptors and donors to observe the change in the Fermi energy with the implantation of dopant atoms. For this activity following questions asked to discuss:

- ✓ How did the Fermi energy change when we add donors? Acceptors?
- ✓ What happened to the Fermi energy when we added both donors and acceptors to the same block?

Having appropriately doped each semiconductor block, students brought the two semiconductor blocks together to form P-N Junction to make the Fermi levels on the two sides align. At this point following questions asked:

- ✓ Why should the two Fermi levels align on the two sides?
- ✓ How did the depletion layer width change with the doping on each side?

After building the p-n junction, studentschose a device such as an LED, solar cell, or tunnel diode which can be used in two different modes. For example "Simple Circuit" mode allows the student to observe the behavior of the solar cell when it is connected to an idealized variable voltage source. To check understanding following questions asked:

- ✓ Why did the LED turn on only above a certain voltage?
- ✓ How was intensity spectrum and turn on voltage of LED related to the material used?
- ✓ Why did tunnel diode need a minimum level of doping concentration to operate?
- ✓ For a given solar cell, how did the open circuit voltage and short circuit current varied with the intensity spectrum?
- ✓ How did the intensity spectrum affect the I-V graph of the solar cell circuit?

These are the brief description of some of the activities that students performed using the Semiconductor Device Simulator.

4 Results

Students reported that this simulator allows us to explore any kind of solar cell with different semiconductors easily. Students also like the fact that formation of virtual p-n junction were fast, simple and could be repeated many times, so they were more confident in their results. However hands-on experiments are difficult when the equipment does not work properly and it is difficult to set up again.

Some students commented “ virtual simulation is very effective to understand properties of p-n junction with different semiconductors but with real experiment I understood better solar cell terms because in simulations computer calculate automatically everything I cannot follow steps, I see just result. However with hands-on experiment I am doing all steps, I see my mistakes “. One student said “I feel it is more convenient in performing the experimentsin a virtual lab. I do not need to find real materials which are expensive and difficult to find components in order to do the lab”.

Teacher observe that for the first time, these students learned the value of trial and error and of gathering and analyzing multiple pieces of data to decide which experimental procedures will achieve the desired result. Many students also reported that the p-n junction simulation increased their understanding of the solar energy and improved their ability to think photovoltaics. Moreover with the simulator we repeated the solar cells without fear of wasting time and materials, and with the ability to create multiple models.

5 Conclusion

The purpose of this study was to analyze the effect of virtual labs on students learning compared to hands-on experiment. Learning with virtual labs motivated students, promote a more active form of learning, offer more individualized and independent learning, and provide simulations of complex scientific processes that are less likely to be demonstrated in a normal laboratory. The feedback from students indicates that they like this innovative working environment and feel encouraged to learn more effectively in this way. The simulations could therefore provide a complement to traditional hands-on lab. The fact that the students do not have real hands-on experience is, however, considered a drawback. The simulations can only give a “real world”-like experience in performing practical laboratory work but this should benefit students in learning the subject (Yang, 1999).

Semiconductor device simulator is more effective with a hands-on activity to reduce the gap between theoretical knowledge and practical expertise. Students should be first exposed to theoretical concepts in the simulation environment, and then required to perform a hands-on activity. This approach ensures progressive and sequenced learning in the form of scaffolding, an aspect of cognitive apprenticeship (Taher, 2009).

We expect that experience with such virtual labs along with limited number of real-world experimentswill help students in learning andpracticingin photovoltaic education concepts.

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EDUWORK-(e)-Learning at Work

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Abstract

Work was from the beginning the key to human development. During the work people gathered experience, learning to develop their skills. Unfortunately this is a unidirectional process oriented towards very specific abilities.We are introducing in this paper a new concept- the EDUWORK. EDUWORK could be understood very simply as self-centred, self-paced education during the work process. EDUWORK could be job oriented or job connected. EDUWORK is a multi-layered cluster of instruments and techniques allowing self- centred, self-paced education of the employee during the work hours. It is a win-win situation because the employer would benefit to have a better trained personnel and the employee would develop his education and his social position through education. EDUWORK could not be applied in every enterprise- as there are units where the work programme should be continuous – nor for every employee- as there are employees that are not interested. However, our experience with the development and implementation of a prototype for 10 enterprises with more than 1500 workers (shown also in the paper) shows that it is an interesting concept and the research shall be continued. The trainee could built his own training programme, could schedule it and also could interact with the EDUWORK content- improving it (if possible- even with its own case study), upgrading it (if possible also), changing the presentation mode or the delivery way. The paper presents also the main steps in order to have a successful development and implementation.

Keywords: e-learning, learning at work, adaptive content, exception learning

WORK AND THE NEED FOR CONTINOUS EDUCATION

In a competitive market there is less time and mood for learning as a distinct, separate process. Leaving work for hours or days- in order to be trained- is a no go or very expensive options- which few enterprises can afford (Atherton 2005). On the other side, a less trained working force could be cheaper- but is less competitive, less innovative and finally less oriented to the profit. More trained workers are sources for new knowledge, innovation and also the improvement of the work environment and work context. Willingly or not each enterprise should search if they could assure (continuous) learning for their employees in order to satisfy both the enterprise objectives (better, more innovative products and services, more efficient technologies, improved sales, better profits) and the goals of their employees (continuous educational advancement that would assure continuous career progress and an continuously improving social status) (Higgs 2004) .The transition from a ”classic” employee- that expects just the end of the shift- towards a well informed and conscious partner that would be interested in the improvement of the enterprise- should be a main goal for everyone. What if the learning could be included in work? What if chunks of learning could be run during the 8 hours programme- with significant results for the work and for the worker also? This paper shows a possible solution- EDUWORK- that means- learning on work- using work patterns, learning included into the everyday work context and finally- learning at work.

EDUWORK means:

- learning at work;
- improving the quality of work life and relieving stress;
- improving the employee career and satisfaction;
- improvement of the enterprise workforce quality resulting in better profits on mid and long term;
- community improvement.

Why is EDUWORK different from other learning related to work approaches? Because:

1. EDUWORK is targeting the work time for education, not before work or after work. In this respect the real time for acquiring new knowledge and developing new skills would be very short and infrequent – rising some very interesting problems about the cadence of learning and the imprint at the end of the day;
2. EDUWORK is using windows of opportunity in order to maximize the learning effect and also kept the pace of the work process;
3. EDUWORK is based on the willingness of the employees to learn and could be work connected, marginally connected to the work or not work connected – giving the freedom to the employee to choose- if there is a required content;
4. EDUWORK is being developed with the active support of the management- that should be committed towards a better educated workforce as the key to success on the market. The management would contribute using the best rewarding procedures and increasing the social status of the learners at the company level.
5. EDUWORK is based on modern dissemination technology- mostly mobile. However, if this is not possible because of the workplace specificity, the usage of classic disseminators would be the solution. It could also involve subliminal learning.
6. EDUWORK defines an adaptive, self-paced learning process. The process should adapt to the readiness for learning of the employee, to the existing conditions and resources (especially time resource) at the workplace and also to the management.

The approach works within existing business processes to embed learning and development inside the work of an organization. The approach includes:

1. Routines that improve learning capacity and productivity by transforming tasks into smart tasks with learning components
2. A Socratic approach to developing capability in the course of real work that can easily be learned by line managers.
3. An emphasis on preparation and accessing company knowledge management systems.
4. The opportunity to learn research, writing and presentation skills at work.
5. A focus on accountability for the work and ownership of the problem, project or client.

Figure 1 shows a general image of EDUWORK.

The figure shows three main types of contexts that could affect the EDUWORK learning process:

- Own Learning Context (OLC) – that reflects the goals, interests and needs of the learner;
- Managerial Context (MC) – that reflects the interests of the management;
- Work Place Context (WPC) – the objective context that reflects the realities from the workplace; if the workplace is one with continuous activity, with a lot of machines or processes that must be supervised, with no time to spare- then EDUWORK should adapt correspondingly(Bolman, 2005).

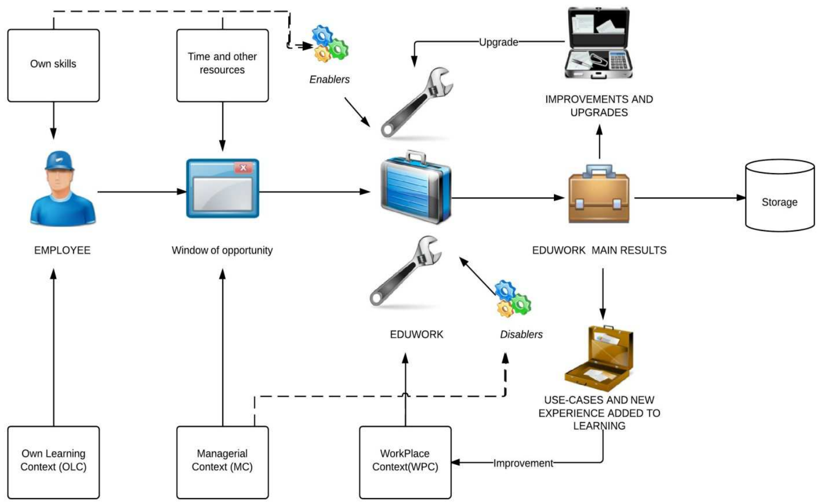


Figure 1. EDUWORK general image

EDUWORK CONCEPTS

The main EDUWORK concepts are:

1. Learners are learning through the work time; learning is complementary to the work, is not affecting the work process and could be seen as a de-stressor.

2. Enterprise management accepts learning, encourages learning and rewards learning – using the learning process as a way to improve the quality of employees without losing time.

3. Learners could learn: what they want; single or in learning communities established ad-hoc; -how they want; giving also plus value and feedback to the learning;

4. Self-directed learning in which learners acquire knowledge to solve immediate tasks, to build skills for the future in their own pace (Honey, 1992).

5. Personalized learning – learning components are tagged and made smart; the educational modules are learner friendly;

6. EDUWORK - Adds to learning: by worker experience upgrades;
- Multiplies learning.

THE MODEL

A general model that includes the three main actors of the EDUWORK concept is presented below.

Based on this model we have developed an operational model that can be used to run simulations.

PHASES OF DEVELOPMENT AND IMPLEMENTATION

The conceptual model is shown in the next figure.

This model has as the main supports:

- the selection of the would be learners (Denny, 2005);
- the build-up of the specific model of the training process (Eraut, 1994);
- the development and particularization of the content;
- the implementation of the content (Kovacs, 2014);
- the analysis of the feedback.

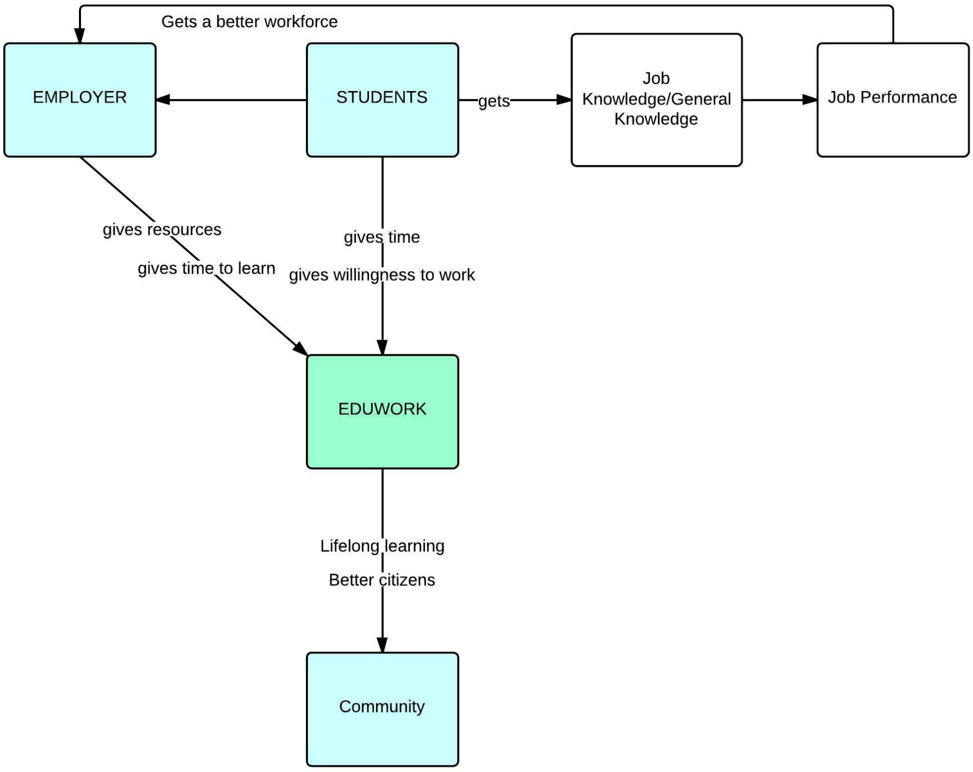


Figure 2. EDUWORK model with the three main actors

This model involves the following steps in order to develop and implement EDUWORK:

1) Selection of the would be learners; selection would be done asking for feasible goals and cross-analysing the employees and the employers goals- the found match would be pursued; the selection procedures should identify the willingness of the employee to learn and also his/hers previous knowledge;

2) Development of a specific training model on the basis of the identified needs and desires of the workers (Leibling, 2003);

3) Validation of the model;

4) Development of learning content on the basis of this model; includes:

- design – taking into account the proposed objectives; to whom is addressed EDUWORK (white collars, blue collars, etc.); links to their previous knowledge and tailoring the EDUWORK so that new skills and capabilities – even informal – could be born); ways of dissemination; what should be achieved- well defined and expressed clearly;

5) Implementing the content at the workplace;

6) Analyse the feedback – store the valuable content enriched with the learner plus value and improve or change the non-conforming content.

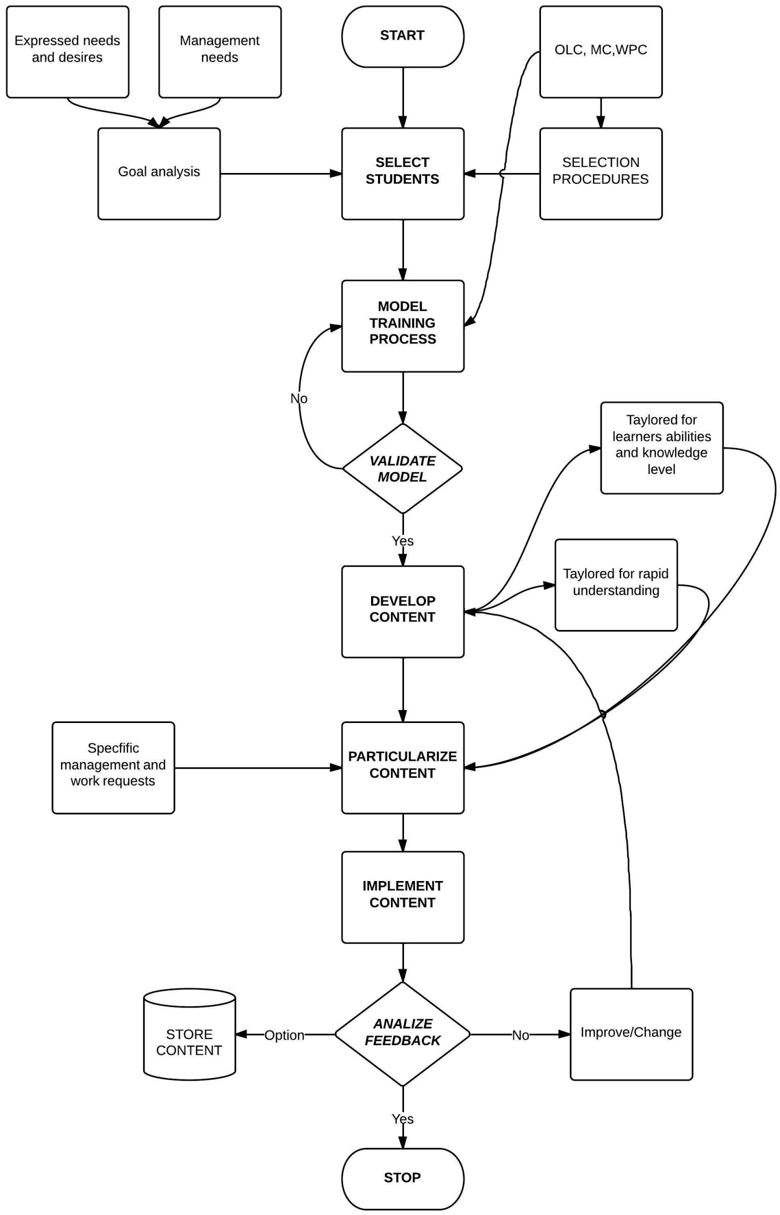
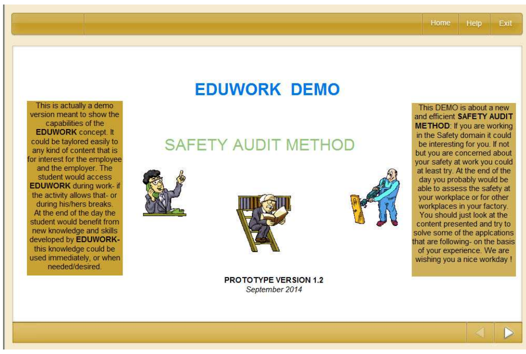


Figure 3. EDUWORK conceptual model with the development phases

THE PROTOTYPE

The prototype was developed using Lectora Inspire .Some relevant images from the prototype are presented below.



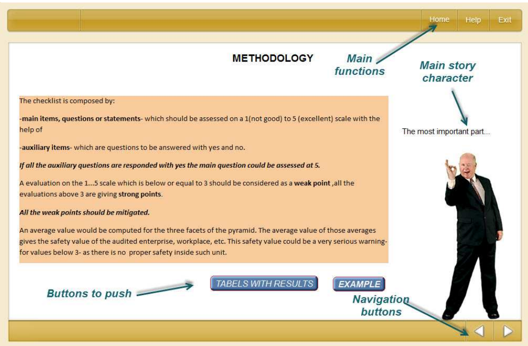


Figure 4. Prototype start-up screen *Figure 5*. Prototype main elements

MAIN RESULTS

We are in the phase of implementation of specific prototypes in about 10 enterprises in Bucharest – that were interested in taking pilots. The expected results are shown in the figure below.

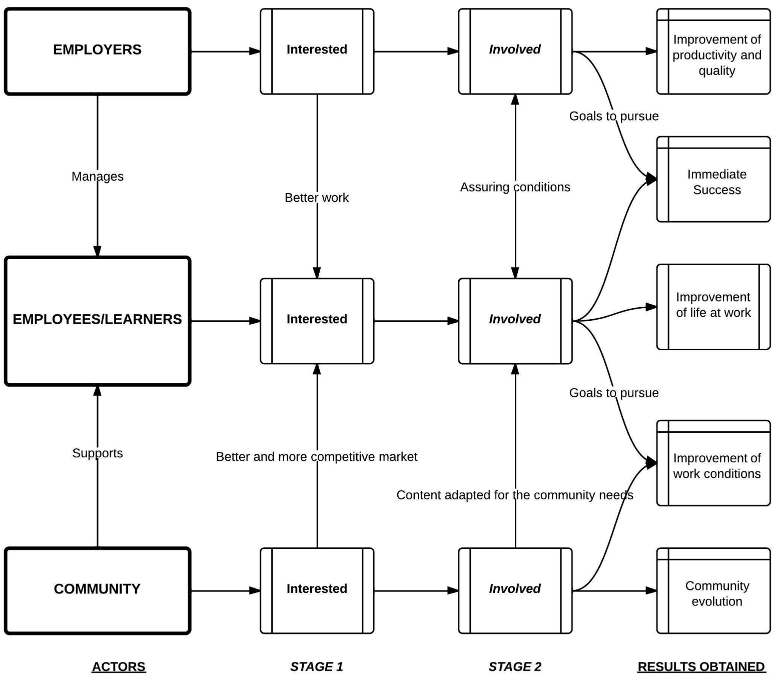


Figure 6. EDUWORK Actors, stages of interest and expected results

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Automated development of individual teaching e-tests

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Abstract

In order to maintain motivation, the content of often repeated open tests for (self)training/ evaluation should vary from one respondent to another and/or from one session to another. Likewise, to eliminate fraud the fixed versions of the tests should be replaced by the individual tests for each respondent. However, meeting these goals (requirements) presumes the development of a large number of items, the composition and realisation of which would take significant additional time that teachers do not have. This paper addresses some methodological issues of streamlining the process of development of parallel items and the content of e-tests. Such process allows for the automated development of any required number of any large-scale parallel items (concerning elaboration-solution-verification) with their direct importing into e-learning/e-testing platform. The streamlined process includes also a function of automated generation-correction-feedback for repeated individual tests in e-learning, e-training and e-testing sessions.

Keywords: individual e-testing, planning and specification of tests, collections of parallel items, methodology of items development, individual generation of e-tests.

1. Introduction

Form and ***content*** of the individual assessment items remain the two key elements of the testing practice, successful combination of which results in the quality individual tests and testing process [3, 4, 9, 10]. Because the performance and quality of individual parallel/ equal tests requires large collections of items, their manual development is costly and practically impossible.

This paper presents some effective techniques in relation to tests specification, automated development of objective items (with closed answers) and automated generation of individual tests based on regular expressions (RE).

One method for automated development of the subjective items with open answers of the problem-solving type is demonstrated in [5]. The proposed methodology enables automated preparation of any necessary arbitrarily large number of individual items/ tasks of the problem solving type. These individual items/tasks can be mathematically modelled through importing them onto an e-learning/e-testing platform for repeated multiple e-training/e-testing sessions, based on one of the most advanced mathematical engines known as the Wolfram Matemathica-8 [14]. The essence of this methodology implies formalising the problem in the language accepted by the Mathematica-engine, which then resolves the problem in line with the specified model and parameters.

The *significant advantage of objective items* with closed answers and *subjective items of the problem-solving* type is that the computer knows the correct answer in advance and this allows automatic correction (verification) of answers, accurately and objectively, practically simultaneously with work performed by any number of respondents.

Automated generation of tests according to previously developed specifications approved by management as well as automated correction and feedback free the teachers from this type of routine work, making it possible to use e-testing as an effective interactive training tool useful both in traditional and distance learning environments, as well as in open, formal and informal training [3, 7].

2. Automatic generation of tests in line with specifications

In order to achieve the purpose for which the various e-tests are designed, they must possess certain characteristics, such as *validity* (of design, content, facade), *reliability* etc. [4, 6, 10]. Teaching theory and practice recommend that qualitative tests include a predetermined number of items for each operational/learning curriculum objective. Such items should be of varied forms, with different level of complexity, rated in line with the purpose of the test and share in objectives. Predetermined items should also cater for each type of evaluated content, the possible number of test launches etc. All this, in turn, imposes certain rules for *planning, specification and generating of individual versions of repeated tests* or tests addressed to a group of respondents in one parallel working session in the same space. Evidently, versions of such tests should be parallel/equal, address the same operational objectives, items of such tests should have the same level of complexity, rating strategy etc.

Solving the problem shall rely on the ***automated generation of parallel individual tests*** with different content but of equal performance, with random inclusion of items with necessary characteristics through appropriate filtering from the collections of themed parallel items. This, in turn, requires the *planning and specification of evaluative events (population of tests), planning of quantitative and qualitative content of the bank of items/tasks of assessment and specification of tests*, all of which are indispensable elements of any curriculum and must necessarily exist, as without these elements the curriculum is not tangible, it is not completely defined [1, 4]. The planning referred to above is followed by composition or generation of tests and carrying out of e-testing according to predetermined schedules.

All of these are briefly examined below, assuming that precise curricular requirements must be met.

2.1. Planning and specification of evaluative events

Specification of population of tests begins from the number of sequences/study units (SU), which usually end up with thematic tests, often including the routinely formative, the interim formative and the overall final test. Thus, the number of tests is directly dependant on the number of SU as well as the content, in other words it is directly proportional to the number and weights of the learning curriculum objectives of the respective SU. For some recommendations and best practices for specification of the population of tests and individual tests, including in curricular goals, levels of complexity and items forms, see [6]. For example, for a course of 75 hours (30 of lecture + 45 of laboratory sessions) divided into eight themes, the list of planned tests contains at least 19 tests: 8 * 2 tests for routinely formative thematic evaluation (of lecture and laboratory learning), as well as two tests for interim formative evaluation and one overall final assessment.

Evidently, developing such a large number of individual tests requires significant efforts and time of highly qualified human resources and thus significant financial outlays. In reality, realising this manually is impossible simply because society and teachers do not have such resources. Reliance on modern information technologies is the only way that can help the efficient realisation of such tasks as easy specification of the tests, development of collections of items of the required quantity and quality and efficient generation and administration of e-tests, as is briefly examined in this paper.

2.2. Development of the test specification matrix

Compilation of tests is usually performed by teachers in line with the specification matrix *[11]* of thematic collections. Specification matrix's cells (at the intersection of content items and taxonomic levels) contain the total number of test items (Figure 1, right).

Development of specification matrix for each test from the population of expected tests is a rather laborious and time consuming task. Indeed, in the example above it was necessary to develop 19 general test specifications, which must then be detailed by type of item. To reduce the effort, specifications can be developed for a group of tests with similar characteristics (eg., with the same number of allocated hours, the same number of objectives, the same share in operational objectives of the respective learning theme), whereas to save time calculations can be automated in Excel tables.

Taking into account the traditions and academic regulations in relation to compiling verification samples with three different levels of complexity, quantity and appropriate quality of items included in the test should provide attribution of rating scores directly proportionally to the number of accumulated points. That means that test items should allow assessment of cognitive levels required (comprehension, application, analysis and synthesis). Traditionally, these levels are associated with items of complexities of grade 1, 2 and 3 [1, 4]. Usually the complexity of low grade (= 1) of an item shall be interpreted as "must know", the average grade/moderate complexity (= 2) as "should know" and "able to apply" the acquired knowledge, whereas high grade complexity (= 3) as "may know" how to solve problems, integrate, analyse, synthesise, form and acquire new skills. Thus, low complexity items form the basis of the knowledge tests (about 50-60%), and the moderate and high complexity items, which verify the cognition at the level of application and integration may have the respective shares of 25-30% and 15-20%.

An effective technique for developing the matrix specifying the quantitative and qualitative content of some tests is proposed in [6]. In essence, the technique proposes to use Excel tables with formulas of pre-programmed calculations and rounding to a whole number (as one cannot use fractions of test items). To determine the required number of items for each test objective and/or level of complexity and/or for each type of items required by the curriculum, one enters the number of test items and their weights. An example of a test's specification taking into account the above rationalisation through Excel tables is displayed in Figure 1.

The left-hand table includes the initial data entered manually into the table, whereas the right-hand table shows automatic calculation of the number of items by themes and objectives. The same applies to determining other specifications, eg. types of items.

Test specification matrix for four themes

Share learning objective	themes (%)	Themes I	II	III	IV	Total items
		20	10	30	40	100
A	10					
B	20					
C	20					
D	20					
E	20					
F	10					
Total items	100					60

Test specification matrix for four themes

Share learning objective	themes (%)	Themes I	II	III	IV	Total items
		20%	10%	30%	40%	100%
A	10%	1	1	2	2	6
B	20%	3	1	3	5	12
C	20%	2	1	4	5	12
D	20%	2	1	4	5	12
E	20%	3	0	3	5	11
F	10%	1	2	2	2	7
Total items	100%	12	6	18	24	60

Figure 1. Development of an interim test's specification for four themes

The specifications' details obtained this way serve as the point of dispatch for effective realisation and management of items, collections of items and the respective tests through the automated transformation of matrix specifications to filters using regular expressions, as examined below.

2.3. Organizing collections and hierarchical identification code of the item

To satisfy the requirements for different variations of individuals tests to include random test items with similar characteristics separation of the latter is required. However, separate grouping is practically impossible to realise due to the large number of collections. For example, the case of a

University course containing 10 learning themes, with each theme having an average of 6 learning objectives, with 5 types of items for each learning objective, with three different levels of complexity and scoring rating from 1-5, requires a total of collection items of: 10 * 6 * 5 * 3 * 5 = 4500! Practical administration of such number of collection items and compilation of respective tests, even if possible, would be very difficult and inefficient.

Usually teachers group the items into thematic categories, each including items by the objectives of studies of different forms, different complexity levels with different scoring rating etc. Then the selection of items for a particular test is done based on the unique hierarchical identification code, which takes into account the necessary characteristics, such as: curricular learning theme, learning/operational objective, level of complexity, type of item, the score rating assigned etc. (Figure 2).

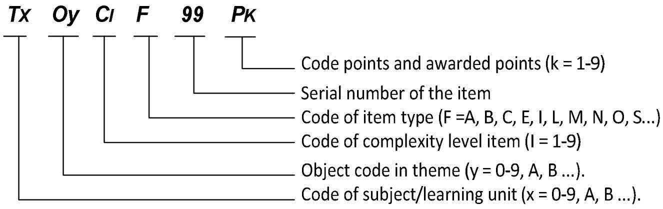

Figure 2. Hierarchical structure of item's identifier

Since the code can be constructed arbitrarily and may include any necessary characteristics, the proposed method is universal and extremely flexible. In this case the items may be grouped/placed in thematic collections or into a single collection on the entire course. Placement into the themed collections is recommended (due to natural way of such grouping, skills, processing speed etc.).

2.4. Generating a test based on regular expressions

While matrices of specifications (Figure 1) are useful for manual compilation of tests, for the automatic generation of tests it is more suitable to use regular expressions over the code/identifier of the item. Regular expressions are strings of characters that represent some stencil (patterns) or types to specify certain conditions, prescriptions of coincidence. The regular expressions are built on the basis of grammar, as well as the languages of programming, for details see [12].

The advantage of the above is that the specifications from the Excel tables can be automatically transformed into RE and from there directly used for automatic generation of tests. The main function of the RE is the recognition: if we have an arbitrary text, the use of regular expressions can find any word or phrase in the respective text. In this case, one says that regular expression accepts that word or phrase. A synonym for RE filtration processes is the word "mask" or condition, filtering limitations, in fact it refers to any templates that identify items for a test.

An example of ER to filter the items that meet the conditions for inclusion in the test of *Figure 1* in view of the structure code in Figure 2:

^ [1-4] [A-F] [1-3] [A-S][..P][01-99]$.

3. Automated development of objective test items`

Objective items in **binary form** - code **B** (selecting a *correct response from the two proposed alternatives, for example, true / false, yes / no,* etc.), with **single correct answer** - code **S** (*one* from *n*), with **multiple correct answer** - code **M** (*m* from *n*), with **association response** - code **A** or **ordering response** - code **O** - from *n* elements can be constructed based on ***recursive / iterative algorithm*** known as **"backtracking"**. *This is a general algorithm for finding all solutions of a computational problem, which is based on incremental construction of candidate solutions, each* *partial candidate abandoned as soon as it becomes clear that it is not likely to be a valid solution* [2].

To design objective items with closed response of the types ***B, S, M*** based on the backtracking algorithm, for each respective objective the teacher has to select / adapt, group and introduce as input data the ***options of correct and incorrect answers*** that we shall call ***false statements*** and ***true statements***, then it is necessary to formulate detailed statements and specify the form of items that have to be generated.

As a result, the application will generate the maximum possible number of items / tasks of type *B*, *S*, *M* by mixing true and false statements. Number of items depends on the form of the item and the multitude of statements and correct/incorrect options or items of association or sorting response types. As demonstrated below:

For binary items of type ***B***

$$B = T + F \tag{1}$$

where ***B*** is the number of items, ***T*** = number of true statements and ***F*** = number of false statements.

For **single-response items** maximum possible number of items **S** is determined by the formula:

$$S = C_F^f * T \tag{2}$$

where ***S*** is the resulting number of items, ***f*** is the number of wrong answers per item, ***F*** - number of false statements and ***T*** - the number of true statements introduced, C_F^f is the total number of possible combinations of ***F*** taken by ***f***,

$$C_F^f = \frac{F!}{f!(F-f)!} \tag{3}$$

For example, if we have 10 false and 10 true statements application can generate:

- 450 items with the choice of single correct response option out of three (I = $C_{10}^2 * 10$ = 10!/(2!*8!)*10 = (3,628,800/(2*40320))*10 = 45*10 = 450);
- 1,200 items with the choice of one correct answer option out of four (I = $C_{10}^3 * 10$= (10!/(3!*7!))*10 = (3,628,800/(6*5,040))*10 = 120*10 = 1,200);
- 2,100 items with the choice of one correct answer option out of five (I = $C_{10}^4 * 10$ = (10!/(4!*6!))*10 = (3,628,800/(24*720))*10 = 210*10 = 2,100);
- 2,520 items with the choice of one correct answer option out of 6 (I = $C_{10}^5 * 10$ = (10!/(5!*5!))*10 = (3,628,800/(14,400))*10 = 252*10 = 2,520) etc.

The maximum number of items with multiple response ***M*** is determined by the following formula:

$$M = C_F^f * C_T^t \tag{4}$$

- where ***M*** is the resulting number of items,
- ***F*** the total number of false statements,
- ***T*** the total number of true statements,
- ***f*** the number of wrong answers per item,
- ***t*** the number of correct responses per item.

For the same example of 10 true and 10 false statements it is easy to determine (*using formula (3) to calculate the total number of combinations* C_F^f *and* C_T^t) that the application can generate:

- 8,100 items with the choice of two correct answer options out of four ($M = C_F^2 * C_T^2$=$C_{10}^2 * C_{10}^2 = 90 * 90 = 8{,}100$);
- 10,800 items with the choice of two correct answer options out of five (or three out of five correct answers = $M = C_F^2 * C_T^3$=$C_{10}^2 * C_{10}^3 =$ 90 *120 =12,800);
- 24,000 items with the choice of three correct answer options out of six etc.

For **items of Association types,** the maximum possible number of items ***A*** may be determined by the formula:

A = C_T^t (5)

- where ***A*** is the maximum possible number of items,
- ***T*** the total number of associations,
- ***t*** of how many association items each item consists.

For example, if ***T = 10*** and ***t = 4*** one obtains a number of items of ***A =*** C_{10}^4 ***= 210.***

Recommendations:

1. For the same statements, the same verified objective one can build items of three different forms such as ***B, S, M.***
2. Varying the number of alternative responses in the item of type S, M allows to generate items with different levels of complexity. The higher the number of distracters, the smaller the probability of guessing the response and the greater the difficulty. For example, the possibility of guessing a correct answer out of three is about 33% (100%/3) and a correct answer out of six is about 16%.
3. The details and statements/response options must not be of the *copy & paste* type, which can be directly found in information texts.
4. For associations the number of response alternatives should be more than the number of combinations required at least by one (otherwise the last combination is determined automatically by default).

The model of development of objective test items, discussed above, offers a number of advantages.

1. For binary items of type ***B*** the power of practical generation is zero (because the number of items is equal to the total number of introduced statements).
2. For items with singular response of type ***S*** and items of association responses of type ***A*** the power of generation is already quite good (from 2,250 to 12,600% for items of type ***S*** and 1,000% for items of type ***A,*** as per the examples above).
3. For items with multiple responses of type ***M*** the power of generation is excellent (from 4,050 to 120,000%, as per examples above).
4. During the different phases of (self)training and (self)assessment based on the same statements/associations one can generate different items, with different number of alternatives/rated scoring etc., which promotes the motivation of respondents for launching the multiple repeated tests and allows for variation of types of test items in relation to the same learning objectives.
5. The developed items are **parallel** and require **relatively short time** for development-verification.
6. The generated items can be directly imported into many platforms of e-Learning/ e-testing (Moodle, Hot Potatoes, Illias etc.) facilitated by import tools such as Gift, XML, Quiz etc.
7. The large number of parallel items allows, on one hand, to reduce the risk of collecting responses by force, on the other hand, it allows to generate equal versions of individual tests for each of the respondents, which measures their performance on equal terms (*the latter being one of the basic requirements towards valid tests* [4, 10]).

4. Conclusions

An important direction of research in the area of open and distance e-testing concerns *automation and intellectualisation of the development of parallel items and individual test items* with varied content. Given that the development of the required number of faceted items requires significant time and human resources, and that checking of tests must usually be done in the restricted timeframe, automation of the latter is considered a favourable solution. The development and practical and scientific foundations of the methods, algorithms, tools and automation applications for the processes of development and management of various types of test items and educational tests remains one of the important research areas.

The proposed methodology for developing the faceted items and generating the individual tests with varied content allows for the individualized (self)training, open and distance learning facilitated through e-learning platforms, for e-testing within personal constraints of place and time, maintaining all the while a certain level of motivation of test respondents. Automated generation of tests using RE also leads to the simplification of test administration and management for the teachers as well as increases testing efficiency for each respondent.

Many of the above suggestions and recommendations were implemented by the author, as well as tested and approved during the academic years of 2008-2014 on the e-learning site of the State University of Moldova, accessible at http://moodle.usm.md, utilizing versions 1.9-2.5 realised based on Moodle platform [8, 13].

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Verbal and Non-verbal Communicationin Game-Based-Learning

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Abstract

While inordinate studies have shown a constant focus and endeavor of not only researchers and practitioners but also developers to come together and find an increasingly more and more refined system and theoretical framework to apply in the realm of serious games and game-based-learning educational effectiveness as such, while methodologies and pedagogies have been brought up on what best works in formal and informal education, while andragogy and corporate training performance indicators have been in search for best definitions, not much has been said on the way all these systems communicate, with reference to paradigms engaged both in the way serious games communicate knowledge or trigger attitudinal changes and in the way a user can communicate his feedback and express options in order to interact with the system or with other users, to build communities and drive change within oneself by simply getting connected, by responding and reacting, via both verbal and non-verbal communication. This paper depicts models of verbal and non-verbal communication and the way they are used in game-based-training to share knowledge, change attitudes and build communities. The message is that conversations are interesting, functional and worthy even when non-human factors are our interlocutors, hence awareness should be raised in what types of messages, encodings and decodings serious games ought to embed or be embedded into.

Key words: game-based-learning, serious games, verbal and non-verbal communication, mediated communication

Introduction

We constantly learn, in formal or informal ways, we increase our knowledge, undergo personal development and set up connections socially and on information grounds, to later on share from what we already know or internalize what we have just discovered in others, by ourselves. Education and training have thus become continuous, informal, non-formal – if we can say so- taking a distance from the “brick and mortar” traditional one.

(Blackenship M, 2011)Along these lines, information media is free from any stereotypes while social media is such an encompassing word that covers anything related to web applications built around a user-generated content (Pew Internet&American Life Project 2010); in other words, social media covers all that is related to the interaction among people by means of which they create, exchange and share ideas and information, within virtual communities and social networks (Alqvist, Back, Halonen, Heinonen, 2008).

While some might argue that serious games have nothing to do with social media and therefore any mentioning of social media terms would be outside the scope of this paper, we dare say that based on some distinctive features such as social presence, a wide array of applications, self-referential and attitudinal ambivalence in order to reveal or hide aspects of own personality, Kaplan & Haenlein (2010) have created a 6 layer social media classification which includes serious games along with collaborative projects, blogs and micro-blogs, common reference communities, social networks and virtual worlds. All these media have been mentioned here based on a common denominator: technology-based communication or, to put it differently, mediated communication. It is in this context that serious games seen as part of social media need to be approached as communication vessels as well, when taken into consideration for either form of education or training.

Needless to say thus that at a time when all the long debated educational effectiveness in serious games is more than design, pedagogies and game attributes, when one of the seven C-skills needed in 21 century lifelong skill-set is communication (http://education2020. wikispaces.com/21st+Century+Learning), Corti's opinion (2006) that game-based learning "is all about leveraging the power of computer games to captivate and engage end-users for a specific purpose, such as to develop new knowledge and skills" would be inappropriate or half-hearted.

The reason for the above mentioned statement is that nowadays, with so many means to communicate " the most probable effect of communication is …even more communication" (Chaffee, 1986); thus, to approach the models of communication that lend themselves to serious games would be a worthy endeavour, as serious games seen as educational tools grant the ability to communicate with, while simultaneously collaborate and compete against, by merely engaging the player/ user. Through the involvement and "fluid forms of engagement" (Calleja, 2007) games create a certain mood for escapism which, in turns, enhances free communication. The manner in which the player gets thus engaged determines us to look beyond the games visual representation, beyond surface but somewhere before reaching the layer of game attributes, to see the manner in which he/ she communicates with the virtual environment and how the environment, the game in our case, in its turn, communicates with the user.

It has already been argued that in case one takes the first layer off a game, a full list of possibilities to stimulate cognitive skills useful in everyday settings can be found (Beck & Wade, 2004; Gee, 2007; Johnson, 2005; Wark, 2007) - among them, the skill to communicate will be further on investigated.

Verbal and non-verbal communication

To express ideas, clear and distinct ones, we have to be very specific on terms to develop, as words are not enough; they are helped by gestures, posture, mimicry as these bring extra information, they complement and double the information given by means of verbal communication. Yet, while verbal communication uses articulate language to render ideas, nonverbal communication sends coded messages by means of ***gestures, posture, visually, auditory, tactile and olfactive signals***, since as a specifically human means to interact, non-verbal communication uses facial expression, postures, body language, more or less conscious ones, common to relate both in human and other livings' interaction. Moreover, nonverbal communication is used to send emotional messages whereas verbal communication is used to send ideas. Thus, studying the nonverbal communication means studying signs, models and specific codes involved in this (JK Burgoon, B Buller & WG Woodall, 1996/1998), while they are combined in a certain structure. In this light, lots of classifications have been done based on signs and ways of transmitting them. The most common classification is the one J. Ruesch & W.Kees (1956) had, combining sign language with gestures, action language -with body movement, whereas object language is ranked separately.

However, the most recent and largely used classification connects codes to the medium used for sending them (JK Burgoon& TJ Saine, 1978; RG Harper, AN Wiens & JD Matarazzo, 1978; ML Knapp, 1978; DB Buller & WG Woodall, 1996): ***kinesics*** – to include body language and facial expression, ***oculesics*** – the study of looks, vocalic or paralanguage, ***proxemics***- perception and use of space, while ***cronemics*** is the study of perception and way of using time.All these are used in human computer interaction with serious benefits, naming here serious games at least.

Considered in general terms, communication is produced whenever a system, the source, influences another system, the receiver, by using various symbols sent through the channel that ties the two systems (Osgood et al, 1957) While communication can be defined as "social interaction by means of messages" (Gerbner, 1967), the process is said to occur in one of the following situations or in all of them simultaneously, doing one/ all of these things : an action over others; an interaction with others; a reaction in others- practically what story board does with the game player and what the gamer himself does to other fellow gamers – actions triggering other actions, by means of communication conducive to flow and game progress and skill development ultimately.

While **planned communication** is used within the educational processes as compared to impromptu instances in everyday conversation, early research first showed that the **strongest effects** this has on humans are rendered **on the volume of information given**, **less stronger effects** are performed **on the attitude** they convey and **the lowest results** are triggered **in one's behavior** (Hovland et al, 1949) yet certain variables must be taken into account, such as personality, social traits and the need for novelty.

It is in this context that we translate all this approach in the realm of interactivity and virtual reality – human interaction, we ought to mention that the human-computer interface literature addresses **the interaction between the individual and the computer** (Johnson, 1998; Kirsh, 1997; Lieb, 1998). In this type of interactivity, key dimensions might be **the nature of the interface** (either apparent or transparent to the user) and **the center of control** (either in the computer or the individual). Other research traditions focus on interactivity between the user and the text or what Szuprowicz (1995) has called user-to-documents interactivity (Barak & Fisher, 1997;; Borden & Harvey, 1998; Hunt, 2000; Xie, 2000). In this type of interactivity, key dimensions might be the nature of the audience (either passive or active) and the level of control that audience members have over the content of the message, all having been established by the game developer having in mind the type of skills one needs to develop and thus the intensity of flow, all expressed in the type of communication being exerted between the user, the game and other fellow participants.

Moreover, when we mention audience, message and interactivity, one cannot but mention the Bordewijk and van Kaam's (1986) four-part typology of information traffic as a vision of McQuail's (1994) mass communication theory. The key element of the Bordewijk and van Kaam's typology is ***control***. One dimension of the model is defined by ***control of information source*** and the other by ***control of time*** and ***choice of subject***. By means of this model the authors provide a four tier basic model of communication showing the correlations that can emerge among them:

1. The model of ***allocution***- implies the fact that information is simultaneously distributed from a centre to more peripheral points; it is a message that goes from one to many. Also, the time and place of the allocution are set by the source.
2. The model of ***conversation*** implies that people found themselves in a potential communication network and interact directly, choosing their partners, time, place and topic of communication. Partners are equal into conversation, could be more that two, but a low number however, as otherwise it turns into model nb.1
3. ***Consultation*** model-a person on the margin seeks information in the centre where it is stored. The moment and place where the information is consulted as well as the topic searched are established by the receiver on the margin.

4. ***Recording*** is the reversed way of consultation model, where the centre asks for information from a participant found on the margin.

A different approach resulted from the work of McMillan and Downes (2000) who, by conducting interviews with people from education and research, created content for the computer-mediated communication, a content that stretches on two dimensions – ***direction of communication*** (Grunig and Grunig, 1989) and ***control*** (Bordewijk and van Kaam, 1986) ***over the communication process***, concepts explored in the literature for interactivity as well. While communication flows both ways, ***receiver control*** is a key concept of computer based information system (d'Ambra & Rice, 1994; Finn, 1998)

In figure 1 below, this kind of control is clearly illustrated (McMillan, SJ, 2002)

Levels of Receiver control		*One way*	*Two way*
	HIGH	Feedback S ⟵ R	Mutual discourse P ⟷ P P ⟷ P
	LOW	Monologue S ⟶ R	Responsible dialogue S ⟷ R

Fig. 1 Direction of communication acc to McMillan, 2002

Monologue is a primarily one-way communication and has relatively little receiver control over the communication process, similar to feedback, yet the latter allows receivers to have limited participation in the communication process. ***Feedback*** tools allow the receiver to communicate with the sender. However, in this model, the sender and receiver roles are still very distinct. Even though the receiver may communicate with the sender, there is no guarantee that the sender will respond to the Feedback that has been received. In some ways, Feedback resembles ***Consultation*** as the receiver can consult with the provider of information in terms over which the receiver has some control. In other words, there may be some symmetry in the communication goals. On the other hand, Responsible Dialogue enables two-way communication but the sender retains primary control over communication. ***Mutual Discourse*** enables two-way communication and gives receivers a great deal of control over the communication experience. This strongly resembles the Conversation.

Communication in Serious Games

When using serious games in education and training, the aspect of communication process and the way it is performed should be of paramount importance as effectiveness in their usage and in reaching the educational / training goals is heavily based on the way communication is performed at the level of human-computer interface and beyond. A good communication will always produce the desired effect in the interlocutors, thus the knowledge transfer or attitudinal change will get maximum chances of being performed provided no hindrances appear in and around.

Should we yet cast a glance at games and the way they communicate with the user, several ideas can be highlighted here:

When playing solely to focus on communication, the story gets serious as various patterns should be included, from formal to informal, from applied linguistics to terminology, from functional language to paralanguage. However, since the focus here is to analyze types and models of communication embedded in serious games, the following can be noticed:

while in a 2D game conversations are limited to a certain extent to executing various missions and tasks based on indications (*Republia Times),* in others the gamer can follow his own lead but-lacking interaction and communication- tasks and their accomplishments are lagging behind

The feeling of community cannot be rendered when communication is broken. In the single player forms there is a lot of narrative burden, even though there is not such a case as complete silence- instances of communication between non-player character (NPC) and the gamer do exist. The communication is yet broken, being limited from the NPC to only choices embedded in the game, while the player is also bound to choose from what he has been offered on the screen. Here only the debriefing session can bring more communication to the game, by means of chat/ live classroom debates. (This is the case with *MetaVals* as well, where users need to use negotiation but in real world or in chat rooms adjacent to the game, in order to reach consensus over the dyads)

In multiplayer games, the player-to-player communicative approach is introduced; yet, here as well, depending on the game attributes only verbal or both verbal and non-verbal communication can be used.

We have spoken so far about the in-game connections and out-game connections (Wiklund, 2005). However, when speaking about avatars, we may have in-character and out of character communication (Wiklund, 2005) Should we think back to *MetaVals* again, the case here was with out-of-character conversation (the characters could not have the ability to speak in game, but, in order to finish the game, the players got out of their characters and negotiated over dyads, then they re-entered their in-game character.) For this type of game, communication is more effective by playing ins and outs. Turning our attention to Afghanistan- Cultural awareness pre-deployment game, it is worth mentioning that there is no communication involved there per se, apart from the message bubbles and the conflict- range meter signaled on the screen. The player acts by selecting various options to react under given situations, thing which determines an increase or decrease in the conflict meter which goes up or down.

Not the same is the case with TOTEM learning, where the business enterprise, for example, as a one to one game gives specialized language but along with the constant little communication it provides, the game also displays facial expressions and mimicry, tone of voice and paralanguage, elements of paramount importance for establishing a communicative approach kind of relation between the in-game player and the user outside the game.

However, by using online multiplayer games you have to share identity and personal information to the other players. The connection thus gets real beyond the game world and this can make the bond increase, stimulating communication, even though people can be totally new to you. The question is- can this kind of communication via games replace the face-to-face one? The answer does not take long to appear: Since young people spend more and more hours in online gaming and since this is bound to increase, what type of communication model should be used inside games in order to simulate the real one? Can real world communication be simulated?

In *Darfur Is dying* communication is similar to *Cultural awareness - Afghanistan* : there is a threat meter going up and down, giving feedback on the users' action; likewise is the health, depending on water supply and food supply; yet, all the actions taken by the player are coordinated by meters appearing on the screen, similar to cultural awareness; these two cases are clear examples of broken communication, as it is the written word triggering simple action control movement. None of the elements of complex communication are given to bear a print on the way the game is played- the gamer has to go/ play by guessing, since the game does not communicate either meaning, context or in-movement feedback. Communication between the game and the player is difficult and scarce, things which bear a mark on the effectiveness of the game-advancement is difficult and somehow groping-like, as message and target are not clear. At this level and type of game, maybe speech bubbles would bring a plus; having the characters inside the community speak to each other could add up and make the game more vivid while the player would get better immersed in the conversation and action, advancing with the game by interacting with other players or with the NPC in the game.

If *Darfur is dying* has an inferior representation of game mechanics and similarly a lower use of player-in-game communication, *Global Conflicts Palestine* is better represented in terms of facial expressions and body language, thus the flow and immersion is better made, while the message gets through more accurately, as the words printed on the screen are reinforced by nonverbal communication, thus becoming more persuasive and more efficient, more touchy, turning the user in a pro-action guy (alert and prone to taking action) Taking another game – *On the ground reporter-Darfur* – which displays video-clips alternating with still images to communicate and ask the user to make choices, one can see that feedback is embedded and the player’s choices are somehow controlled – should you make a choice, then you are declined the access until you select the one offered by the game as valid. A false feeling of freedom of choice is given, therefore an open and free communication is far from being performed between the game and its user. As far as nonverbal communication is concerned, this only comes up as question marks and caps lock. Guidance again, is missing.

While *Republia Times* (you are the editor in chief of a newspaper and you have to increase the loyalty of the public towards the government by highlighting stories that bring up good things) is somehow a drill game where everything is artificially communicated, with signs and drag-and-drop options to interact and thus barely give an artificial feedback, in *Darfur* human presence is a plus, bringing not only verbal but also body language: the translator, the old man, etc. Human presence and communication here are also rendered by the display of the mobile phone screen showing messages for the user to perform onward. The video sequences also send good contextual messages that are realistic and offer immersion, flow and escapism, similar to media, but they do not allow for the user’s feedback. This way, communication staggers, it is fragmented and it diminishes from the effectiveness of the targeted learning goal.

More openly viable, realistic and communicative- if so to speak - are yet two other games we bring into focus - *Win the White House* and *The Migrant Trail.*

While in *Win the White House* the gamer can communicate things about himself by choosing his last name, his slogan, looks and the political party he runs for, he in addition expands his message by expressing choices of the subjects for his campaign. Moreover, there is a moderator that constantly intervenes and somehow communicates with our gamer subsequent to the path he has chosen, offering him an array of option answers to choose from, for some given situations.

Conversely, *The Migrant Trail* is a first person game with a story unfolding through Arizona’s desert borderlands. The game can be played as undocumented. By playing the game you can get an alternative platform to further engage conversation, investigation and inquiries into themes and questions raised by the documentary. Instructions alternate with two options to choose, based on what you choose the game continues with that specific alternative; the atmosphere is rendered auditory, by specific music playing in the background. The gamer’s choices influence the group’s capacity (including yours) to survive and reach destination, i.e. back to your family in the US; this capacity obvious involves the ability to cross all the desert. Communication thus embodies various forms, from music to controlled choices, from specific displayed background information to nonverbal communication of the character’s motion and aspect.

Were we to design a model of communication that would be taken care of in the cooperation between game designers, pedagogy specialists and storyboard designers as well as subject matter experts with an end to design and set a game in motion, we would draw attention to the following:

Taken from the simplest games where communication between game and the player is done intuitively or it is teacher-guided outside the game environment and the input is at a later stage applied to the game thus triggering a change seen as steps taken into the game to advance and eventually win, to the most sophisticated 3D game characters, avatars and NPCs which together act, react and interact, communication is performed between the game and the player, as human computer interaction.

As long as we consider that communication occurs when an action is performed over another, an interaction with another subject occurs or when a reaction in others is triggered, then this is a solid argument to see games and especially serious games as sources of communication, while these games are used to train and bring change into the individual playing. Now, that training is involved, planned communication is also involved, compared to the non-planned, impromptu one, used in everyday speech. With planned communication, the part that gets most beneficial is the volume of information while attitude is second so that behavior is the part least influenced in the process of communication.

Therefore, game designers should bear in mind when focusing on the dialogical side, on the discourse and narration within a game and settle learning and training goals, that information must prevail over trials to bring change in one's behavior. All this is possible due to interactivity between the interface, the game and the gamer, due to the centre of control (computer or the individual), nature of audience (active or passive) and level of control the audience members have over the content of the message. Moreover, all of the above mentioned features operate with the information traffic concept that set basis on the idea of control of information source, control of time and choice of subjects, all of them largely influencing and heavily defining the process of communication in a virtual environment but also between the VR and the user.

Hence, game designers should allow more consideration on the following, in order to enhance better game communication between game and the gamer and thus change is induced either in behavior or knowledge, according to training objectives embedded in the game:

- If the centre of control is in the computer, then the individual is restricted to options set by the game attributes and thus the scaffolding is the main element, whereas in the case when the centre of control is in the individual, then the game should offer more alternatives as choices and multiple paths for learning, tailored to students' choices and needs; the info-layer should be more complex and the storyboard should be of a tree-like diagram. All these are referred to as information source.
- Should we now talk about control of time, we should mention that time can only be controlled from within, from the game, on sequences or stages; overall, the control for performing action can only lay in the hands of the player. He can break, repeat, stop, change time and sequences at his own disposal; only stage meters are set by the developer. Allowing a better time control to the gamer yet, a better communication will be performed as empathy, immersion and easiness triggering friendliness and eagerness to perform onward
- As far as choice of subject is concerned as another facet of communication between the gamer and the game, it has been clearly seen that the more choices a gamer has for subjects and inordinate array of options to take actions, the more information can be transferred with various and repeated attempts. Plus, freedom of choice of subject triggers various courses of action leading to different endings. By multiple trials the same gamer can explore more and gain better info than a single choice of subject game.
- Should we consider the model Bordewijk and van Kaan (1986), then we must pay attention to the fact that the **model of allocution** in a game can only be applied to MMOG (massive multiplayer online game), when the info goes from the centre to periphery and time and place of allocution are set by the centre (master, server, designer, tutor). It is also MMOGs yet that

make use of **the model of conversation**, where people interact directly, choosing their partners, time, place and topic of communication. In games where extra info sources are embedded and can be referred to upon request and based on trial-error, **the model of consultation** is applied, where topic, place and time of consultation are established by the player, i.e. the person in the margin. This can apply very well to single player games, see Afghanistan Cultural Awareness for example. Taking a closer look at the model of conversation, there are several types of conversations able to exist within a game, therefore we can enumerate the following based on McMillan model:

a) Monologue, to be met when the receiver has limited participation (existent in simple games, brain train, math games, etc)

b) Feedback, when tools are existent for feedback, the receiver can also communicate with the sender, so a dialogue is engaged, triggering movement and change between gamer, interface and game itself.

c) The mutual discourse type of conversation is present in complex games where the receiver gets a great deal of control over the game, communication exists between characters in the game, between the gamer and his avatar or through his avatar, with other players either in or out of the game, but also communication with the NPC can be engaged, based on the game attributes.

The model of recording where the centre asks for info from the margin can be seen in the fact that the game records the gamer's moves and quantifies his success and failure, also recording the feedback the player gave.

By a correct employment of the above mentioned models, communication is ensured at various levels and among all components of the game, tailored to the specificities of the game (single player or massive multi-player ones) and by proper communication messages as learning goals are sent to the player, feedback is obtained and knowledge transfer or skills are built as a result of this interaction. Should designers be aware of the communication aspects employed in any game and coordinate things from scratch with the story board and game mechanics, training and learning would improve performances.

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WEB oriented entrepreneurship through business simulation online tools

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Abstract

This paper aims to present the issue of setting up the simulate enterprises that use the online support tools to facilitate the degree of assimilation of information and knowledge by students. Entrepreneurship is the engine of innovation and future growth and the Digital Agenda 54th action aims to develop a new generation of web-based applications to stimulate networking activities and innovative enterprises. The concept of "Young Enterprise" try to be a new approach on how to learning, inspired by the concept of simulated enterprises. Young Enterprise is like a virtual game, adapted to the needs of learning, where students learn how to establish, to manage and to increase the profit of a company. We will follow the presentation of the results of this project, focusing on the role of WEB tools to enhance individual and collective decision-making capacity, to support knowledge sharing and teamwork, to understand the dynamics and market risks, the effects of global collaboration, to facilitate the transition from theory to practice and understanding of individual and collaborative processes of a company.

Keywords: Entrepreneurship, Online tools for business, Virtual Platform for Simulate Enterprise

1 Introduction

The concept of simulated enterprise (SE) means a virtual representation for a real business with educational purposes. SE represent a skills-oriented educational process, which try to create the same similar economic processes conducted within a real company, with respect the principles of market economy. This is based on a valid business model and also is integrated in a specific economic environment (ROCT, Central Network for Simulated Enterprises in Romania, www.roct.ro). Modeling a Simulated Enterprise is an essential step to meet its dual perspective, first seen as a center of education and also as entrepreneurial initiative.

This project aims to ensure an "innovative higher education for labor market", applying the strategic proposals for implementation of Education Law at the system level and in the European context (Kroes, 2011; 2013).

It offers also the conditions to promote the methodologies to increase the attractiveness and quality of vocational education and training programs, the capacity of higher education to implement the measures and tools to support the economic and social development (Stanescu and Stefan, 2013).

Simulate Enterprise is based on the systematic interconnection between theoretical learning and practical applications deployment. The objective of this teaching method is practical testing, applying the acquired knowledge and generating new skills and abilities. The entrepreneurial initiative, the main objective of simulated enterprise, is available for students in a complex environment of action and experience, developed within a virtual organizational structures, similar to those existing in the real economic life and labor market (Stefan, 2007; 2008).

In the simulated enterprises students are encouraged to identify the interdependencies in the whole microeconomic system, to adopt the entrepreneurial decisions and to evaluate the consequences, not only for isolated commercial activities. These actions require linking technical and economic knowledge, as for the services management, the launch of a new product on the market or the development of e-commerce transactions.

By encouraging students own initiative, the simulate enterprise promote the idea of skills development, providing a link between theory and practice and also developing an action-oriented educational process (EC, 2013; 2014).

2 Academic initiative and social cooperation

To increase the chances of employment and insertion of young graduates on the labor market, it is very important the support of business environment. In this way students who did not experienced the real economic processes can conduct economic and financial activities in conditions of simulating the operational real economy through the SE. With this purpose, the modern interactive learning method of simulated enterprise created partnerships between academic programs and business environment, to expand entrepreneurship development programs for young entrepreneurs and to facilitate the exchange of ideas promoting managerial techniques.

Two initiatives are particularly important:

- Set up industrial parks by associating business and academia, with the support of local decision makers (Raceanu, 2014);
- Founding the initiative of organizations of young students, teachers and business entrepreneurs who support this teaching method.

Such an initiative is AYVE (Association of Young entrepreneurs in the Virtual Environment (www.tinintrep.ro). AYVE was founded at the initiative of teachers involved in economic teaching for students with the aim of promoting interest for more involvement in the real economy, even during the university time. It is mainly aimed to provide the material and organizational support for students to develop their professional skills and improving labor market insertion, advice, assistance and guidance to students who assume the roles of young entrepreneurs in the virtual environment of Simulated Enterprise. This initiative facilitates learning and development of economic and legal knowledge required in a real company and supports programs implemented by the Ministry of Education.

The main objectives of Association of Young entrepreneurs in the Virtual Environment relate to the next issues:

- Ensure legal and organizational framework to support students to develop their entrepreneurial skills and improving labor market insertion;
- Counseling and guidance of students pursuing entrepreneurial activities in the virtually Simulated Enterprises;
- Developing entrepreneurial programs for young entrepreneurs and students by implementing the new interactive teaching method SE;
- Development of managerial and entrepreneurial skills of young entrepreneurs for projects and participation in national and international competitions;
- Developing public-private partnerships to support local businesses environment and organizing internships and practical activities in the regional companies engaged in virtual entrepreneurship activities.

Figure 1. AYVM on the FB Webpage

2.1 Implementation methodology

Simulated Enterprise is a company operating in the "mirror" of a real company, according to its structure, functionalities, operations and its purpose. Since the establishment of operational enterprise, the students are supported throughout all the stages of the process by representatives of real companies. In a simulated enterprise each student has to take at least two roles (job rotation) in order to experience a diverse casuistry. The range of roles could include different positions depending on the type of company.

For example, for a software development company: manager, assistant accountant, responsible for sales, analysts, software developers, testers, system engineers, etc. For a company working in the field of renewable energy resources, as producers, the roles for students could include: manager, assistant, equipment manufacturers, consultants, accountant, responsible for sales, designers, analysts, engineers, etc.

Each simulated company sets its objectives on which will make the assessment work done (development of software applications, preparing documentation for a tender, organizing fairs, etc.). Evaluation of each student and the results will be considered depending on the roles assumed in the simulated company and based on professional advice and guidance sheet. The activity of each simulated enterprises will be assisted by an official and the final evaluation for each simulated enterprises will be based on a specific allocated theme.

2.2 Monitoring and evaluation tools

Establishing the procedures and the instruments for monitoring, evaluation and updating the business simulation system means an important step. These refer to:

- Assessment of professional skills acquired by the student/graduate and revision of the integrated business simulation used in the project (feedback questionnaires, studies, analyzes, reports, strategy for transition from the school to active life;
- Organization of fairs, from the students trained in SE.

Throughout the fairs for simulated enterprises in the fields of tourism companies, the students-entrepreneurs could learn new ways to promote strategies for differentiation from other competitors. Such an event took place on 14-16 May 2014, highlighted at www. istargoviste.com/targuri/ (Figure 2).

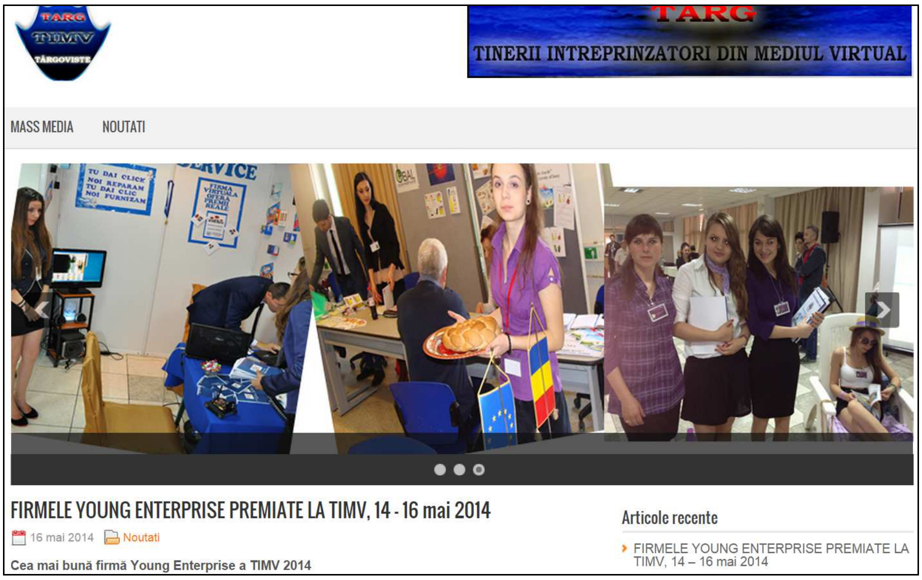

Figure 2. Fair for simulated enterprises

4 Technical solution

Online tools to support simulation of business are designed to familiarize students with the activities of internal organization within an enterprise: planning, allocation and human resources tracking, financial and material tracking; accounting (invoices, travel, returns and budgets); analysis and reporting (risk analysis for planning, working time, activity report). These tools are necessary for efficient assimilation of skills that allow the transition to real life and labor market integration. Informatics tools include gamification elements to attract student involvement, to highlight the results obtained and recognize the progress and merits, based on activity.

All informatics tools for online support will be integrated on a Virtual Platform for Business Simulation (VPBS), allowing the operational functions of Simulated Enterprise.

4.1 Operational organization of the SE

Following the procedures established by ROCT, establishing the functionality of each Simulated Enterprise created in the project include:

- Names reservation, authorization to operate, registration in the database of ROCT, opening bank accounts for each SE;
- Realization of practical activities in the simulated companies by the students under the guidance of tutors;
- Development of methodological working tools for the operation and functioning of simulated enterprises: Internal Rules, Procedures, Working procedures for SE.

4.2 Development of integrated platform for business simulation

Activity of simulated enterprises created by the project will be supported in practice by developing online tools available on an integrated virtual platform for business simulation (VPBS), experimental management processes for an enterprise like a web page for electronic commerce (Figure 3, source http://istargoviste.com/simservice/index.php).

Figure 3. Simulated enterprise Website

The online platform integrates support tools for managing activities in the simulated companies, and contains the following:

- Creating teaching materials to be disseminated in the seminars and working meetings between the teams of SE and real business representatives;
- Providing resources for research (books, subscriptions to magazines and online databases) studies, analyzes, reports, strategies for the transition from the school to active life;
- The identification and coordination of e-learning materials as a teaching progressions and posting them on e-learning platform that will be accessed by students;
- Development of IT tools to support business processes.

This activity will include maintenance of the platform for the whole cycle of life of the virtual enterprise, ensuring the optimum functioning, including security, data consistency and necessary updates.

4.3 Results

The virtual platform for business simulation integrates many tools available online, to facilitate the transition from the school to active life:

- Planning of human resources, financial and material decision making, monitoring schedules; electronic timesheet employees; track income and expenses on salaries and activities;
- Analysis and reporting: risk analysis for planning - working time, progress report, performance evaluation;
- Evaluation components allowing analysis of SE employees performance by integrating a repository of activities using API experience;
- Collaborative and communication components that allows real-time interactions between users of the virtual space through various online tools (audio, video, text).

Organizing internships will be made in compliance with 3955/9.05.2008 Order of the Minister of Education, research and youth. The internship practice in university programs and themes for conventions of practice will include:

- Analysis, design and development of software applications using programming languages that are not covered by the curriculum;

- Integrated systems;
- Interoperability of an enterprise;
- Protection and safety at work;
- Using of existing software from the partner companies (ERP, CRM, Accounting, Call Center).

The online business tools include tutorials and predefined scenarios, students becoming familiar with the flow and specific activities of a company (Dinu, 2014a, 2014b). The platform provides mechanisms that allow the integration of risk factors in the activities of simulated enterprises, to reflect closer the reality of participating in a competitive market.

5 Conclusions

Students need learning experiences focusing on practical implications, in line with the dynamic demands coming from business and labor market directly applicable. The transition from theoretical concepts to practice is a complex process affected by many factors. The fact that the absorption rate for young graduates in the labor market remains low, highlights the need to invest in additional and specific skills that students develop in universities and to enhance their ability to adapt and integrate quickly into the labor market.

This project will generate significant benefits for students and for the partner company that will provide the practice environment, skills acquired will enable easier integration of the students on the labor market. With their wide area coverage and applicability, the acquired knowledge will increase student’s opportunities for future professional career.

Horizon 2020 will stimulate innovative enterprises, including web entrepreneurs by funding pilot projects and awards that lead to the establishment of new start-ups. Among the key elements of the future framework program we find the development of closer links between entrepreneurs and universities and networking activities.

This project reflect a concrete materialization of the European initiatives, supporting a new generation of web entrepreneurs through a complete and integrated set of mechanisms for professional orientation, offering some practical training and direct interaction with experts from enterprises on labor market, engaged in developing business using online tools for simulation.

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How to Motivate Students Learning Instead of Cheating On a Test

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Abstract

The quality of education is a crucial aim. Technology impacts so many areas of modern life. There are streaming too many information from everywhere, plenty of information. Technology provides a bounty of tools for learning and in the same way of cheating on a exam. The ability to improve quality of education is the main goal to any institution, formal or informal organization for education. In that article we will spoke about the methods that are often use for cheating on e-tests, how we try to prevent that way of practice and what is important teachers to do in order to reduce bad manner of cheating among students.

Key words: quality of education, distance education, e-learning

1 Introduction

In recent years, studies have indicated that there is an alarming increase in cheating behavior among students (Neils, 2012). When start to write the article, I didn't know that for cheating there are so many methods and has writtenmanual or practical guide in the web (http://www.wikihow.com/Cheat-On-a-Test). There are too many methods to overcome exams and not to be taken in the proper way by learning the material of subject. It was seems to me as like a new field of knowledge and really hard work to learn how to cheat well to avoid bad consequences.

It is amazing, in the web, there are too many useful and practical rules that give you information how to reach your goal in both cheating&learning. What you will use depended of your choice. It is proven that most young people cheat at least once in their high school career (Neils, 2014).

According to a 2010 study conducted by Rutgers University, 64% of college students have cheated on tests. In 2009, global research firm, the Benenson Strategy Group, conducted a poll which found almost one-in-three middle school and high school students have cheated on a test *using their mobile phone*; *over half said they've used the Internet*to cheat in some capacity. What's more, *one-in-four students said they didn't see anything wrong with using technology to cheat*. Seems times have changed (Scott, 2012).

About 75 percent of college students admit to cheating, suggesting that probably even more than three quarters of college students have done something against the rules to improve their grades (Buchmann Bryce, 2014). Psychologists and sociologists have applied theories of deviant behavior in order to understand cheating. However, cheating is no longer deviant behavior, normal (Neils, 2014).Jon S. Katzman, president of Princeton Review, an organization which prepares students to take standardized tests, believes that "ten years ago students were stressed because they wanted to be the winner. Now they are stressed because they don't want to be the loser („Record Number of Applicants Are Reported by the Top Colleges," New York Times, 18 February 1996).

2 Why students cheat during exams

Neils (2014) believes the answer to this lies in **a survival instinct**. The vast majority of young people and adults believe that cheating is wrong, and nevertheless behave in ways that are inconsistent with their stated beliefs. Of course, the survival instinct isn't the only reason young people cheat. They might cheat because they find a lesson or a course to be meaningless - having no perceived relevance to their lives. They might also cheat because they belief something is unfair, so feel justified in cheating (Neils, 2014).

Researchers found that cheating habits among college students develop prior to arriving at college, more than 2/3 of college students report in engaging in some form of cheating, cheating is rampant in professional schools (McCabe et al., 2012). Below is a list of the most commonly expressed reasons for student cheating (Lathrop&Foss, 2012):

1. **Performance concerns**
   - *Need to excel at any cost*
2. **External pressures**
   - Academic
     - *Semester workload too heavy*
     - *Others' cheating puts me at disadvantage*
     - *Professor/text did not adequately explain material*
     - *Too many tests on one day*
   - Nonacademic
     - *Pressure from parents*
     - *Job leaves no time for study*
     - *Illness prevents adequate preparation*
     - *GPA for athletic qualification*
     - *Financial aid depends on GPA*
     - *Good grades needed for job or graduate school*
3. **Unfair professors**
   - *Overly harsh grading*
   - *Unfair tests designed to fail students*
   - *Unreasonable workload in course*
4. **Lack of effort**
   - *Did not attend class*
   - *Did not study, do reading, etc.*
5. **Adherence to other loyalties**
   - *Helping a friend*
   - *Loyalty to a group (fraternity)*
6. **All's fair in love and academia**
7. **Opportunity**
   - *Unexpected opportunity arose*
   - *Instructor left room during exam*
   - *Instructor wasn't watching carefully*
   - *Other students didn't cover their paper*
8. **Campus ethos**
   - *Others do it*
   - *No one ever really gets punished/caught*

3 Different methods for cheating on a test

Cheating is defined as copying material without proper citation, padding bibliographies, getting exam questions in advance, collaborative homework, turning in paper done by others, and using notes during exams (McCabe et al., 2012).

In order to cheat successfully, you must be prepared for that, almost the same as to study for exam. Amazing, but it is true. You can find tips, methods, prescriptions and etc. Whenever you are simply unprepared, not confident with your knowledge, lazy, or thinking that you are unable successfully pass an exam, or just feel compelled to use cheating as a strategy to get through a test, you can find guide in the web, some steps and tipshelping you to accomplish your purpose.

3.1Methods for cheating

Cheating on a test is never a good idea. You cheat both yourself and your future. However, if you do it, must do it right – that is written on a web and sounds correctly. Thus cheating is like also as a science about how to cheat in proper way.

There are different methods of cheating - old traditional (fig.1) and new electronics methods (fig.2).

3.1.1Traditional old methods for cheating on tests:

- ***Cheat-Sheet Methods (fig.1)*** - *gathering the information you will need* - formulas, key words, vocabulary, dates, definitions, names, conjugations, etc.;*write or print the information correctly with proper fond,* clear to read (fig.1); c*opy it down* - copy down the spellings in your spelling book to a piece of paper, or fill the test on computer. This is a high risk method (fig.1).
    - ***Hide the sheet***(fig.1):
        - ***"Body Part Cheat-Sheet" method*** - instead of printing out the cheat sheet, try writing it on a part of your body;
        - ***"Water Bottle Cheat-Sheet" method*** - print out the cheat sheet on a colored piece of paper that matches that label of your water bottle. Paste it on the label and turn it so that it only faces you;
        - ***"Binder Cheat-Sheet" method*** - if you have a binder that has a clear slot in the front, slide your cheat sheet into there;
        - ***"Calculator Cheat-Sheet" method*** - save the math formulas into your calculator, into archive.Clear the memory after the test;
        - ***"Stashed Cheat-Sheet" method*** - hide a cheat-sheet in a separate place all together to avoid it getting connected back to you. This includes on a bulletin board in the classroom, in a bathroom stall or on someone's chair.

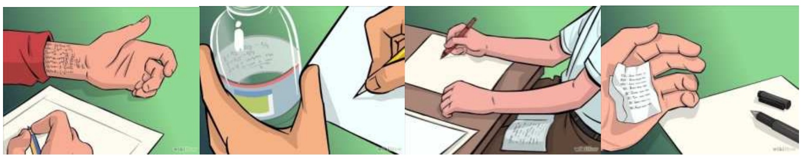

Fig. 1 Old classical high risk methods for cheating on a test *(http://www.wikihow.com/Cheat-On-a-Test)*

- ***Partner-Cheating Methods –*** the rule is "seat behind someone who will do well on the test". Students very often use that supporting their confidence methods.
- ***Hard-to-Prove Methods***

- ***"Getting correct answers"*** - find the correct answers to the questions. Before a quiz memorize the answers to the questions.
- ***"The Mechanical Pencil Method"***-there are plenty of ways you can sneak a cheat sheet into your exam; one of the best is in a mechanical pencil.
- ***Open parallel window on the computer with similar test –*** usually, students open parallel windows with quiz for self-preparation, so they look on that parallel open quiz and check for the correct answers.

3.1.2 New electronics methods for cheating on tests

There are about 12 methods for cheating with the help of electronics in the web classification:

- ***Internet Method –***e-tests in computer rooms, give good opportunity to search in Google, known as „***The Google Method***". Our practice shows that the only good way to prevent that cheating is to shorter the time of answer to a quiz, as example 1 minute per question in the test (if we have multiple choice questions).

Fig. 2 New Internet methods for cheating on exams
(http://www.wikihow.com/Cheat-On-a-Test)

- ***Calculator Method –***it is recommended to create a fake, password protected program and use the text box. One of them is "*The Graphing Calculator Method*" - this may be the oldest high-tech cheating method;
- ***iPod Bathroom Method -*** load your MP3 with audio notes and store it in a bathroom near your exam room; take your one bathroom break;
- ***Cell Phone Method –*** several methods exist; can attempt to text your friends, who should be waiting in front of a computer to help with certain questions. Can use it "*The Smartphone Notes App Method*",just add notes on your phone;
- ***MP3 Method Part –***one of the methods is using special program as for example speakonia off, text to speech program; Students from countries with different language than English will need other alternative programs. Second method - save the file as a .wav and put it in a MP3 player. The next method that can be use is record your notes with a microphone and put them on your MP3 player "*The Headphone in Sleeve Method*"(fig.2);
- ***Spy Earpiece Method–***that is the latest most popular methods of cheating in exams is with usage of a bluetooth spy earpiece and an inductive transmitter (fig.2, Scott, 2012).One option is like the MP3 player method above, you can record information and play it back, but there is no wired earphone, if you go for the bluetooth option then the connection is completely wireless and undetectable. Other option is to make a call before you enter your exam, then communicate with someone via the earpiece and a microphone that is built into the inductive transmitter.

3.1.3 Actual identified and presumed methods of cheating and bad practices during the conduction of electronic tests in our faculty

- ***First Method –*** Obtaining the correct test answers in the form of cheat sheets from the local university bookstore;
- ***Second Method –*** Shooting test with phone when the teacher introduced it into learning circumstances and subsequent processing of correct answers at home. Therefore I think the

test is a form adequate for current control after each lesson to verify the acquisition of knowledge, it is not a form suitable for examination;

- ***Third Method –*** Sometimes tests are made available for self-study at home. Even attempts to be limited in number, some working in teams students can replay all the questions and to obtain correct answers;
- ***Fourth Method –*** Despite the small chance, there are students practicing the method to appear an examination just in the name of sport, without being prepared, considering that the test form with multiple choice answers still gives them a chance to get to the minimum positive assessment;
- ***Fifth Method –*** Use of an outsider, the two people log during the test with the same username and password, one remote - from home, the other at the University. The person at home solves test, that one in the university simulates and switch between pages during the outsider solves test and a few minutes before the end the guy in the university closes the test. This can be prevented by using special settings in the administration of the test - test access can be limited to certain subnets on LAN or Internet by specifying a comma-separated partial or full IP addresses. This may be important when conducting enclosed tests to ensure that only the people in the room can only enter in the test.
- ***Sixth Method –*** Using a parallel opened browser and Internet during the test to find the right answers – this can be prevented with the use of filtering of network traffic and limit it only to the site with the test systemor use an account in the operating system, only for tests with very limited network access - only to the site or system with the tests;
- ***Seventh Method –*** Use knowledge of adjacent and claim to know colleague for helping in solving test;
- ***Eighth Method –*** Directly copying from lecture notes and exercises or mobile devices;
- ***Ninth Method –*** Receiving the rights and privileges of access to the questions of the test and the test itself from internal university source.

The test must be so designed and well thought out during its establishment at the time that attempts to guessing correct answers the student never received a positive evaluation, if he or she has not learned, and only rely on luck.

Our practice shows the correlation between success and the presence of students during lectures and seminars students and inversely proportional to their absence - attending students almost never fail the test, and those who did not attend during the classes cannot receive a positive evaluation.

4 Methods of well taking exams without cheating:

4.1Try to refresh information in the last minutes:

- For essays - *try to remember key words;*
- For math exams - *try to memorize formulas;*
- For multiple choice exams - *try "chunking" information you know will be on the test.*

4.2 Rules for study efficiently for exams

4.3 4.2.1Creating an Environment of Learning

- ***Make sure you are studying in a clean, quiet and orderly room;***
- ***Turn on the light! –***Brighter and oxygenated room is better for focus and study.
- ***Turn the TV off -*** The combination of visual and audio stimuli will likely reduce your studying performance, as it makes it more difficult for your brain to prioritize information acquisition (rapidly swapping attention between studying and watching TV). It may be beneficial to begin studying with the TV on in the background, and then turning it off once you're under way.

- ***Decide if music is right for you*** **-** music can make studying more enjoyable, and in the same way detracting from memory performance. Music's effect on memory performance varies between individuals.
  - *If you absolutely must listen to music, find instrumental music so that the words in the music don't interfere with your studying.*
  - *The idea that listening to Mozart or classical music makes you smarter or keeps information in your brain, by the way: total myth.*
- ***Get plenty of rest the night before*** **-** poor sleep has been found to accumulate. Severalweeks of daily optimal sleep may be required to return to optimal performance.
- ***Eat a healthy, light meal*** **-** take a balanced breakfast full of lean protein, vegetables, omega-3 fatty acids, and antioxidants.
- ***Get to the exam room with time to spare*** **–**being in theexam room five to 10 minutes before the exam starts, in order to gather your thoughts before starting the exam.

4.2.2 How to study efficiently
- ***Find the right hours*** **-** don't study when you're tired, better take a good night's sleep after studying for a short time. You won't remember much and you're likely to see a performance drop the next day.
- ***Start as early as possible*** **-** study when you have a chance. Studying before and going over it multiple times really is the best way to learn the material. This is especially true with things like history and theoretical subjects.
- ***Study for your learning style*** - If you're a visual learner, using pictures can help. Auditory learners should record themselves saying notes and recite it afterwards. If you are a physical person lecture to yourself (out loud) while also using your hands or moving around; this way it will be easier for you to memorize.
- ***Different subjects call for different studying*** **-** Working problems out will help burn them into your mind, and remember: if you can't solve the problem before the exam, you won't be able to solve it on the exam either.
- ***Pay attention while you're learning to begin with*** **-** pay attention in class,teachers often give hints like "The most important thing about this topic is...“.

4.2.3 Organizing Your Learning
- ***Plan ahead*** **-** is good to organize your study, always create a schedule;
- ***Create a timetable*** **-** ensure that you cover all the topics and left time for regular breaks, relax and exercise;
- ***Do some research on the exam*** **–**format of a test, how many questions, what types (open, closed, calculating, solve a problem, essay and etc.), how it will be graded, etc. Usually all students are informed well about that in the beginning of a subject from the lecture;
- ***Write yourself a study guide***–rewrite the most important information, highlights it;
- ***Use your notes*** **-** a kinesthetic learner benefits from that. Also, when you re-write something, you assimilated what it's about; you refresh your memory, but it is important to be sure that you understand what you are trying to learn.

4.2.4 Keeping Motivated
- ***Take breaks*** **–**always take a break, usually, 20-30 minutes of study and then a 5 minute break is the most effective method.
- ***Think positive but work hard*** - think positive, self-confidence is important.

- ***Work with others*** - that help you cover gaps in your own knowledge and remember more information.

5 Consequences of cheating *vs*to be well graduated

The consequences of getting during cheating are very severe, but that cannot stop using high and low-tech ways for trick way to agreat score A (Scott, 2012).Anyway, it is important teacher to demonstrate to students why it is important for them to know the material (Neils, 2012).

Tightening the rules on classroom behavior during exams seems like the most obvious and readily available solution (Buchmann, 2014). Placing cam in the computer room, so students will know that they are all time under observation. The University of Central Florida has a testing center designed to prevent, or at least limit, cheating on campus. Exam proctors record everything suspicious, measures are taken to prevent students from photographing a test, and students aren't even allowed to chew gum as it provides a way to hide that they're talking into a hidden microphone (Buchmann, 2014).

6 Conclusion

The information on cheating is beneficial to all individuals working in higher education (McCabe et al., 2012). Moreover, the variety of tactics used to cheat illustrates the creativity and ingenuity of students today (Shon, 2006). Cheating offers an easy way out. Anywayremoving the desire to cheat is the least immediately practical but most assured way of encouraging academic integrity (Buchmann, 2014).

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Two Effects of the Digital Textbook Design on the Metacognitive Strategies

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Abstract

Globalisation changes traditional vision about cognition and metacognition. Cognition and metacognition requires learner-centered learning environments. Moreover, the modern learning is influenced by the digital content challenges. The aims of this study are to explore students' opinions about metacognitive strategieswith digital textbooks in diversity of learner-centered learning environments. This article reviews scientific literature to shed some light into the relationships between metacognition as a part of the self-regulated learning process, metacognitive strategiesused individually by learners and digital textbooks interface design. It was found that metacognitive strategies are indispensable element of digital textbooks functional structure. To relate theory to educational technology, a survey was designed for students engaged in reduced frequency courses at Ioan Cuza University of Iasi, Romania.The results indicate two effects of the digital textbook design: reproductive learning and self-regulated learning.

Keywords: Digital textbook, self-regulated learning, metacognition, metacognitive strategies

Introduction

Investigations have shown that "metacognition plays an important role in oral communication of information, oral persuasion, reading comprehension, writing, language acquisition, attention, and memory, problem solving social cognition, self-control and self-instruction"(Flawell, *1971, p. 906*). Many researches have completed this work, emphasizing also the interdependences between digital textbook and metacognition (Yang&Teng, 2014; Krabbe, 2014; Kivunja, 2014;Railean, *2014b*etc.).

At its most general level, the digital textbook is: a) a *digital/ digitalised version of a printed textbook* and b) an *Open Source Textbook*. There are many tendencies in the use and development of digital versions of printed textbooks: digitizing the existing textbooks, developing textbooks in digital form, developing open source textbooks collaboratively, developing personal digital textbooks using authoring tools etc. Digital textbooks are designed as *eTextbooks* and *Open Textbooks*. eTextbooks represent "a technological innovation with need to use ICT as the medium through which textbook content is delivered" (Feldstein&Lewis, 2013, p. 179). The Open Textbook is "the open accessible content, which allows anyone to edit individually or collaboratively, and give it away for free reading on the Internet" (Acker, 2011, 47).

Digital textbook design directly influences the *metacognitive strategies.*To prove this hypothesis a surveywas designed using *Google Drive Form*. This experiment extendsthe ideas of MetaSystems Learning Design with a) knowledge management model; b) instructional dynamic and flexible strategy and c) digital textbook in learning portfolios(Railean, *2012*; Railean, *2013*; Railean, *2014a*). Starting from the theoretical approaches of metacognitive strategies (Volet, *1991*; Lysenko&Abrami, *2014*; Lawrence, *2014*etc.)was shownthatin design of eTextbooks*reproductive* *learning strategies*are used, but, in design of Open Textbook – *self-regulated learning strategies* are used. Therefore, reproductive learning and self-regulated learningare two main effects that correlate Digital Textbook Design with the metacognitive strategies. The term “reproductive learning strategies”defines strategies based on rote memorization and reproduction of *a priori* or new anchored knowledge. In learning with digital textbooks students apply these strategies mostly to memorize new concepts or definitions. The term “self-regulated learning” refers to some rather specific ways that learners take control of their own learning. Winne (*2014*) notes that self-regulated learning is metacognitive.

Related works

The key definitions of metacognition is "knowledge and cognition about cognitive phenomena” (Flawell, 1971, p. 906) and “knowing about knowing” (Metcalfe and Shimamura, 1994). Metacognition refers tohigher order thinking which involves active control over the cognitive processes engaged inlearning. Activities such as planning how to approach a given learning task, monitoringcomprehension, and evaluating progress toward the completion of a task are metacognitive in nature (Livingston, 2003, p. 2).

More recently studies about metacognition refer to dual systems, consisting from a cognitively “learn” system, which operates implicitly and is for the control of processes with one agent (intra-personal cognitive control) and a cognitively “rich” system, which is unique for humans and is for the control of processes with multiple agents (supra-personal cognitive control), as was related by Shea *et al.* (2014).

Metacognitive processes are strongly related to learning and learning performance (Stankov and Kleitman, 2014; Veenman, Bavelaar and De Wolf, 2014; Kleitman and Costa, 2014; Bransford et al. 2000; Zimmerman, 2001). On one hand the metacognitive skills regulate and control learning processes (Veenman, Bavelaar, De Wolf and Van Haaren, 2014). On the other hand, students are required to master their own learning processes, which includes metacognitive, motivational and behavioral processes (Lehmann, Hähnlein and Ifenthaler, 2014). A large body of literature shows that cognitive affective theory of learning from media is intended to better incorporate motivation and metacognition into theories of multimedia learning (Mayer, 2014; Moreno, 2005 etc.).

Researchers have demonstrated that *metacognitive processes can be developed through practice and appropriate scaffolding*(Kinnebrew, Segedy and Biswas, 2014, p.1). When applied to learning situations, metacognition, as in evidenced by Kinnebrew, Segedyand Biswas (2014, p. 1), encompasses:

- the knowledge and control learners exhibit over their thinking and learning activities;
- awareness of one’s own thinking and conceptions;
- active monitoring of one’s cognitive processes;
- an attempt to control and regulate one’s cognitive processes to support learning; and
- the application of heuristics or strategies for developing one’s own approach to solving problems.

Walker (2014) putts a metacognitive approach into action. In was presented two groups of activities for metacognitive instruction: integrated experiential listening tasks and guided reflection activities. The activities are designed for use during the pedagogical sequence outlined in the previous chapter, and to help learners to better regulate the metacognitive processes they need to apply for successful listening.

Metasystems Learning Design

The MetaSystems Learning Design is focused on learning design based on cognitive, affective and psychomotor integrity. This means that authors of the digital textbooks need to think not only about the content and structure of the textbook, but also about the user interfaces, including consistencies of screen design, changing colours, font sizes as well as how users will learn and self-assess knowledge and/or skills. The core theoretical idea of MetaSystems Learning Design was generated by Klir (1990). Therefore, in MetaSystems Learning Design of digital textbook "meta"should be used for *systems of systems*, which are more organised, have higher logical structure and can bemeta-analysed. For example, if digital content aims to provide understanding in learning of new concepts is a multimodal text, a feedback loop with delayed feedback should be added. Otherwise, if the content of digital textbook aims to summarise concepts, a feedback loop with immediate feedback should be designed.

The principles of MetaSystems Learning Design are the following:

- self-regulation (the automatic regulation of learning processes through activation of metacognition using didactical and psychological methods, cybernetics techniques and management systems);
- personalisation (the individualization of learning objects through increased formation of the individual as a self and as a member of global learning community);
- feedback diversity (electronic educational context needs to be evaluated through immediate and delayed feedback);
- clarity (the formation of structural skeleton content with powerful interconnected concepts);
- dynamism and flexibility (the learner' active inclusion in elaboration of the content in order to provide the competence development skills);
- ergonomics (ergonomic interfaces and ergonomic places of work).

Future research can be conducted on analysis and development of metasystem thinking based on integrated structure of competences with savoir–vivre architecture according to students' cognitive and metacognitive development in real and virtual learning environments.

Experiment

Students who have a secondary job in psychology was engaged in University Education. They receive all materials during distance learning courses and attend face-to-face (F2F) education for short-time courses, communication and exams. These reduced frequency courses allow working students to learn individually, using F2F system, and distributed learning system. The central role is attributed to educational technologies and self-regulated learning skills. From the distributed learning perspective, it can be identified evidences on the convergences of F2F traditional methods in using of additional resources for learning, for example open source digital textbooks, eTextbook, social media and others. In addition, there is greater emphasis on cognition, metacognitionand metacognitive strategies.

Participants

Thirdly-two second year students from Department of Psychology and Pedagogy, Ioan Cuza University of Iasi, Romania participated in this experiment. Regarding age, the majority of participants were 30-40 years (45%); eleven participants were 20-30 ages (35%), four of the participants were 40-50 ages (13%); one (3%) has more than 50 years and one – less than twenty. The majority of students was engaged in distance learning courses, including Massive Open

Online Courses (MOOC). Before engagement in university learning psychology and pedagogy courses at the University, they finished other University (32%); college (10%); lyceum (48 %) and other institutional forms (10%). They are distance students more than one year (90%) and less than one year (10%). Each participant was engaged in distance learning education. Same of the participants are familiar with digital textbooks and same not. The participants that are familiar with digital textbooks use them to read additional information related to studied topics.

Method

Participants of the experiment were invited to complete a survey. Firstly we explained who collect the data, why, and the confidentiality of the information. We discussed the survey length and estimated time required to complete and send the information.

The survey consisted of 16 closed-ended and opened-ended questions, divided into general and opinion questions. The questions were designed as to be relevant to participants, following a logical flow from simple to complex. In some cases simple questions were grouped together. The closed-ended questions included five-six possible questions and option "other". This allow participants the possibility to complete the answers with reflections about the interdependences between digital textbook design and metacognition. Theoretically, open-ended questions did not provide the specified answer. The example of such question is: *What characteristics, in your opinion, should have a digital textbook aimed to develop metacognition?* It was estimated that open-ended questions will provide new data about attitudes of participants regarding the investigated subject "Metacognition and digital textbooks".

The language and notions were choice to be familiar to participants. However, in some cases to avoid confusions, definitions were used throughout the survey. The sensitive questions requiring personal information about learning track of the participant during distance learning were included at the end of the survey.The questions were short, easy to be read and to answer. The consistent rating scale was taken into consideration during the design phase by providing an equal number of positive and negative response options and Likert scale. Each point of the Likert scale represented a response scale ensuring clarity and equal weight to each of the response options. The majority of questions were objective and included single or multiple choice questions. The answers allow a choice of single or multiple answers, respectively. Two questions required the ranking of potential choices by a specific characteristics. The role of these questions is to provide insight into how important is the metacognition and knowing of metacognitive strategies for comprehension of the oral and written messages and how the metacognitive skills could be developed with metacognitive strategies. In the designing of these questions was used a rating scale. The responses ranged from "strongly agree" to "strongly disagree" with five total answer options. Each option was ascribed a weight (1 = strongly agree, 5 = strongly disagree and 3 = nether agree nor disagree).

Procedure

The survey was designed using Google Form template. Initially was created a Form and then, was send a link with directed survey to all participants in the experiment. The responses were collected and analysed using Google Docs spreadsheet. This allow to view the total number of responses and summary of responses.

Results of the experiment

The results of the experiment can be divided into three main categories:

a) results related to students' knowledge about digital content and metacognitive strategies;
b) results related to students' attitudes about metacognitive strategies;
c) results related to students' skills related to metacognitive strategies through digital textbooks.

Results related to students' knowledge about metacognition

The most of the closed-ended questions rely on metacognitive strategies used in distance learning courses. The first questions used to ask students what strategies were used by students for learning. It was found that most of the students have used *Web lecture* (33%). According to Day and Foley (2006, p. 420), when is using Web lectures to present lecture material before class, more in-class time can be spent engaging students with hands-on learning activities-using class time for more learning by doing, less learning by listening. The second grouprefers to *active learning* (27%), one of the most used strategies. Theoretically, the active learning strategies require metacognitive skills and are used by individuals, who solve the problems properly, can "easily recognize the imperfections and lapses in their thinking, express their thinking processes clearly, and revise their activities" (Akbaria, Khayerb and Abedi, 2014, p.224). Practically, however, the active learning strategies are used by teachers or specialists in learning design of digital content or/and environment allowing immediate feedback. The average used strategies are *case study* and *blended learning*. The case study can be considered a metacognitive strategy when involves doing in-depth investigation of a subject by a single person or by a group in learner-centered learning environment. The blended learning is another metacognitive strategy when the student reflects about his or her own cognition after reading at least a part of the online delivery of content, with some element of student control over time, place, path and/or pace, plus at least in part is supervised brick-and-mortar location away from home and the modalities along each student's learning path within a course or subject are connected to provide an integrated learning experience. In addition, the less used strategies are *group discussion* and *cooperative learning*, which was chosen by the less of the 5% of students (figure 1).

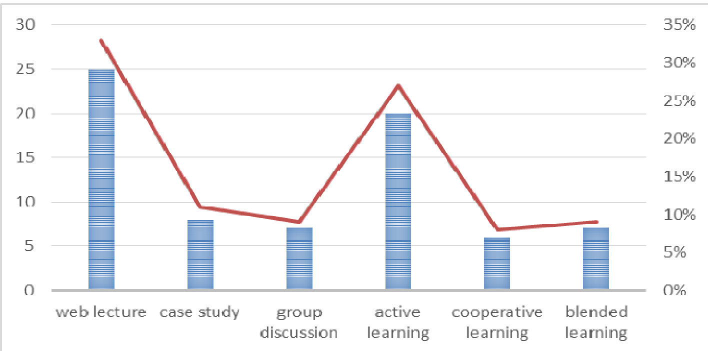


Figure 1. Prcentage of students using Web lecture versus cooperative learning

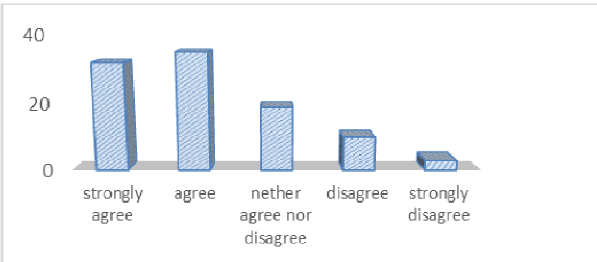
The second question relies on strategies used after reading a textbook with digital and interactive content. It was found thatmajority of students (38%) will review the studied material and will make notes. However, only 25% of students will reflect about the matter studied, discussing with colleagues; 22% will elaborate a concept map; 9% will read again and 6% will use other metacognitive strategies. In addition, the most efficient way to lean is teaching of appropriate content and knowing learning methods and techniques (38%). Moreover, only 16% of participants emphasis the role of generalizations and conclusion for learning. Our assumption is that students don't like to makejudgments, opinions, evaluations or generalizations, because this issue is not explained and experimented by the teachers. Students don't have developed self-regulated learning skills, don't know how to apply metacognitive strategies or how to explore generalizations. Examples of questions for generalizationsand conclusion are:

- What generations can be made based on the reading selection?
- Is this statement a valid generalization or/and conclusion?
- Why do you think so?
- What other theoretical studies and experimental data prove your conclusion?

More surprising is the factthat students don't belief that identification of a priori knowledge or visualization of learning analytics are the effective strategies for learning. Only 9% of participants believe in this idea. In addition, only 3% of participants agree that development of attitudes toward personal skills (communication, writing, scientific presentation of ideas etc.) are important. On the other hand, attitudes, values and believes are very personal. They form the basis for how to develop metacognitive strategies.

Results related to students' attitudes about metacognitive strategies

Two main questions help us to understand the students' attitudes regard metacognitive strategies. The first question is: *According to researches metacognitive skills can be developed. How much do you agree with this idea*?The second question is: *How much are you agree with ideathatmetacognition contributes to the understanding of oral messages and writing, problem solving and decision-making on complex tasks, training of attention, memory and self-control?*Astonishing, but surveys provide similar results in both cases. 35% of participants are agree that metacognitive skills can be developed and that metacognition contributes to the understanding of oral messages and writing, problem solving and decision making etc. In both cases 32 % agree with provided ideas (figure 2). Therefore, results indicate about the issue related to development of metacognitive strategies and those practical application on the base on concrete practical application.



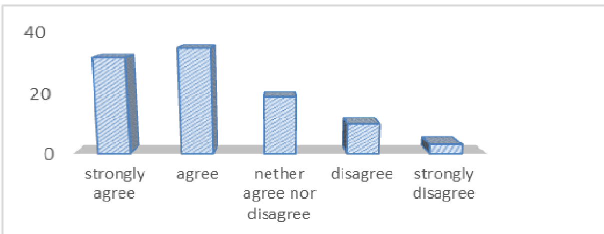


Figura 2. The results of attitudional questions

Additional questions explore activities required in a learning environment. The concept of learning environment is understood as "a place or community in which a number of activities are occurring with the purpose of supporting learning and those actors can draw upon a number of resources when doing so" (Midoro, 2006, p. 42). Therefore, the third question relies on collaborative learning methods in virtual learner-centered learning environments. The most of students (81%) agree that metacognition can be developed in virtual learner-centered learning environments, and 19% - are not. In such environment are used digital textbooks, both a digital/ digitised version of a printed textbook and Open Textbooks. According to definitions digital textbook is a textbook-length publication in digital form, consisting of text, images, audio, video, interactive features etc., and produced on, published through, and readable on computers or other digital devices. The Open Textbooksare "textbooks that are made freely available online for faculty and students to use, modify and reuse through non-restrictive licensing. Open textbooks are most frequently highlighted as alternatives to traditional textbooks for their cost and accessibility benefits. Through nonrestrictive licensing and accessible technology, open textbooks – like open educational resources, more generally – are also oft-cited for their potential to facilitate a community of users who collaborate, share, discuss, critique, use, reuse and continuously improve educational content" (Petrides, Jimes, Middleton-Detzner, Walling and Weiss, 2011, p. 39-40).

But, it is possible to replace printed textbook with digital textbook at least in University Education? Analysing the students' answer allow to coincide that digital textbook will replace printed textbook in the near feature (84% of participants agree with this idea versus 16 % - are not). Moreover, "for efficient learning environment <…> will provide tools for synchronic and asynchronic communication, tools for taking notes and storing this in individual and collective journals". How much are agree with this statement? 35% of students agree and 26% are strongly agree with statement. However, 32% are nether agree nor disagree. Moreover, the technique of strategic question is most used in metacognitive strategies. 39% of students agree and 39% - nether agree nor disagree with this statement.

What could be, in your opinion, the contribution of digital textbook for theory of metacognition? This question is focused on understanding the digital textbook research area. It was found that multimodal text extents the features of digital content through hermeneutic dialogue and exploration of learning objects with digital devices. In our understanding multimodal texts communicate message using more than one semiotic modes or channel and could be easy personalised.Therefore, is important to integrate in digital content relevant techniques for metacognitive strategies (32%). Secondly, is important to design relevant interactive multimodal content (26%). Less important is the possibility "to personalise" digital content from study units (19%); to present the progress in learning (13%) and to use techniques for diagnostic which of the metacognitive strategies were used (11%).

Results related to students' skills to develop metacognitive strategies using digital textbooks

The questions in this category relies on digital textbook with metacognitive strategies. According to students' opinions the most efficient way to learn is to attend a well-taught course (28%); to know the most relevant metacognitive strategies (28%) and to make generalizations and conclusion (16%). Pre-assessment of a priori knowledge and skills, visualization of learning analytics and development of personal attitudes are not so important. In addition, a digital textbook with features which may contribute to the development of metacognitionshould bea tool for teaching/learning/assessment with techniques allowing generalizations andconstruction of relevant conclusions (39%) and learning analytics (29%).On the opposite is digital version of scholar textbook (0%). Less important is to design a manual for understanding (objects, phenomena and complex processes)or that will allow the possibility to complete the gap in knowledge (22 and 10%, respectively). The result of the second study is presented in figure 3.

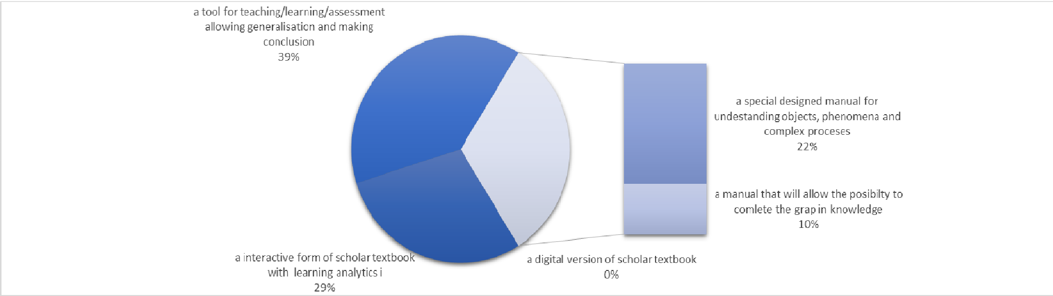


Figure 3. The effect of digital textbook design on metacognitive strategies

What features do you think should meet a manual focused on developing metacognition? This is an open-ended question, the answers of which allow to coincide that a digital textbook aimed to develop metacognitive skills should have simple, conciseand interactive content with relevant practical examples or/and tools for practical applications of theoretical concepts. The digital textbook should motivate students to learn and understand the content through self-exploration of textual, audio, video and multimodal content without F2F interventions of a university teacher. The logical structure of digital content should allow personalization, place(s) for insight on the base on experiments completed with digital photos, videos etc.

The most significant difference between tasks designed for cognitive and metacognitive development consists indesign. Students agree that the most important solution for this issue is *learning design* (45%); *instructional design* (42%)and, finally, *a didactic model* (13%).

CONCLUSION

The results presented in this article provide evidence that digital textbook design correlates with metacognitive strategies and that there are two main effects: reproductive learning and self-regulated learning. In our work of investigating students' opinion regard learning with digital textbook, it was designed a survey using Google Drive Form. Analysis of the data revealed some interesting results. Most importantly, the results related to students' knowledge about metacognition, show that students prefer web lecturer, active learning, and case study and blended learning. There are two less used strategies during metacognitive learning: group discussion and cooperative learning.

"Metacognition is not a linear process that moves from preparing and planning to evaluating" (**Anderson, 2002, p. 5**).This statement was proved also by our students. After reading a textbook, students prefer to review the studied material and make notes, then to reflect about the matter studied, discussing with colleagues; to elaborate a concept map; to read again or to use other metacognitive strategies. However, these results contradict with a model of metacognition describing metacognitive strategies through five components: preparing and planning for learning, selecting and using learning strategies, monitoring strategy use, orchestratingvarious strategies, and evaluating strategy use and learning. According to students' opinions there are efficient ways to lean: a) teaching of appropriate content and b) knowing learning methods and techniques. Only 16% emphasize the role of generalizations and conclusion. More surprising is the fact that students don't believe that identification of a priori knowledge or visualization of learning analytics are the effective strategies for learning and that development of attitudes toward personal skills (communication, writing, scientific presentation of ideas etc.) are important.

A significant component of this research involved analyzing students' attitudes about metacognitive strategies. It was argued that metacognitive skills can be developed and that

metacognition contributes to the integrated structure of competence. The complex processes of learning requires diversity of learning environments. For such environments students prefer collaborative methods and digital lectures. However, the brain interprets printed and digital text differently. Research has shown that people generally read digital text 20-30% slower than print. Moreover, people who read print text comprehend more, remember more, and learn more than those who read digital text. Asking students about these ideas, it appears that digital textbooks will replace printed textbooks in near future. The contribution of digital textbooks for theory of learning consist on metasystems approach of learning design, based on multimodal text with knowledge graph structure, allowing hermeneutic dialogue and personalization of content.
In summary, the proposed survey has allowed us to identify two effects of the interdependencies between digital textbook design and the metacognitive strategies: reproductive learning and self-regulated learning. Future work is needed to investigate the construct validity and other psychometric proprieties of the measure of metacognition and metacognitive strategies.

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Virtual Learning Environments, Blended Learning and Teacher Intervention

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Abstract

This paper presents the findings of a study at a "new university" in the UK, in a context of precariousness of languages and expansion of "Technology-Enhanced Learning".Conducted from a phenomenological perspective and in association with socio-constructivist principles, the study investigates students' experience of the Blackboard VLE on a blended learning module.A mixed-method approach was adopted based on 96 questionnaires and 6 interviews, leading to an interpretive analysis of data.Findings indicate that, although participants may be considered as digitally literate, their response shows difficulties in the transferability of skills to formal learning contexts. Therefore, lecturers need to guide students in a structured manner in order to maximise their engagement with the VLE.

Keywords: Blackboard, Blended Learning, Pedagogy, Scaffolding

1 Introductory remarks

1.1 Context of the research

This study was conducted in a context of precariousness of languages in the United Kingdom and promotion of technology-enhanced learning at national level.

The targeted institution, a "new" university in the United Kingdom, aims to promote the quality of the students' experience, their use of technologies and a greater access to resources, (Targeted institution 2010a, 2010b, 2010c, March 2011). The targeted department offers accredited modules in various languages to students of all faculties, as well as members of the public. All the modules last twelve weeks, include three hours of lectures per week and the use of Blackboard. Data for this study was obtained from students of elementary French. All participants had at least one semester's experience in using Blackboard for French at the time of the data collection. Materials are organised in folders such as "what we do in class", "to do after class" etc. Communication tools are exploited with various degrees of intensity by lecturers. All groups are taught in classrooms with multimedia facilities. Blackboard is operated by lecturers only during lessons but students are normally taken to the self-access centre for web-based activities early in the semester.

1.2 Rationale for the study

The National Student Survey for 2013 indicates that, at national level, 84% of participants are satisfied with the learning resources presented to them.Students at the targeted institution fill in a standard university end-of-module questionnaire, which only includes a couple of questions on Blackboard. Over 88 % of beginners and 71% of post-beginners of French responded positively to Blackboard and considered it useful.

There is an identified need for a greater knowledge of the students' experience of Blackboard linked to a valuable opportunity for reflective practice (Ellis 2012:26)

2 Key concepts

2.1Blended learning

Several authors (Littlejohn & Pegler 2007; Mason & Rennie 2006; Motteram & Sharma 2009) give their definition of blended learning. Littlejohn & Pegler's (2007:1) report that blended learning involves a range of combinations of resources and activities, taking into account socio-constructivist principles, which I feel currently occupy an important position in the educational discourse. Mason & Rennie (2006:12) provide us with their own definition of blended learning, giving examples of possible combinations:

"The original and still most common meaning refers to the combination of online and face to face teaching. However, other combinations of technologies, locations or pedagogical approaches are increasingly being identified as examples of blended learning".

Blended learning is more and more frequently associated with e-learning. Garrison & Vaughan (2008) stress the interest of blended learning from a transformational perspective, highlighting the need to create more engaging experiences for students. Garrison (2011:78) goes on to say that "blended learning is about actively involving all participants in the educational enterprise. It means moving away from using scarce face-to-face time for information transmission", recognising the importance of the integration of face-to-face and e-learning activities (2011:75).

In addition to the definitions of blended learning (Mason & Rennie 2006; Littlejohn & Pegler 2007; Motteram & Sharma 2009), issues of interest concern connections between blended learning and socio-constructivist principles (Littlejohn & Pegler 2007), the value of student engagement (Garrison & Vaughan 2008) and the necessity to review pedagogical practices (Garrison 2011).

2.2 Normalisation of technologies and digital literacies in formal learning contexts

Within the education context, Gillespie (2012:131) considers a triangle between students, lecturers and institutions, seeking to "discover what the past can teach us about how students, teachers and institutions react to change both technical and pedagogical […] and what key principles apply in the adoption of new strategies of teaching and learning." Although, unlike Hampel & Stickler (2005), Sharpe & Beetham (2010) and Salmon (2002&2011), Gillespie has not actually drawn a representation of his model, I find his vision of a triangle between lecturers, students and institutions a very interesting concept. Gillespie's triangle, which he discussed at the EUROCALL conference (2012), includes an angle which I consider as essential to a successful learning: the lecturer, who transmits not only subject knowledge, but also gives guidance on how to learn, together with a human element both in and out of the classroom. Omitting the lecturer would produce a straight line (institution-students) which unfortunately can potentially take the form of a vertical line with a top-down approach.

Ellis & Goodyear explain that students' habits have changed but also warn that "there is little evidence to suggest that students understand, or are demanding access to, some of the more varied and powerful ways of learning that IT can open up" (2010: 40).

Warschauer & Matuchniak (2010:179) confirm that "there is broad consensus among educators, communication scholars, sociologists and economists that the development and diffusion of Information and Communication Technologies (ICT) are having a profound effect on modern life."

With an ever-increasing normalisation (Bax 2003, 2006a, 2006b; Chambers & Bax 2006), various researchers stress the significance of changes in habits and expectations among students (Littlejohn& Pegler 2007:2).

Bax (2011:5), as well as several other authors, refers to Vygotsky and the social dimension of learning (Lamy & Hampel 2007, Woollard 2011, Herrington et al 2010, Harasim 2012, Laurillard 2012 and Coleman et al 2012). Pachler & Daly (2011) also recognise that technologies are increasingly normalised in our daily lives and in Higher Education and that, therefore, we need to engage with these changes in order to meet students' needs and expectations.

Tammelin et al agree that students from the "net generation" do not necessarily possess the required e-learning skills in a context of shifting paradigms from a teacher to a learner-centred approach. They believe that "e-learners need guidance in making them aware of what skills they need and how their roles as e-learners may differ from their traditional classroom roles" (2008:77).Walker et al (2010:213), in agreement with Ellis & Goodyear (2010) and Tammelin et al (2008) express concerns regarding learners' ability to transfer e-learning skills to formal learning situations.

Key points of this section are related to the transformational nature of technologies (Bax 2003, 2006a, 2006b; Chambers & Bax 2006; Littlejohn & Pegler 2007; Warschauer & Matuchniak 2010; Pachler & Daly 2011). The notion of transferability of digital skills to formal learning situations is also of interest to this research (Haythornwhite 2007; Tammelin et al 2008; Ellis & Goodyear 2010; Walker et al 2010).

2.3 Socio-constructivism, scaffolding and teacher intervention

Various researchers mention the necessity to change our learning and teaching environments (Jung & Latchem 2011) and to innovate in a context of ever-increasing normalisation of technologies, with a view to provide engaging learning experiences (Garrison & Vaughan 2008). Conole & Alevizou (2010) report on the changing of learning and teaching, as well as strategies to promote the use of technology. The social dimension of learning seems to be prominent in the current educational discourse. Mason & Rennie (2006:31) explain that we need a structure to learn, that new knowledge is based on previous knowledge, and comment that "learning is a social activity: our learning is intimately associated with our connection with other human beings, our teacher, our peers, our family, as well as casual acquaintances."

Williams & Burden express views similar to those of Mason & Rennie and show the importance of the context or environment where the learning experience takes place, indicating that they have identified "4 key sets of factors which influence the learning process-teachers, learners, tasks and contexts." (1997:43)

Harasim (2012:67) explains Vygotsky's concept of ZDP (Zone of Proximal Development), declaring that "learning takes place when learners solve problems beyond their actual developmental level – but within their level of potential development- under adult guidance or in collaboration with more capable peers."

Apart from Harasim (2012), several other authors have adopted Vygotskian perspectives and referred to the social dimension of learning (Herrington et al, 2010; Bax, 2011; Woollard, 2011; Laurillard, 2012 and Coleman et al, 2012).

Harasim (2012:72), as part of her explanation of Vygotsky's Zone of Proximal Development, defines the notion of scaffolding as follows:

Scaffolding refers to specialised teaching strategies or tools designed to support learning when students are first introduced to a new subject. Scaffolding gives students a context, motivation and foundation from which to understand the new informationColeman et al (2012:164) stress the importance of the learning environment, taking into account principles of scaffolding:

"The learning environment provides the starting point for the language learner to make choices; engage with materials, tutors, and fellow learners; and create a learning event. "Scaffolding", a term based on further developments of Vygotskian thoughts, can be provided by various means; through the teacher, through the structure of the materials, and through support from peers".

Mason & Rennie (2006) believe in the need for scaffolding in order to support students' adaptation to web-based learning, and gave examples such as training courses and inductions to allow students to familiarise themselves with the e-learning environments and approaches. The social dimension of learning, the necessity for student support and the notion of scaffolding are recommended by Salmon (2002 & 2011).

Laurillard's conversational framework constitutes another essential framework of reference, especially about the interaction between learners and teachers, a process which goes back and forth between learners and teachers, and is guided by teachers as "it is the teacher who takes responsibility for "eliciting from the student a new way of experiencing a concept, which is constituted in the person-world relationship." (Laurillard 2002:77)

3 Methodology

This study presents itself as a piece of applied research, which focuses on the notion of students' experience of Blackboard. It relates to the notion of informed and reflective practice and may help to improve the e-learning provision presented to students and to contribute to the staff development programme at the targeted institution.

It concentrates on students' perspectives and their accounts of their experiences regarding Weblearn in connection with the self-study element of their French module.

The data collection tools include student questionnaires with a combination of closed and open questions, completed by 96 students as well as 6 follow-up interviews with volunteers. More information is available on my microsite (http://ticheler.blogspot.com)

4 Snapshot of the study

Over 75% of students describe Blackboard as easy to use, convenient and useful, especially if they have used it before in other subjects. Nearly 70% are satisfied with the layout and nearly 80% of participants are satisfied with the contents. Differences in students' satisfaction are visible when the data is considered in connection with the various tutors. Satisfaction with the provision for homework, which includes written tasks, varied greatly according to the tutor. Only a third of students report they follow tutors' guidance on study skills and how to use Blabkboard. There appears to be a greater spread of practices such as note-taking when data is considered in connection with tutors. Nearly 90% of participants report a high level of confidence in their use of Blackboard and here again differences emerge in relation to the various teaching groups. However, interview data as well as their response to open questions indicate that they welcome the tutors' guidance.

5 Recommendations and conclusion

Although students are generally considered as digitally literate, they may not always easily transfer their digital competence to formal learning contexts. This may apply even more in a context where the subject, and the module contents and approach, are new or fairly new to them.

Indeed, they reveal a lack of awareness of the potential uses of Blackboard, especially its communication toolswhile web-based communication tools appear as increasingly popular. Participants to the study welcome the integration of lectures and self-study and are keen to be guided by lecturers. Some of them mention alternative learning preferences, such as the use of printed materials, and the desire to keep the use of tools such as blogs to their own private life. These findings correspond indeed to previous research which shows that digital literacy does not necessarily transfer easily to formal learning contents. They also suggest there is a need to assess carefully students' level of digital literacy in formal learning contexts, as well as their general and language learning skills, as the transferability of skills cannot be assumed. This should be done not only at the start of the module but also more informally throughout the course. In addition, I would recommend seeking regular feedback in order to achieve a higher degree of engagement.

Lecturers have a central role to play in students' use of Blackboard. Adopting it as part of the class routine and guiding students every step of the way are likely to lead to a greater normalisation among students. This can be done in various ways, such as briefing students on the blended nature of the module and organising a hands-on demo at the first session, focusing not only on the various functions but also on what to do as learners. I find it important to use it as a preferred tool of communication, with specific reference to these communications in class. In short, the key is to embed e-learning in regular learning and teaching activities, in hand with careful scaffolded training. These practical recommendations are based on the following theoretical models: Vygotsky's Zone of Proximal Development, the Model of Teaching and Learning Online (Salmon 2011) and the Developmental Model of Effective E-learning (Sharpe & Beetham 2010). There is a need for lecturers to integrate this perspective, in a context where digital learning design should facilitate the shift towards learner-focused activities, taking fully into account and promoting the social dimension of learning, based on previous research and theories such as Vygotsky's socio-constructivist principles.

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Some Issues Regarding the Recognition of Learning Outcomes

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Abstract

Our age is called "digital age" due to the technological advances in Information and Communication Technology (ICT) use, especially in forming the knowledge society. Thanks to ICT, people are constantly learning everywhere and at all times and this new learning leads to additional skills, knowledge and/or competences for all individuals. Considering the lifelong learning concept, all individuals, adults in particular have Access to learning sources at home, at the workplace or elsewhere in addition to the formal teaching and learning settings. However, learning that occurs outside the formal learning system is not well understood, made visible, appropriately valued or officially recognized. This paper aims to focus on the issues related with the recognition of the informal and non-formal learning outcomes in some Organization for Economic Co-operation and Development (OECD) countries, focusing on a report produced for OECD.

Keywords: formal learning, informal learning, non-formal learning, recognition

1. INTRODUCTION

In general, education is classified as formal education, informal education and non-formal education. Formal education is regarded as the official education system and the educational organizations applying the official curriculum. However, non-formal education and informal education do not have a clear-cut definition. To avoid the slips of meaning and content due to the confusion in content, Colley, Hodkinson and Malcolm (Helen Colley, Phil Hodkinson ve Janice Malcolm, 2012) sates that the differences between these terms can be understand only under some contexts. In use, Demirel terms formal education as organized education while he uses non-formal and informal education as extended education and it is stated that non-formal and informal education is open to those who can not have access to formal education or leave the formal education and wish to complete the rest (Özcan Demirel, 2001). Fidan and Erden (Nurettin Fidan and Münire Erden) divides education into two: formal and non-formal education and they define the non-formal education as the one that goes on in life itself as a process and it has no plan and target. Informal education involves those how are involved in the formal education and leave it after words and need to complete that education

2. MATERIAL AND METHOD

This paper is based on the account given in some reports related with lifelong learning. The terms, definition and issues are given making use of these official documents.

The report by Symposium on Non Formal Education (Lynne Alison Chisholm, 2000) states that non-formal education is term which is in use after 1970s and defines non-formal education takes place out of the formal education as organized or near-organized. Non-formal education has a long and lively tradition in Europe, a tradition that is widely acknowledged to have been spearheaded and shaped by the Council of Europe, in particular its youth sector. the importance and relevance of non-formal education has been increasingly recognized by civil society, governments and European institutions alike. Non-formal learning and education have been consistently confirmed as key priorities and work areas of education-related organizations and institutions, particularly in the youth sector. Non-formal learning and education have been indisputably established as key priorities within the European institutions' policies and programs. several instruments were developed to facilitate the validation and recognition of skills and competencies acquired through non-formal learning. Among them is the European Portfolio for youth leaders and youth workers, introduced by the Council of Europe to support youth workers and youth leaders in identifying, describing and assessing their competencies and, in doing so, contributing to the recognition of non-formal education and learning.

EU mentions non-formal education under lifelong learning. Responses to the consultation on the Memorandum called for a broad definition of lifelong learning that is not limited to a purely economic outlook or just to learning for adults. In addition to the emphasis it places on learning from pre-school to postretirement, lifelong learning should encompass the whole spectrum of formal, non- formal and informal learning. Lifelong learning is given as "all learning activity undertaken throughout life, with the aim of improving knowledge, skills and competences within a personal, civic, social and/or employment-related perspective". This definition The breadth of this definition also draws attention to the full range of formal, non-formal and informal learning activity (Making an European Area of Lifelong Learning a Reality, 2003).

1. *According to the same document, Strategies must also address issues of equality of opportunity (e.g. gender equality) and of targeting specific groups, in order to ensure lifelong learning opportunities are genuinely available to all, especially those at particular risk of exclusion such as people on low income, disabled people, ethnic minorities and immigrants, early school leavers, lone parents, unemployed people, parents returning to the labor market, workers with low levels of education and training, people outside the labor market, senior citizens (including older workers), and ex-offenders. Such targeting should address the needs not only of people in deprived urban areas, but also those in rural areas who may have particular learning needs. Key points include removing social, geographical, psychological and other barriers, for example by promoting ICT, workplace learning and local learning centers to bring learning and learners together at times/paces and in places suited to people's other commitments; and within the formal sector, adapting entry, progression and recognition requirements to take account of non-formal and informal learning.*

According to the Council Resolution on lifelong learning (Council Resolution on lifelong learning and Official Journal of the European Communities, 2002), lifelong learning must cover learning from the pre-school age to that of post-retirement, including the entire spectrum of formal, non-formal and informal learning. Furthermore, lifelong learning must be understood as all learning activity undertaken throughout life, with the aim of improving knowledge, skills and competences within a personal, civic, social and/or employment-related perspective. Finally, the principles in this context should be: the individual as the subject of learning, highlightning the importance of an authentic equality of opportunities, and quality in learning. The same document stresses the importance of the contribution of the youth sector towards defining global and coherent strategies on lifelong learning by highlighting the value of non-formal and informal learning in the youth field and by defining the priorities for lifelong learning in this context. The main problem is the effective validation and recognition of formal qualifications as well as non-formal and informal learning, across countries and educational sectors through increased transparency and better quality assurance.

On the other hand, the OECD is a unique forum where the governments of 30 democracies work together to address the economic, social and environmental challenges of globalization. The OECD is also at the forefront of efforts to understand and to help governments respond to new developments and concerns, such as corporate governance, the information economy and the challenges of an ageing population. The organization provides a setting where governments can compare policy experiences, seek answers to common problems, identify good practice and work to co-ordinate domestic and international policies. The OECD member countries are: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The Commission of the European Communities takes part in the work of the OECD. Although learning often takes place within formal settings and designated environments, a great deal of valuable learning also occurs either deliberately or informally in everyday life. Policy makers in OECD countries have become increasingly aware that non-formal and informal learning represents a rich source of human capital.

Policies which recognize this can play a significant role in a coherent lifelong learning framework, and present practices can be improved to make the knowledge and competencies people acquire outside of formal schooling more visible. The challenge for policy makers is to develop processes for recognizing such learning, processes that will generate net benefits both to individuals and to society at large. This report (Recognizing Non-Formal and Informal Learning: Outcomes, Policies and Practices, http://www.oecd.org/edu/innovation-education/recognisingnon ormalandinformallearningoutcomespoliciesandpractices.htm), based on an OECD review in 22 countries, explores the advantages of recognizing non-formal and informal learning outcomes, takes stock of existing policies and practices, and recommends how to organize recognition of these learning systems. According to the report, formal learning is always organized and structured, and has learning objectives. From the learner's standpoint, it is always intentional: i.e. the learner's explicit objective is to gain knowledge, skills and/or competences. Typical examples are learning that takes place within the initial education and training system or workplace training arranged by the employer. One can also speak about formal education and/or training or, more accurately speaking, education and/or training in a formal setting. This definition is rather consensual.

Informal learning is never organized, has no set objective in terms of learning outcomes and is never intentional from the learner's standpoint. Often it is referred to as learning by experience or just as experience. The idea is that the simple fact of existing constantly exposes the individual to learning situations, at work, at home or during leisure time for instance. This definition, with a few exceptions (Werquin, 2007) also meets with a fair degree of consensus.

Mid-way between the first two, non-formal learning is the concept on which there is the least consensus, which is not to say that there is consensus on the other two, simply that the wide variety of approaches in this case makes consensus even more difficult. Nevertheless, for the majority of authors, it seems clear that non-formal learning is rather organized and can have learning objectives. The advantage of the intermediate concept lies in the fact that such learning may occur at the initiative of the individual but also happens as a by-product of more organized activities, whether or not the activities themselves have learning objectives. In some countries, the entire sector of adult learning falls under non-formal learning; in others, most adult learning is formal. Non-formal learning therefore gives some flexibility between formal and informal learning, which must be strictly defined to be operational, by being mutually exclusive, and avoid overlap.

Because non-formal and informal learning is happening everywhere all the time, this OECD activity could not address all the issues related to non-formal and informal learning in general. In consultation with the participating countries, it was agreed to focus solely on the processes that make visible this learning that has not been formal. Therefore, this OECD activity focuses on the process of formal recognition of non-formal and informal learning. Whether through the awarding of a full certification, a partial certification, a right of access to the higher education system or to any program in the formal lifelong learning system or any recognized document (portfolio of competences, competence passport…): this activity makes the case that individuals engaging in a recognition process for their non-formal and informal learning outcomes must be awarded a document that has social value and is widely recognized so that they can benefit from it, now or later in life, when returning to the formal lifelong learning system or to the labor market.

According to the report by Patrick Werquin (Patrick Werquin, 2010), in the United Kingdom, and especially Scotland, the disadvantaged groups are the elderly, single people with children, immigrants and those with neither a job nor enrolled in education or training, known collectively as NEET (Not in Employment Education or Training). In Greece, three groups take priority, namely women, elderly workers and persons at risk of social exclusion, especially in rural regions. Apparently, the groups that might gain most from the recognition of non-formal and informal learning outcomes are the long-term unemployed, immigrants, women, young people aged under 25 and elderly workers. In South Africa, the main target consists of those who were excluded from access to education and training opportunities under apartheid and those whose knowledge and skills were developed experientially and through political struggle but not recognized in the formal system. In Slovenia, the leading beneficiaries of the 1998-2000 Phare Mocca program have been the unemployed, particularly those who left school early, as well as more elderly unemployed persons or the long-term unemployed. In Spain, a large proportion of the population is not professionally qualified to a very high level, such as the many young people who leave school early.

While Canada has stated that it has no special surveys available, certain groups are clearly potential targets for public action, including people with differing abilities, women, visible minorities, persons whose mother tongue is neither English nor French, single parents, persons receiving assistance from the social welfare system, the unemployed, those from the First Nations and Métis, immigrants, refugees, the inhabitants of rural areas, and those who live in Canada's Great North. Canada is a fascinating example for the development of a theory concerning the recognition of non-formal and informal learning outcomes. Indeed, its approach seems essential and probably the only one possible when "western" learning methods do not work, as is clearly the case for aboriginal people. In Italy, there are many local experiments and it is difficult to refer to the situation at national level without citing regional actions, some of which are excellent as in Emilia-Romagna, Marche or Valle d'Aosta.

In Germany, non-formal and informal learning are an integral part of the education system and above all the Dual System. Contrary to many countries that are (re)discovering learning of this kind, Germany has, as it were, already institutionalized it. In Austria, the recognition of non-formal and informal learning outcomes is a means of by passing the period of formal learning by enabling eligible candidates to take the final vocational apprenticeship examination Life Asset Portfolio (LAP) on the basis of experience.

3. CONCLUSION AND SUGGESTIONS

In conclusion, the scarcity of data on the recognition of non-formal and informal learning outcomes contrasts strangely with the plentiful supply of figures on lifelong learning. There are even some data on non-formal and informal learning, but data on recognition of the resultant outcomes are very uncommon. There are no data in the Czech Republic and no special studies in Scotland. Iceland has no data concerning impact, as the recognition system is very recent. In Hungary, users would like to have information on the practices of private and multinational companies. South Africa has no official data. However, a few studies reveal that the potential and scope of recognition of Non-Formal and Informal Learning Outcomes (RPL) are still very controversial. In particular, there are doubts about its ability to hasten the transformation of the tertiary education curriculum. The few studies that exist in Slovenia are hardly ever used. In Spain, research is undertaken almost entirely by the training and employment service in the province of Valencia.

The suggestions regarding the case in Turkey and Romania are as follows:

The definitions and content of formal, non-formal and informal education and learning should be clearly defined on the way of recognition. The society should be aware of the recognition of non-formal learning and organizations such as guidance and counseling should be formed. The priorities of lifelong learning should be established considering the work market, competition, human sources and employment. Skills, especially, of the disadvantageous groups, should be considered in the recognition process.

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Research on teachers' skills in developing online surveys

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Abstract

According to European Commission document entitled Improving the Quality of Teacher Education (2007), "the professional development implies that teachers undertake classroom-based research and incorporate into their teaching the results of classroom and academic research." An important component of this research is the surveys method. Online surveys are a modern and more convenient alternative for the classical paper and pencil questionnaires. This paper presents a quantitative research of teachers' skills in developing online questionnaires. 35 teachers enrolled into the Curriculum Management Master's program were involved in this research. They were guided to create and apply online surveys, and to interpret the results. Each step of their activities was analyzed, and their feedback were gathered. All teachers consider the survey method to be an important or a very important part of their teaching activity, and 82% of them would choose the online survey instead of the paper and pencil survey. However, almost 30% of them consider that they have difficulties developing online surveys.

Keywords: Research, teachers' skills, online surveys, Google Forms

1. Introduction

The quality of teaching is a key factor in the achievement of the Lisbon objectives for social cohesion, growth and economic competitiveness. Communication from the Commission to the Council and the European Parliament of the 3rd of August 2007 entitled *Improving the Quality of Teacher Education* established the Common European Principles for Teacher Competences and Qualifications. One of these refers to the reflective practice and research. "In a context of autonomous lifelong learning, their professional development implies that teachers:

- continue to reflect on their practice in a systematic way;
- undertake classroom-based research;
- incorporate into their teaching the results of classroom and academic research;
- evaluate the effectiveness of their teaching strategies and amend them accordingly; and
- assess their own training needs.

The incentives, resources and support systems necessary to achieve this would need to be put in place." (European Commission, 2007).

An important component of research is the survey method. Online surveys is a modern and more convenient alternative for the classical paper and pencil questionnaires.

This paper presents a quantitative research of the teachers' skills in developing online surveys by using Google Form.

2. Online surveys

A survey is a research instrument consisting of a series of questions and other prompts for the purpose of gathering information from respondents. "We define an electronic survey as one in which a computer plays a major role in both the delivery of a survey to potential respondents and the collection of survey data from actual respondents" (Jansen K. et al, 2007). Currently, because of the development of virtual environments the online (or Web-based) surveys become a more convenient alternative to the classical paper and pencil surveys. Online surveys "are generally defined as those survey instruments that physically reside on a network server (connected to either an organization's intranet or the Internet), and that can be accessed only through a Webbrowser" (Green, 1995; Stanton, 1998). "Web-based surveys are often connected directly to a database where all completed survey data is categorized and stored for later analysis" (Schmidt, 1997; Lazar and Preece, 1999). The advantages of the online surveys are obvious: easier to design, easier to edit, quick distribution, cheaper, saving time, data collected in real time, data results automatically generated, the storage of the data etc. In addition, an online survey allows to add collaborators to the survey, insert images or videos.

A wide variety of online survey instruments are available, for example: SurveyMonkey (www.surveymonkey.com), Zoomerang (www.zoomerang.com), Polldaddy (www.polldaddy.com), SurveyGizmo (www.surveygizmo.com), survey module from Moodle (www.moodle.org) etc. On the online directory of business software and vendors Capterra appear 184 Survey Software products in 2014 (http://www.capterra.com/survey-software).

An instrument for online surveys is offered by Google Drive (https://drive.google.com). Google Drive is a file storage and synchronization service provided by Google, released on April 24, 2012. According to BGR (Boy Genius Report), a weblog specialized in technology and consumer gadgets ranked among the Top 100 Blogs in the world (http://technorati.com/blogs/top100/), in June 2014, Google Drive had 190 million monthly active users. About eight percent of Fortune 500 companies are using Google Drive, while 72 of the top 100 universities are also on Google Drive (http://www.bgr.in/news/google-drive-has-over-190-million-30-day-active-users/). Google Forms is a free tool from Google that can be used with the personal Google account. Google Forms allows the user to perform the following:

- Create forms, surveys, quizzes, and such
- Share the forms with others
- Allow others to complete the forms online
- Collect all the responses in a spreadsheet
- Provide summaries of the collected data with charts and graphs.

3. Research Method

The research was carried out during the second semester of the 2013/2014 university year, subjects being enrolled in a Media Education course. The subjects were guided to create and apply online surveys by using Google Forms from Google Drive and to interpret the results. Their performance in developing online surveys was measured and their feedback were gathered and analyzed.

Activities were carried out during 8 weeks as follows:

1st week: This is when students' particularities were established, general ICT knowledge and knowledge about online surveys. Students who did not have an email address on gmail.com were assisted in order to open one.

2nd -3rd week: Students had a documentation period in which they chose the topic of the survey, target group and they elaborated the survey' argumentation. The information sources proposed were chosen to be available online, but subjects were encouraged to find other sources of information. Subjects had the opportunity to exchange views. Among the proposed sources we mention: www.eurydice.org, www.europa.eu, http://www.rocnee.eu/, http://www.oecd.org/statistics/, www.insse.ro, www.edu.ro.

4th – 5th week: Students worked at the surveys design, they chose the types of questions and formulated them. Then they implemented the survey online by using Google Forms from Google Drive. Students were assisted by teacher in the online implementation of surveys. Surveys were sent via Internet to target groups.

6th -7th week: Students analyzed results generated by Google Drive. They made a portfolio which contains: the survey, the survey's argumentation, the responses spreadsheet, the summary of responses generated by Google Drive and the interpretation of results.

8th week: Students presented the surveys and provided feedback on the activity. They drew conclusions about the advantages, disadvantages and difficulties working with online surveys.

Activities were conducted in the computer lab, all workloads and activities carried on only on the computer. Activities in each phase started in class and were completed at home if this was necessary. A condition of minimum 5 present participants was imposed for practical activities.

4. The Sample of Participants

35 students enrolled into the second year of the Curriculum Management Master's Program from the Faculty of Psychology and Educational Sciences, Babeş-Bolyai University have participated in the research. 34 of them were female and 1 participant was male. 28 participants were Preschool and Primary school teachers and 7 participants were Middle and High-school teachers. The distribution of subjects taught by participants is presented in the figure 1 and the distribution of their teaching experience years is presented in the figure 2. We remark that more than 65% of teachers had less than 10 years of teaching experience, all of them were Preschool and Primary school teachers while Middle and High-school teachers had all more than 10 years of teaching experience.

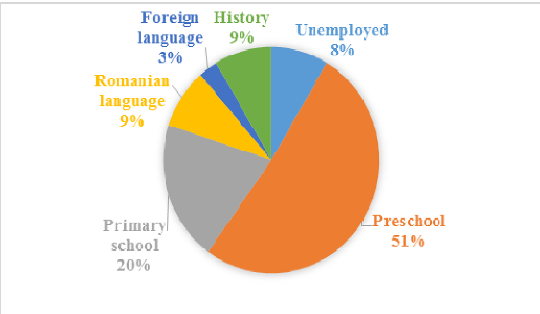

Figure 1. The distribution of subjects taught by participants

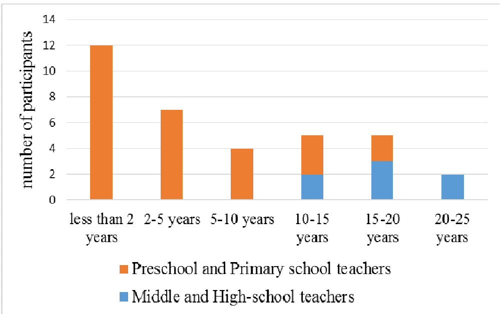

Figure 2. The distribution of teaching years for participants

The students had already passed the *Information and Communication Technologies* (ICT), *Computer Assisted Instruction* (CAI) and *The Theory and Practice of the Educational Research* courses.

At the beginning of the experiment 81% of participants were aware of online surveys, 51% of them had completed online surveys, and 18% knew the facilities offered by Google Forms from Google Drive but had not used them.

5. The Research Tool

To assess students' skills in developing online surveys their activity was analyzed on three components:

a) **Survey's quality.** For this skill we considered more indicators: the concordance between the survey's topic and target group, the argumentation of importance of completing the survey and the utility of results, the survey's structure and the formulation of its questions. Regarding the structure of the survey we assessed the adequacy of types of questions for the survey (factual, opinion and / or knowledge questions,), logical ordering of items, variety and quantity of different types of items (open ended questions, multiple choice questions etc.) In the analysis of questions formulation besides language we were interested if the questions were appropriate to the type of response, and if the proposed answers of multiple choice questions were disjoint.

b) **Interpretation of results generated by Google Drive.** For this part each student made a Word document which analyzed the results generated by Google Drive. To asses this skill we checked both the typing skills of a Word document, as well as students' ability to summarize open ended questions responses and draw conclusions based on the responses collected.

c) **Working with Google Forms.** At this skill we assessed in what measure students are able to access Google Drive, Google Forms and their own survey, sending the online survey to the target group, accessing summary of the results and saving data on their own folder.

To appreciate teachers' performance we used a 5 - grade scale (where 1 means a very low performance, 2 - a low performance, 3 - a medium performance, 4 - a high performance, 5 - a very high performance). Scores were given by analyzing students' portfolios, observing their interaction with the computer and achieving individual observation sheets.

6. Results and Discussions

During the experiment all students were able to accomplish tasks. Table 1 shows for each skill and its subcomponents the distribution of participants' grades on the 5-grade scale and also average grades.

Table 1. Distribution and average grades obtained for the development of online surveys

Skills \ Scale		Percentage of participants 1	2	3	4	5	Average grade	
a) Survey's quality	Concordance between the survey's topic and target group				42%	58%	4.57	**3.87**
	Argumentation of survey's topic		6%	17%	37%	40%	4.11	
	Survey's structure	3%	11%	26%	51%	9%	3.51	
	Questions' formulation		23%	29%	43%	6%	3.31	
b) Interpretation of results generated by Google Drive		3%	17%	26%	37%	17%	3.48	**3.48**
c) Working with Google Forms	Accessing Google Drive, Google Forms and their own survey		11%	17%	23%	49%	4.08	**3.91**
	The survey implementation in Google Forms	6%	23%	20%	29%	23%	3.40	
	Sending the online survey to the target group		9%	14%	20%	57%	4.25	
	Accessing summary of the results		9%	17%	23%	51%	4.17	
	Saving data on their own folder		11%	17%	37%	34%	3.65	
Average grade 3.85								

With an overall average of 3.85 students achieved 77% of goals.

At component a) participants were able to correlate very well the survey topic with the target group and made a good argumentation. A lower average is seen in the structure of surveys and the accuracy of questions formulation. We identified the following types of errors:

- Using of just one or maximum two types of questions as: text, paragraph text or multiple choice. Scale or grid type questions were avoided.

- Type of response was not appropriate for the question. For example the question *What does reading mean for you?* should have an opened ended answer but the student chose for it a multiple choice answer. This kind of answer obviously did not cover all possibilities and also suggested to the respondents some possible answers, instead of asking them to reflect.

At the second skill b) the average was influenced by the quality of surveys. When reaching this stage some students realized that they could not do certain interpretations of the results because some questions were not properly formulated. This explains why the average data interpretation was less than that obtained in quality surveys.

At item c) the lowest score was achieved in the implementation of surveys, because of the difficulties encountered by students when it was necessary to change them. Saving data on their own folder was also quite difficult, only a few students found the way to do this by themselves.

In table 2 we made a comparative analysis of the averages scores for that two categories of teachers participating in the research: Preschool and Primary school teachers respectively Middle and High school teachers.

Table 2. Comparative analysis of average grades between categories of teachers

Skills	Preschool and Primary school teachers average grade	Middle and High school teachers average grade
a) Survey's quality	3.99	3.38
b) Interpretation of the results generated by Google Drive	3.46	3.57
c) Working with Google Forms	3.94	3.79
Average	**3.91**	**3.60**

Note that the Preschool and Primary school teachers achieved superior performance in quality of surveys. Analyzing deeply this indicator we observe that Preschool and Primary school teachers average scores are higher than Middle and High school teachers average scores for each component skill (see table 3). The Student test confirms a significant difference between that two categories of teachers involved in our research.

Table 3. Comparative analysis of average grades for quality of survey's skills between categories of teachers

Survey's quality skill components	Preschool and primary teachers average grade	Middle and High school teachers average grade
Concordance between the survey's topic and target group	4.68	4.14
Argumentation of survey's topic	4.17	3.85
Survey's structure	3.68	2.85
Questions' formulation	3.46	2.71
Student t- value	2.16882974*	

*significance level .04

Differences of survey's quality between the two categories of teachers are due, on the one hand, because of a greater experience in micro pedagogical research ever since the license of Preschool and Primary school teachers. On the other hand, the second category of teachers tended to make more elaborate surveys, but they could not manage them properly and thus generating more mistakes in their conception.

When it comes to other skills, differences between the two groups of teachers were insignificant, but it is observed that a significantly greater experience in teaching of Middle and High school teachers lead to better interpretations of the results of surveys. In fact, only at that skill did Middle and High school teachers obtain slightly better results than Preschool and school teachers.

7. Participants Feedback

At the end of activities the participants' feedback was gathered. Regarding how accessible is the development of online surveys 60% of respondents considered easy or very easy to do this (see figure 3). For 28% of respondents to develop online surveys was difficult or very difficult. These students are those who did not have significantly good knowledge of ICT and / or Internet usage.

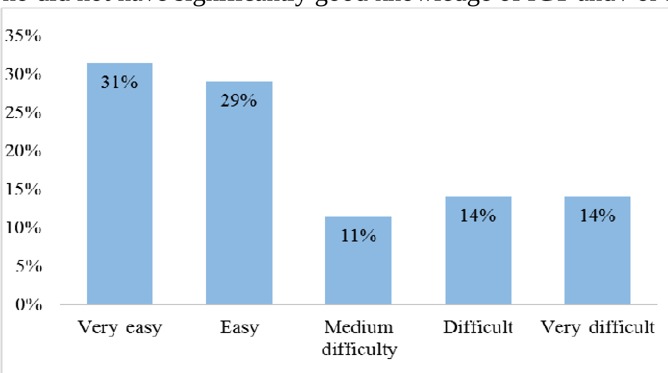

Figure 3. Participants' opinion about accessibility of developing online surveys

At the beginning of our experiment only 15 students (42.8%) were willing to try to develop online surveys, the rest of them being reluctant towards this idea and wanted to make it on paper. At the end of the experiment 29 students (82.8%) would choose the online survey instead of the paper and pencil one. Only two students (5.7%) remain consistent to surveys on paper and pencils, while four students (11.4%) were undecided.

Finally, it is important to note that all students consider their knowledge about developing online surveys as important or very important for their didactical activities.

8. Conclusions

In our study were involved teachers who had prior knowledge in pedagogical research and in the development of surveys. Our research results shows that these teachers can develop under guidance and with few difficulties online surveys. Middle and High school teachers' average in developing online surveys is slightly lower than Preschool and Primary school teachers' average but the difference is not a significant one. Preschool and Primary school teachers have better performances in quality of surveys but cannot be establish significant differences on the other components: interpretation of the results generated by Google Drive and skills in working with Google Forms. All teachers are aware of the importance of developing online surveys in their teaching career. At the end of the experiment over 82% of respondents would choose the online surveys instead of the paper and pencil ones, although for almost 30% of them this activity may be difficult or very difficult.

The problem of online surveys is a topic of great interest for teachers because of their importance in teaching activities. Based on the results of our research we can say that teachers need support in this direction because more than half of them are reluctant to try making online versions of surveys on their own. This support covers both psycho-pedagogical aspects of drafting surveys and implementation using online surveys instruments.

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Making the best of oral history through flipped classes

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Abstract

This article is a study of MyStory project, which created a reliable collection of life-stories, articulated by senior citizens and collected by younger people in the form of videos. The present article shows how the collected stories were used to transfer their lessons to young generations. This has been done through a recent method, flipped learning, which aims at flipping or reversing traditional instructional practice with the help of the videos that the project created. Within the flipped classes the short videos were viewed by students at home before the class session, while in-class time was devoted to exercises, projects, or discussions. The class turned into a workshop where students inquired about the video content, tested their skills in applying knowledge, and interacted with each other in hands-on activities benefiting from the teacher's guidance.

Keywords: Oral history, social history, videos, interviews, flipped classes

1 MyStory project

MyStory, a project funded by the European Commission (under KA3 ICT) for the years 2011-2013, was developed within an international partnership including institutions from Finland, Ireland, Lithuania, Romania, Slovenia and the United Kingdom.

The project aimed:

- To empower senior citizens to develop basic technical skills via intergenerational learning
- To gain access to new learning opportunities
- To make contact with different social categories facing the risk of social exclusion.
- To use the process of story-telling as a process of healing wounds and have therapeutic long term effects on the story-tellers
- To collects life stories that have exemplary relevance as models for the youth
- To collect resources that illustrate the EU history of the past 60-80 years in both post-communist countries and in Western Europe countries and by doing this to make a repository of subjective pieces of oral history that have relevance as valuable unique moments of historic events with a personalized reception by the teller (http://www.mystories.eu/project/).

The two primary beneficiary categories were senior citizens and young people, who were expected to interact while sharing learning and providing support for each other. At the core of the project lay a collection of life-stories, narrated and shared by senior citizens and collected by younger people (who were recruited and trained as digitally competent story collectors and gatherers). The collection was made available online and accompanied by a complete set of user information packs and background contextual materials.

The voices of the stories came on purpose from all walks of life: public figures and well known personalities in the countries involved in the project, common persons whose personal life experiences were as relevant as the voices of well-educated and well informed story tellers from the point of view of the project. The result was a big puzzle of life experiences which recreated the recent history of Europe from different perspectives. The interviews either invited the story teller to narrate whatever they wanted to share from their life experiences or focused on some specific questions directed to life episodes selected as important from the project point of view: understanding historical roots of contemporary change and/or conflict, dislocation of families, holocaust, economic and social change, second-world-war consequences, current political and social organization in the countries studied, post communism effects.

1.1 Oral history/ Social history

The MyStory project made a repository of subjective pieces of oral history, which captured memories from the past in an attempt to extract its lessons. Oral history, generally defined as a systematic collection of living people's testimony about their own experience, is known to be an invaluable source of new knowledge about the past. Findings are verified analyzed and placed in an accurate historical context. Oral history is both the oldest type of historical research and one of the most modern using state-of-the-art digital technologies http://www.oralhistory.org/.

Oral history has provided information about everyday life in the past and insights into the mentalities of “common people”. Oral history is closely related to social history which has a ‘bottom-up’ approach, encouraging students to analyze people’s lives, their relationships, activities and the social context of political developments (Wood, L., 2003).

Oral history is a valuable educational tool, which enables students to develop both educationally and personally (Walbert, K., 2002). The role that oral history can play in educating the young generation is three fold:

- empower students to create, preserve, and publish an invaluable primary source document through an oral history interview.
- develop students’ understanding of the oral history process and the strengths and weaknesses of this historical methodology in comparison to more traditional historical sources.
- make the complete voice recording and transcription available to educators and researchers through both an institutional and online archive (Smith, 2013).

Linking students with the people who lived the history they study can dramatically enrich their understanding of the past as well as their classroom experience.

2 Theoretical Frameworks for the Flipped Classroom

The project aimed at making good use of the collected stories by passing on their lessons to young generations. This has been done through a recent method, flipped learning. At the core of this concept is the notion of flipping or reversing traditional instructional practice with the help of the videos that the project created (Lage et al., 2000). According to the method the flipped classroom is made up of two components: one component that requires human interaction (in-class activities), and a second component that is automated through the use of computer technologies such as video lectures (outside activities). Within a flipped class short video lectures are viewed by students at home before the class session, while in-class time is devoted to exercises, projects, or discussions. The video lecture is often seen as the key ingredient in the flipped approach, such lectures being either created by the instructor and posted online or selected from an online repository. The class turns into a workshop where students can inquire about lecture content, test their skills in applying knowledge, and interact with one another in hands-on activities. During class sessions, teachers function as coaches or advisors, encouraging students in individual inquiry and collaborative effort (Berrett, D., 2012). The concept has most recently gained popularity through the work of Salman Khan (founder of the Khan Academy—a non-profit organization developed by Khan to provide video-based instruction), and Eric Mazur of Harvard University, researcher at George Mason University and Pearson.

The theoretical foundations of flipped learning are linked to the advance of technology as well as the new generation's rising interest in ICT. Flipped learning stems from a large body of literature on student-centered learning (constructivism and collaborative learning, peer-assisted learning, problem-based and active learning, experiential learning, Kolb's learning styles). Flipped learning supports the 21st century teaching and learning structures and practices. The new practice is based on the needs of the individual student (customizing materials and using strategies to meet students' interests), students' responsibility for their own learning, and differentiation of learning adapted to the strengths and weaknesses of all students (Noora H, et al., 2013).

Flipped learning requires (Fulton, K. 2012):

a). a shift from a teacher-centred to a student-centred learning environment; student engagement in active learning strategies, individualized support for students, activities designed to help students master content, and flexible timelines for student work. This has been defined as active learning (Michael, 2006), which engages students in the learning process forcing them to reflect upon ideas and how they are using those ideas (Michael, 2006).

b) a shift to a blended environment based on the integration of technology into instructional practices; blended learning environments include at least in part some online delivery of content and instruction and the ability for students to have some control over time, place, path, and/or pace of their own learning.

c) a shift in pedagogical practices that focuses on individualized learning structures (differentiated learning and mastery learning supported by Tomlinson, C., 1999 and Bloom, 1971) and active learning structures (cooperative and collaborative learning) where students are engaged in their learning (Bloom, 1971; Michael, 2006). Among many innovations and research-supported strategies mastery learning "individualizes instruction within the context of ordinary group-based instruction; mastery learning strategies stem from the constant flow of feedback information of both the teacher and the learner" (Bloom, 1971, as cited in Valdosta). Feedback, according to Hattie (2012) has great effects on learning: feedback is second to the instruction and it is tremendously useful in boosting student performance. Additionally, he states, research shows that less teaching plus more feedback (through technology, peers, and other teachers) is the key to achieving greater learning.

2.1 The flipped class experiment

In the flipped class experiment carried out by EuroED Foundation, Iasi, the teachers and the students came from several educational institutions in Iasi (high schools and the school of medicine). The materials were used during history, literature, counseling, therapy, and civic educational classes. Teachers and students were recruited according to their interest in the experiment, availability and access to the required IT tools. They were first familiarized with the method; then the teachers were given access to the stories and asked to select the ones that suited their purposes. They also set a sequence of stages to be covered in a flipped class:

Students watch videos presenting topic outside the class;

Students do exercises and critical thinking projects in the classroom;

Formal discussion and review in the classroom;

Brief quiz to check understanding and retention.

Teachers also collaborated on the selection of the activities students had to carry out during the classes:

- Written reports: Using the interviews in the videos and other notes from the research carried out on the topic, the students prepare a written report quoting and paraphrasing the narrator to support the thesis.

- Oral reports: The students interpret the narrator's story. The students have to defend and support statements made in the reports.

- Question-and-answer format: The students write the narrator's story in "interview style," with the student as the person asking the questions, the narrator's answers accompanied by the student's analysis of the responses.

- First person or autobiographical narrative: turn the interview into a story and take on the persona of the interviewee;

- Research stages; students are asked to identify research stages.

- Formal written research paper, an informal reaction paper, or a journal entry on the findings in the videos (e.g. the ways in which major events affected and influenced their communities, which are too small or too new to appear in books);

- Detect and deal with contradictions between what their book says about an event and what their interviewee reports, finding ways of explaining the differences and deciding which account they find more credible or persuasive;

- Examine and analyze primary sources (learning how to interrogate sources, compare varied accounts of the same event, and consider the biases and perspectives inherent in any research source can help students not only understand their interviews, but also think more critically in a broader sense); examining primary sources gives students a powerful sense of history and the complexity of the past. Helping students analyze primary sources can also guide them toward higher-order thinking and better critical thinking and analysis skills.

- Creating websites, documentary films, museum-like exhibits, or slide-shows;

- Write questions for interviews: it also helps them become better conversationalists, more mature listeners, and more poised speakers under pressure;

- Debates on the values/ principles shown in the videos;

- PPT presentations of the findings;

- Dramatic performances based on the videos (script, acting out, performance). The students turn the story into a dramatic text, they write a script and produce a play; they assume different roles in the story and present it in front of an audience (parents, peers, teachers etc.).

The teachers were asked to note down any changes they had to make or they observed in terms of the content, class management, teacher/ student behavior or teacher'/ students' time. The experiment lasted for two months and at the end of the period teachers had to report their findings.

Participants reported a shift in their planning and their thinking about content. In selecting the story and organizing the class activities the teachers started from what the students had to learn. They had to carefully organize the content in terms of what students needed to know and be able to do. They considered what they needed to flip—what content students had to handle outside of the class time and what content students would handle inside the class time. Therefore they had to select the videos for the lessons that fitted the skills they wanted to improve. A lesson was considered efficient in relation to the following questions (suggested by Hattie, 2012): "Did the students know these?" "Could they articulate them in a way that showed they understood them?" and "Did they see them as appropriately challenging?"

Teachers held that class time was no longer focused on the teacher's time. Class time was available for students to engage in peer collaboration, deeper discussion of the topic at hand, and personalized instructor guidance. Some teachers even created a students' blog. When students had a question about a particular topic, they had to normally post it there and wait for a fellow student to respond. There was often little teacher interaction with the whole class.

Participants also reported a change in class dynamics. They had to organize the student work in pairs or groups, with each group being given a task to achieve and then present the results to the class. As a result teachers reported they began to work more individually with students and with small groups of students rather than with the whole group. They believed flipped learning allowed for individual pacing for students; more interaction among classmates; and more attention to what individual students need to know and be able to do relative to course content. The focus was no longer on the teacher. The participants realized their role changed in their classrooms from lecturer and giver of knowledge to facilitator of learning. Teachers saw themselves as “change agents” who took responsibility for enhancing student learning and motivation.

Teachers appreciated flipped learning as being focused more on learning than teaching. This did not imply that a teacher’s job was easier but that it was less visible. This was best exemplified by the teacher’s physical position in the flipped classroom. Teachers moved around the groups, helped, encouraged or guided students who worked within their groups. Students were no longer passive. They gathered the information outside of class, by watching the recorded stories. When they were in class, students did what was typically thought to be homework, solving problems with their professors or peers, and applying what they had learned to new contexts. They continued this process on their own outside class.

The teachers also highlighted the role of teacher’s immediate feedback and peer assessment in learning. Students received feedback on their work either from the teacher (who circulated around the groups) or their peers.

Teachers had to integrate technology in the process of learning and also to create a blended learning environment that met the needs of the students. The online delivery of content (the stories) enabled students to watch them at home and have some control over time, place, path, and/or pace of their own learning. At school student work included working with each other and the teacher face-to-face as well as using technology tools. Teachers noticed an intense use of the internet outside and inside classes (Google, Skype, emails, Facebook, Twitter, mobiles, class blog).

Teachers stated they had to take some specific steps in order to create their own flipped learning environment. They had to prepare their students for the change in teaching and learning. First of all they had to explain to students what flipped learning meant; this was followed by a survey of their students’ technology access. They also had to instruct students how to watch a video and how to take notes. Some teachers said that when they informed families about what was happening in classes and brought parents into the experience, they enhanced students’ engagement in their learning.

Teachers reported that there were some problems until students got used to the method, most of which being related to students not watching the videos at home. The teachers reported students were more prepared for class the next day and were more successful when they watched the videos or completed the assignment. In time students realized how important it was to watch the videos at home. They even said they liked watching the videos so they would not be behind the next day. Some of them realized that watching the videos helped them with what to expect from the new lesson. Students said they felt more prepared and more willing to interact with their peers and teacher in class.

Everybody agreed that the method makes teaching more challenging: it requires a lot of one-on-one time with students and preparation of in-class activities. In the flipped classroom, the teacher’s challenge is to design learning experiences that engage students in higher level thinking and problem solving during the class time. It is about creating, evaluating, synthesizing, and analyzing together. Class learning experiences are defined by Hattie (2012) as “deliberate practice,” which involves challenge, concentration, and someone monitoring and providing feedback during the practice.

Teachers noticed students engaged in a flipped learning environment also had a tendency to conduct more Internet searches for related material. Technology enhances student engagement. Everybody agreed that the flipped classroom became a busy, collaborative, and social place, although there were teachers who complained about its being too noisy.

On the whole the findings revealed that the teachers had positive perceptions of the method which used videos as a main method of content delivery. Some of the benefits noted include increased student-teacher interaction, increased student responsibility for their learning, increased student motivation and participation in classes, easy management of student absences, and teacher guidance during application of learning. Some of the downsides noted by these teachers included accountability for students watching the videos, the need for instant feedback mechanism, teacher multitasking role, and the time it takes to prepare for this method in the beginning.

3 Conclusions

Flipped learning has a lot of potential if it is well organized. It goes beyond students getting the information or skills related to the topic. It helps them develop themselves professionally and personally in a very independent and personal way. Flipped classes enable teachers to help students work on their analytical and critical thinking skills (Marshall, H. W., 2013). Students focus on the higher forms of cognitive work (application, analysis, synthesis, and/or evaluation) in flipped classes where they have the support/ feedback of their peers and teacher. As a result, misunderstandings and mistakes are corrected when they arise.

To sum up a flipped class:

- encourages interaction between students and teachers;
- empowers students to become independent learners and participate in the management of their own learning process;
- changes teacher's role: the teacher is not the "sage on the stage" but the "guide on the side" (King, A. 1993);
- encourages alternative assessment;
- encourages blended learning;
- prevents students who are absent or have impairments from being left behind;
- engages students in their learning;
- personalizes learning;
- improves student attitudes towards learning.

The flipped classroom provides a new teaching and learning methodology, which takes advantage of the state-of-the-art technology and students' addiction to it. It brings about changes in teachers' and students' roles. The flipped classroom asks teachers to give up their leading role in teaching in order to encourage students' contributions. It also asks students to change from passive to committed participants and assume the responsibility for their learning. It is likely that the flipped classroom will impact schools and universities worldwide and if combined with traditional methods it will no doubt play a major role in education.

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The Issue of Autonomy in Using Computer Information Technologies as a Means of Teaching Music

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Abstract

The present article is aimed at looking closer at the issue of the globalization of informational space in the life of a society, especially in reference to musical education - the sphere where mastering the already existing resources of musical information is also a topical matter. The research is centred around the phenomenon characteristic of the information technologies, namely, aspiration to autonomy which is revealed in the «teacher-learner» communicative chain turning into the «computer-learner» one. Having analysed the didactic, aesthetic and artistic goals of programs teaching music, the author arrives at the conclusions concerning the appearance of new didactic situations caused by the peculiarities of teaching with the help of informational technologies. The author of the article states the formation of a new teaching strategy in reference to computer technologies which consists in stimulating the learning activity and giving an impetus to the process of reflection. As a result, the independence and artistic self-realization is obtained in the process of coping with the learning tasks - the fact that contributes to a more effective knowledge acquisition: the learner does not get, but obtains information (the active position). Thus, the «computer-learner» system is formed as an autonomous one.

Keywords: Musical education, Information technologies, Musical information, Means of teaching music

1 Introduction

Both information and information-based communication have always been indispensable attributes of the life of human society. Information is one of the most relevant and significant factors in almost all spheres of human activity, whereas communication provides its existence in the society. It should be mentioned in this connection that these two attributes not only accompany the life of human society, but also constitute a powerful engine of its progress.

The latest trend in this respect is the rapid development of the means of communication and the accumulation of information. This process has reached such a scale that it has led to some significant changes in various spheres of the life of the society – those of education, industry, scientific research, household activities etc. The present state of the society with a large number of existing and recreated information units and flows is defined by the philosophy of culture as an “informational boom”, or an “informational blast”, whereas the processing of information is seen as one of the main varieties of human activity in a post-industrial society that is taking shape (Абдеев, 1994). Thus, for example, the Internet network forms a single common informational space with equal or almost equal possibilities of access to informational resources, the actual location of the consumer of information being irrelevant. As a result, the borders are blurred and a physically scattered society consisting of quite a few local territorial units turns into a single global society, as far as information is concerned.

Information has assumed an extremely important and essential role for the development of humanity. New meaning of information in modern society, increase in its quantity because of new technological processes, and growing significance of communicational information technologies lead to an accelerated development of society. (Минаев, 2000). Information has turned into a global and, in fact, unlimited resource of humanity (Абдеев, 1994). Taking into account the fact that it is one of the leading factors of progress, assimilating this resource becomes a topical issue of the present time, and its settlement will ensure the acceleration of social development.

2 Information Technologies as a Means of Assimilating Information Resources of Humanity

Humanity has accumulated a vast store of information, and its total amount is practically impossible to embrace. However, the modern world is organized in such a way that the load of information carried by a person is constantly and inevitably increasing, the issue in question becoming even more pressing. The solution of this situation may consist in turning to information technologies.

Information technologies in general should be regarded as a means of assimilating information resources of humanity. Modern socio-cultural situation is characterized by a progressing activation of various information technologies present in all spheres of human activity (Суминова, 2006). Nowadays information technologies have become one of the key factors of social development. They contribute to the rapid growth of the intellectual potential of the society (Полозов, 2002).

Informational technologies help a person to get an understanding of the flow of information that he or she faces. One of the most decisive roles here is performed by computerized means that provide the automatized access to information and its processing. As a result, a large amount of work on its search and processing can be commissioned to the computer, thus economizing a person's effort and time.

What has just been mentioned above also refers to the art of music – a part of the global system of a person's informational space. The necessity of embracing the vast accumulated resources of musical information is also obvious.

3 Problems Appearing in the Process of Using Information Technologies

Information technologies are created in order to satisfy the informational needs of a society, i.e. they meet people's demands. At the same time, they make the society adapt to some peculiarities of their functioning. Therefore, apart from the undoubted advantages such as optimization and acceleration of the access to information, they also carry certain disadvantages. In order to get such an access one not infrequently has to comply with the given rules, accept some limits, agree with the imposed conditions etc.

These problems include unification. In the 20th century the process of unification of information technologies became overall and global; all aspects of communicational activity in culture and science are subjected to it (Аронова, 2001). This unification has various manifestations: from the forms of presenting information to the way of its transmission. As a result, when turning to information technologies one has to accommodate himself to the respective standards.

A number of issues are specially typical of network informational technologies. Becoming part of the global informational net, one voluntarily surrenders his or her independence to a certain extent (Громадин, 1992). One of the most pressing issues in this respect is the accessibility of confidential information. Another problem which is no less important consists in its reliability.

In what follows we shall pay attention to yet another problem in reference to the existing limiting of a person – aspiration to autonomy. Information technologies intentionally and systematically penetrating in the new spheres of human activity are gradually ousting humans and taking their place. They claim the right to be the source, the producer and the consumer of information, thus seeking to eliminate a person's participation in these processes. For the sake of the advantages provided by such technologies, the society assigns them a number of tasks essential for people, allowing them to act autonomously; this is the way the society partially sacrifices its freedom and creates a certain dependence on them.

The latter problem is especially prominent in using informational technologies in musical education. It is generally believed that teaching is one of the most intellectually charged forms of human activity. These days entering any profession is linked to mastering a large amount of knowledge and skills. Therefore, the modern society imposes certain requirements on the system of education – the requirements which lead to the increase in the amount of information that has to be learned. Even though the informational load on the learner is extremely high, it is still growing. This situation can hardly be resolved by means of extensive methods, endlessly increasing the number of lectures. That is the reason why modern didactics is looking for the ways of teaching intensification. In these conditions computer technologies can become a means of increasing the efficiency of teaching (Полозов, 2011). Their practical value in the process of teaching, first and foremost, deals with knowledge acquisition, since they constitute a rich source of educational information. This allows us to define informational technologies as a storage of knowledge which can be reclaimed when necessary (Полозов, 2009). Moreover, computerized information means are capable of resolving various didactical tasks, assuming the teacher's role (Полозов, 2002; Полозов, 2009; Полозов, 2011), thus creating the problem of autonomy.

4 Using Computer Information Technologies in Teaching

The main and most obvious premise of the appropriateness of using computer information technologies in teaching consists in the fact that during the traditional system of lectures the teacher is hardly able to organize several informational flows at a time, which would address every learner separately (Талызина and Габай, 1977). As a result, he has to orient himself to an abstract "average" learner, ignoring the specificity of his personal temper, the level of knowledge, mental capabilities etc. However, the organization of a flow of information of such intensity which would correspond to the individual qualities of the learner is necessary. The abundance of information may cause the loss of a large quantity of educational information, whereas low informativeness may result in losing attention, interest and motivation. Retaining the content of the informational flow of medium difficulty creates optimal and effective conditions for teaching (Полозов, 2009). Computer technologies individualize education, adapting to the personal characteristics of the learner – the fact that ensures a personal speed of learning. This creates the conditions for increasing the efficiency of educational process, since the level of reliability of acquiring knowledge and skills rises.

However, from the very beginning of the implementation of computer technologies in musical education in particular and the system of education in general, a conflict has appeared between the teacher and computer as the elements of the informational system "teacher – computer – learner". Computer programs tend to occupy the sphere of activity in teaching music which belongs to the teacher. Therefore, computer claims the role of teacher and attempts to eliminate him from the system of education. As a result, the "teacher – learner" informational channel turns into the "computer – learner" one.

5 Computer Programs Dealing with Teaching Music

First attempts of the automation of teaching music appeared in 1960s (Evans et al, 1960; Stolurow, 1961; Richmond, 1965). It is only natural that today computer technologies teaching music are on another stage of development. In what follows we shall carry out the methodological analysis of several programs dealing with teaching music.

5.1 Sesame Street: Music Maker

The plot of the program «Sesame Street: Music Maker» (Encore Software, USA 1999) consists in preparing and performing a musical concert, the participants of which are virtual characters – those of a famous American educational TV-show for children called “Sesame Street”. These virtual characters teach the pupil the basics of musical art, but the movement inside the program is directed by the learner.

This program demonstrates the possibilities of computer technologies for the aesthetic and artistic development of the learner. Moreover, it offers several forms of realization of artistic tasks. Didactic peculiarity of the program consists in the fact that it is not aimed at acquiring musical knowledge and skills typical of the primary educational stage – omitting these phases, it turns directly to artistic practice and education based on the principle “teaching without teaching” characteristic of the cognitive pedagogy. Colourful animation and musical and sound design fill the learner with joy and optimism that makes the process of education pleasant.

5.2 Adibou: The Mysterious Music Machine

The program «Adibou: The Mysterious Music Machine» (Mindscape, France 2002) developed in France has one plot line which is followed by Adibou (a virtual character controlled by the learner) and his friends travelling through a fairy world and fulfilling various musical tasks. It is generally designed as an original interactive cartoon.

This program demonstrates the possibilities of using computer technologies at the earliest stage of musical education. It should be mentioned that the program under discussion is quite self-sufficient, as far as formulating and fulfilling didactic tasks are concerned.

5.3 Трое из Простоквашино: Матроскин учит музыку

The Russian program «Трое из Простоквашино: Матроскин учит музыку» (“The Three from Prostokvashino: Matroskin learns music”, Akella Software Limited, Russia 2008) is also designed as an original interactive cartoon with the characters from the books by Eduard Uspensky. It has a strictly organized plot which is centered around teaching music.

The program consists of several blocks which are alike, structurally speaking. Each section begins with the presentation of educational material in verbal form. A virtual teacher whose role is performed by one of the characters of the plot introduces the theoretical material. At the end of the section there is a training part where a practical application of the acquired theoretical knowledge takes place. It is not possible to pass on to the next section without fulfilling the final task. Such persistence of this program is quite fruitful. Actual practice has shown that if the section is fully completed, including the test, the acquisition of the respective knowledge and skills is guaranteed. Thus, the program is an analogue of the traditional school education in the form of a game with a plot. Its undoubted didactic advantages consist in forming the basic fundamental musical knowledge and skills, even though it should be acknowledged that the creative factor is hardly present here.

5.4 Музыкальный класс

The Russian program «Музыкальный класс» (“Musical class”, New Media Generation, Russia 1997) is organized the same way. It presents 14 lessons on the theory of music (from notation to musical texture). Moreover, it contains a lecture on the history of the appearance and the development of musical instruments of a symphony orchestra with their characteristics, a musical dictation, a computer pianoforte with the timbres of various musical instruments, karaoke and three games teaching music.

This program uses the academic methods of teaching music. The off-screen voice reproduces the manner in which a teacher gives a lesson. The interface of the program is very ascetic, whereas the dialogue with the learner is minimized. However, the supplementary possibilities include games and artistic means.

5.5 Music Ace

Yet another program structured into lessons is the American program «Music Ace» (Harmonic Vision, USA 1994; Harmonic Vision, USA 1999). It consists of two blocks containing 24 lessons each. It is a real automatized educational system which fully reproduces teaching process. It is also possible to see the statistics showing whether the material was successfully mastered.

The educational material of the program is vast: it embraces tempo, meter, time signature, bar, rhythm, names of the notes, accidentals, pauses, keys, modes, tonalities, intervals and chords. Each lesson contains the presentation of the educational material and an exercise in the form of a game aimed at its practical application. The program is based on the traditional methods of teaching; however, the form of the program is captivating and playful. It is an imitation of the learner being present in a school class where the lesson is taught by a funny conductor Maestro Max and his choir of Singing Notes. The material taught in the program is accompanied by various kinds of exercises due to which the learner is actively involved in the action on the screen.

6 Peculiarities of Organization of Teaching Music with Using of Computer Information Technologies

As can be seen from the adduced examples, teaching programs are not infrequently organized according to a certain plot. Moving through the informational space of the program and acquiring respective knowledge and skills are carried out on the basis of a strictly organized scenario of the learner's actions elaborated as a plot of a story with various virtual characters taking part in it. These characters control the actions of the learner and, therefore, the process of education. Due to personification, the learner is actively involved in the action on the screen and participates in it in person. The learner's involvement into the plot can be both direct (by means of controlling a character) and indirect (when he or she becomes a certain superpower helping the virtual characters resolve the problems they face). Anyway, the involvement into the plot provokes the feeling of a direct participation in what happens, taking into account that the role in the development of the plot provided for the learner is a significant and decisive one.

The peculiarities of organization of teaching in these programs include the following aspects. First, the form of offering educational material here is a dynamic video. This cartoon-resembling form itself arouses interest and, therefore, activates perception. High emotional tonus of working capacity creates favourable conditions for mastering educational material. Second, the presentation of material is often performed as a game. As a result, the learner's attention is concentrated on the plot rather than on the knowledge on a certain subject. Such situation stimulates an involuntary mastering of educational material without additional intellectual effort. Third, mastering the educational material is constantly controlled. This is realized by means of introducing a number of problematic situations into the plot that are to be resolved using respective knowledge and skills. Searching for solution is often carried out by the learner in the situation of the absence of the necessary knowledge, i.e. reflection precedes exteriorization. A correct solution in this situation will show the success in interiorization of the educational material. Naturally, all these conditions are premises for an effective acquisition of respective knowledge and skills by learners.

To sum up, it has become obvious that the use of computer information technologies in teaching music should not be regarded as an alternative to the traditional forms of teaching. The appearance and the development of these teaching technologies is based upon the idea of the modernization of traditional teaching with a view to increase its efficiency.

7 Autonomy of Computer Informational Technologies in Teaching Music

The use of computer information technologies in teaching music presents an opportunity of building up a teaching strategy that would stimulate the pupil's learning activity as well as the process of reflection. The teaching environment formed in this case creates objective premises for revealing their independence and artistic self-realization while solving educational tasks. The learner usually initiates the process of learning himself, which presents an objective premise for the formation of a more effective educational environment.

An important aspect of both the informational-research and artistic work is the capability of computer information technologies to meet the learner's demands. The all-important elements of education include not only answering the questions, but also putting them. This is the way any artistic and informational-research work begins. Possessing vast informational resources, computer technologies offer an opportunity for its realization.

Computer information technologies create some special and quite effective conditions for acquiring knowledge. In traditional education the teacher usually *passes* the knowledge, whereas in the case of computer programs the learner *obtains* knowledge. In the latter situation the learner has an active position, and the acquired skills become his personal property.

As can be seen, all the programs mentioned in this paper do not require the presence of a teacher, and the "teacher – learner" informational system actually turns into the "computer – learner" one. The latter has all attributes of autonomy: it is independent and self-governing, existing and acting regardless of any external forces. However, in order to organize computerized teaching music, it should somehow be initiated. The first initiative on part of the learner is unlikely. This creates a serious problem of viability of the autonomous computerized systems of teaching music.

Modern trends in the development of computer information technologies as a means of teaching music clearly show the aspiration to autonomy and independence from the teacher. At present there are quite a few computer programs all over the world that claim to be teaching music autonomously. They limit themselves to the initial state of education and it should be acknowledged that it is quite mastered. Now we should expect a further movement along these lines. However, a question is bound to arise here: will the society follow the way of limitations up to the end, assigning computer the functions of teaching and educating (however, the teachers in the system of musical education are against the dissemination of computerized teaching music to a certain extent)? This question remains unanswered.

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On Some Specific Features of Using Computer Technologies in Foreign Language Teaching

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Abstract

The fact that we live in the century of high technology has already become a commonplace. Computers and the internet are used in all spheres of human life including the educational system – the one that is of crucial importance for the functioning of our society since it lays its foundations. The aim of this article is to discuss the advantages and disadvantages of using latest technological achievements in one specific field of the education sphere – that of foreign language teaching. It is widely believed that the more innovative the technology used during the process of foreign language acquisition is, the better the students' results are. However, our article underlines both positive and negative aspects of using modern technology for language learning. Last but not least, we shall point out what kinds of electronic means we use during our lessons, as well as those our students prefer after leaving the classroom. The conclusions we have arrived at in the present study are based on our personal teaching experience since the best proof of the efficiency of a certain technology is its success in real practice.

Keywords: Modern technologies, Foreign language teaching, Foreign language acquisition

The issue of using computer technologies and electronic devices in language teaching has already come to the fore in the modern system of education – the system that is of crucial importance for the development of our society since it lays its foundations. Moreover, it has always been extremely sensible to social changes, reflecting the way people and their way of life change. At the same time, the system of education has always been one of the most conservative ones, attempting to preserve the old and traditional way of learning, his opposition of tradition and innovation being characteristic not only of the educational system – the same processes can be seen in almost all spheres of human life to some extent. Thus, despite the indisputable efficiency of using modern technologies in education, teachers are not infrequently reluctant to be innovative and implement them, trying to persuade the learner of their inconsistency and uselessness (Полозов, 2002).

It should be mentioned from the very start that we do not belong to this kind of teachers. Neither do we belong to those who claim that computer technologies can replace real teachers, offering unlimited possibilities for language learning. We prefer to accept new technologies and innovations since their efficiency has already been shown, but to remain rather critical and careful when using them. In what follows we shall list and describe electronic means and devices used in foreign language teaching both in the classroom and outside it, basing our conclusions not only on the specialized literature, but also on our own teaching experience since the best proof of the efficiency of a certain technology is its success in real practice.

Electronic dictionaries constitute, probably, the most widely used electronic device in language learning – a great test of that is the number of such dictionaries to download on the internet and to buy in the shops. This kind of electronic devices include two separate categories:

offline and online dictionaries. It goes without saying that they have some major advantages: first and foremost, the search is conducted much quicker and easier – the learner only has to type the word instead of turning the pages of a voluminous book; second, it gives an opportunity for an almost unlimited number of words, expressions and contexts that can be incorporated in the dictionary, whereas ordinary dictionaries risk either to be too big and unhandy (the fact that matters very much when the learner uses the dictionary outside the classroom or home and has to transport it) or to become practically useless because of a too small number of words contained in them. For example, the electronic version of a widely used English explanatory dictionary – Longman Dictionary of Contemporary English (http://www.ldoceonline.com/) – is a great alternative to its printed version. The content of the electronic version fully corresponds to that of the printed one; moreover, it can be used absolutely free of charge, whereas the original book might prove to be rather expensive for some learners. However, this is the online version of the famous dictionary which cannot be used offline – a slight disadvantage which can hardly be called pressing since the majority of modern electronic devices provide the access to the internet. Besides, if the learner has no internet connection, there is yet another variant of using the tool – the electronic offline version that can be purchased on the internet.

Even though electronic dictionaries have major advantages and are widely used by language learners, gradually eliminating their printed counterparts, the use of such dictionaries is not infrequently questioned by the teacher. In some cases, the dictionaries found on the internet do not present a reliable source of information, being the result of the collective work of some translators, but not being verified by a professional native speaker. Moreover, some foreign language teachers – true philologists – are reluctant to recognize the advantages of the electronic device and claim that the book version is more precise, accurate and comprehensive.

The next electronic means used in foreign language teaching and learning is **electronic translators**. This device is also widely used in language learning and translation. Its advantages are obvious: first, the learner gets the translation of the whole text at a time, which means that he or she does not have to waste time translating each single word; second, it is especially useful for those who do not know or hardy know the language of the text and have to understand its meaning. Such translators also have online and offline versions – both free of charge and purchasable ones. The most widely used online translator which we also resort to during our classes is Google Translate (https://translate.google.com/). It offers an impressive variety of languages for translation that can be combined in every possible way – one of the most crucial aspects when we deal with multi-lingual groups comprising native speakers from different countries with different native tongues, especially in the cases when the learner and the teacher have no common language (i.e. not all the learners can speak English or French even at the elementary level).

However, it should be mentioned in this connection that this electronic device has a substantial disadvantage – it is commonly believed that no machine can translate as accurately as a human being, even if it is most sophisticated and modern (Bar-Hillel, 1964). As far as grammar, lexis, morphology and syntax are concerned, the resultant text presented by electronic translators not infrequently abounds in mistakes. In some cases, these mistakes may prevent a correct understanding of the whole text. We would therefore recommend the use of such means in the classroom guided by the teacher whose task would be to make sure the word, expression or even text is clear to all students. Another disadvantage that should be mentioned here is the different level of accuracy in bilingual translations. For example, Google Translate offers several variants of translation in English that ensure that almost all possible meanings are embraced; however, if the combination of language is more exotic – like, for example, Russian and Romanian – it gives the only variant of translation which may not correspond to its real meaning in a certain context.

Yet another electronic tool used in language learning is **computer games** and **mobile applications**. We shall not discuss the former since they are traditionally created for children and are not so popular among university students. However, mobile applications for tablets and smartphones have already become an extremely popular tool among adults and they are getting more and more popular along with the spread of sophisticated mobile devices. The reasons for this are not difficult to see: they are very handy since they can be used practically everywhere – while waiting in a queue, sitting in the bus, laying on the beach etc. In the majority of cases they are user-friendly, offering a pleasant interface and a simple structure. Moreover, they do not give the learner an impression of a boring school class with endless grammar exercises – the aspect feared most by the modern grown-up language learners. Instead of looking at the pages in black and white full of ordinary tasks, they are offered a colourful game with pictures and audio materials.

However, apart from the obvious pros, there are also some cons as far as mobile applications are concerned. The main problem here is, again, the reliability of these applications – being used without the teacher's guidance, they may provide less information than necessary (or even contain mistakes) and, therefore, cause an incorrect use of a word, form or structure by the student.

To look at the issue from another angle, the internet offers an almost unlimited source of information, including that referring to language. Thus, it provides us with a large number of **web pages on various language aspects**, including, first and foremost, grammar, lexis, morphology and syntax. Such pages may prove to be extremely useful since they might give some additional information which was not provided by the teacher or explain a certain issue in an easier way that would be clearer for the learner (this aspect is especially important when dealing with large groups of students, where the teacher is unable to control everyone's understanding of an issue). A reliable online English grammar reference source was created by the British Council (https://learnenglish.britishcouncil.org/en/) – their web page provides the learners of all ages with theoretical material, exercises, games and podcasts, as well as some exercises and tips on passing the IELTS examination. Another source that is worth mentioning here is the online dictionary provided by Wikipedia – the Wiktionary (http://www.wiktionary.org/). The information it provides is comprehensive and clear; it incorporates the data on the etymology, pronunciation, morphology and meanings of a word, as well as its derivatives and alternative forms.

Obviously, the major problem here is that of reliability – the information contained on such web pages might be misleading and incorrect. In some cases, these pages are created by amateurs that are not infrequently mistaken. Unfortunately, the learner may prove to be too inexperienced to become aware of it, thus retaining false information.

The Internet also provides the learners with vast opportunities for **online testing**. The offered tests may reveal the general level of language acquired by the student or provide some exercises on a separate grammar rule, phraseology, collocations etc. This means is handy for the learners since it does not require the presence of the teacher in order to estimate whether the material has been fully mastered – both the web page and the offline test (such tests are often contained in electronic versions of explanatory dictionaries) automatically correct the learner's mistakes. Thus, the learner can decide whether he or she needs revising the material or not.

The advantages of this kind of language learning can hardly be doubted; however, there is one serious disadvantage – the machine is not able to replace the teacher and to provide necessary explanations (even though some tests attempt to do this, they often fail since the question raised by the student can hardly be predicted in all situations). Moreover, the machine is not able to estimate whether the learner's mistakes are the result of his carelessness and lack of attention or the material needs to be revised. Thus, this kind of electronic tools is far from being interactive; however, it is useful for the students who have already acquired the knowledge on the subject and need the confirmation or exercise of their skills.

Another opportunity provided by the internet is **social networks for language learners**. Apart from international interactions in ordinary social networks (like Facebook) there is a number of web pages that offer an opportunity to learn a language actually using it in conversations with native speakers or other learners. Let us adduce two examples of such networks. One of the most widely known web pages is Livemocha (http://livemocha.com/). First and foremost, the site provides the learner with a number of colourful exercises which, like mobile applications, do not reproduce boring lessons, but offer a set of expressions and grammar structures that are to be memorized through repetition. The exercises are divided in five blocks that almost fully correspond to those which are traditionally used when discussing language skills – use of the language (construction of phrases, collocation, lexis), listening, writing and reading. The exercises which cannot be corrected automatically (for example, writing a text of your own or reading a text offered by the web page) are revised by native speakers. Thus, a person entering such network is immediately stimulated and excited since he or she performs not only the role of a student, but also that of a teacher, a native speaker commenting upon the way language learners cope with the tasks and even giving them evaluation marks. Moreover, the web page also includes a messenger and a chat where people can talk privately – all the learner has to do is to set the target language and wait for the persons available at the moment. Another popular social network of this kind is InterPals (http://www.interpals.net/). It does not provide the learner with exercises, resembling an ordinary social network, apart from the fact that it is created for the people who wish to practice their language skills. It contains a more sophisticated search section – the learner can set not only the target language, but also the region or even the country, age and gender of a potential interlocutor. The web page also has a chat where complete strangers meet and talk – the fact that may constitute a sound advantage for introverted people with difficulties in interaction. To this list we can also add language forums – the web pages where people discuss some unclear language issues and find a solution with the help of native speakers.

The main disadvantage of such social networks is not the network itself, but the people using it. Unfortunately, they abound in the cases of fraud – the reason why such networks should be used with great attention and care. Moreover, the exercises present in these networks have certain disadvantages: first, they are verified by native speakers who, in the majority of cases, are not professionals in the field and, therefore, can sometimes provide the learner with incomplete or even incorrect information on the subject (as we all know, the way native speakers see their own language differs dramatically from the way it is perceived by foreigners – the reason why native speakers should complete a certain training in order to be able to teach their own language (Medgyes, 1999)). Second, the issue of reliability again comes to the fore – the exercises contain mistakes, and no explanation is provided. Thus, we would recommend the use of social networks for language learners primarily for practicing writing and speaking skills rather than as the main source of information and the only tool in language learning.

The development of the internet also made it possible to share the **electronic versions of manuals**. This means that the learner has a larger access to educational materials: now he is able to download a book printed in another country and not available for sale in his or her region. The teacher also profits in this situation since he can use a larger variety of workbooks during his lessons.

The negative aspect of this issue consists in the fact that uploading electronic versions of manuals is illegal in the majority of cases. However, some electronic versions can be legally purchased at the web site of the respective editing house.

Some other ways students can use technology in language learning include using **software, social networks etc. in the target language**. The settings of the majority of programs and networks allow the user to change the language of its interface. Even though this might seem an insignificant detail, it is especially effective at the early stages of language learning, when the student has to memorize the verbs such as *to send, to receive, to check, to open, to close, to enter, to set, to save, to delete* etc. Moreover, it would help the user to get accustomed to the language and its structure with a view to form the student's perception of the target language as a real tool actually used in life.

To sum up, nowadays, in the epoch of computer technologies, the issue of using electronic means and tools in teaching is becoming more and more topical. The internet is the largest existing source of information with the full freedom of access; however, this freedom in some cases results in some serious disadvantages since the user should be able to distinguish the reliable and unreliable sources. This constitutes the main problem of using electronic tools in language teaching and learning – even though some sophisticated devices, programs and applications have been created, they can hardly replace a real person – the teacher – under whose guidance these programs ought to be used. This does not mean to say that we deny the obvious advantages of using electronic tools in foreign language learning; on the contrary, we acknowledge that they make the process of learning not only more efficient, but also more entertaining and pleasant. However, we prefer to remain critical of these means in order to provide the learner with the correct and updated information, controlling the way he or she gets it and giving advice on the use of these sources of information. Otherwise stated, we believe that electronic tools can and should be not only taken into account, but also used by foreign language teachers after considering their pros and cons and warning the students of the possible difficulties.

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Online Live Broadcasts in Student Interpreter Training: Advantages and Challenges

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Abstract

Student training in the field of conference interpreting has traditionally been performed in a controlled environment in which the teacher selects the (already recorded) input material having in mind a certain outcome which is usually confirmed by the end results. The risk of encountering unexpected situations is reduced to a minimum, unlike real life situations where interpreters are often faced with unpredictable conditions. The aim of this paper is to present a possible remedy for this problem: simulating conference interpreting in the classroom context using online live broadcasts, in order to improve the skills of future conference interpreters. We will focus on the advantages, as well as on the challenges, of this web-based activity, illustrating them through a case study.

Keywords: translation, simultaneous interpreting, live online broadcast

1. Introduction

Student training in the field of translation has attracted a lot of attention in recent years (Garzone and Viezzi, 2001; Schaffner, 2004; Tennent, 2005), and many of the studies devoted to this topic also cover interpreting as a form of translation. The increasing interest in translation has led to more studies being published, more conferences being held, more specialized organizations being created, but it also had an important impact in translation training as more translation modules were incorporated into undergraduate and master programmes, or such programmes were created specifically for translator training.

Most translation modules have traditionally focused on written translation, however it is generally accepted that different training is required for interpreters than for translators because of the differences between the two fields. This paper draws attention to the training needs of future conference interpreters and the way they could be better served by using web-based tools in the classroom, for example online live broadcasts. The first part of the paper introduces the topic of training interpreters highlighting the specific features of interpreting as opposed to translation, which should be reflected in the training programmes. While the second part presents a case study of such a web-based activity in order to assess its advantages and challenges for both teachers and students. The aim of this paper is to determine to what extent the use of online live broadcasts is recommended in interpreter training as a simulation of conference interpreting in the classroom context.

2. Training Future Interpreters

Interpreting is usually defined as the oral translation of oral discourse. This type of translation includes various forms depending on the setting in which it takes place and on the features of the activity itself. Thus, by applying the first criterion we obtain, according to Gile (2004: 11) a “social” classification of interpreting which includes: *conference interpreting* at meetings held by international organizations, by large industrial corporations, by government bodies at a high level and for radio and television, *court interpreting* at court proceedings, *sign-language interpreting* in all environments where deaf people need to communicate with hearing people, *community interpreting* in environments where “individuals from minority groups or foreigners interact with the public authorities and medical authorities in a host-country” (Gile, 2004: 11).

Taking into consideration the activity itself, interpreting can be sub-divided into **consecutive interpreting**, the interpreter listens to a speech segment for a few minutes or so, takes notes, and then delivers the whole segment in the target language, repeating the operation until the end of the speech; **simultaneous interpreting**, the interpreter sits in an interpreting booth, listens to the speakers through a headset and interprets into a microphone while listening; and **whispered interpreting** (or **chuchotage)**, the interpreter does not sit in a booth but in the conference room, next to the delegate who needs the interpreting, and whispers the target-language version of the speech in the delegate’s ears (Gile, 2001: 41).

As previously stated, most translation modules have focused mainly on written translation. This is not enough in the case of the students who intend to pursue a career in interpreting because translation and interpreting are two distinct activities. Although it has been claimed that translators and interpreters basically fulfill the same function, many argue that they are completely different. Regardless of the position we adopt, we cannot ignore the undeniable differences between translation and interpreting in practice, most of which stemming from the fact that translators deal with written language and have the possibility to revise their work, whereas interpreters deal with oral language and have no time for revision (Gile, 2001: 41). According to Gile (2001: 41), the main implications of this situation can be summarized as follows:

♦ “translators need to be familiar with the rules of written language and be competent writers in the target language; interpreters need to master the features of oral language and be good speakers, which includes using their voice effectively and developing a ‘microphone personality’

♦ any supplementary knowledge, for example terminology or word knowledge, can be acquired *during* written translation but has to be acquired *prior to* interpreting

♦ interpreters have to make decisions faster than translators.”

The author (Gile, 2001: 41) adds that “unlike translation, interpreting requires attention sharing and involves severe time constraints”. In fact, a major difference between the two processes is that they impose distinct constrains in the working environment: “In (business) translation, the main source of stress is the required speed of processing and associated fatigue. In conference interpreting, stress may originate in stage fright at high-level meetings or when interpreting for the media, especially in view of the fact that, unlike translators, interpreters cannot correct their initial utterance (with some exceptions), and also in the physical environment in the booth.” (Gile, 2004: 12)

According to Riccardi (2001: 22), the result of the (simultaneous) interpretation process, i.e. the interpreted text (IT), has a hybrid character because of “growing intercultural communication and of the international setting in which SI [simultaneous interpretation] takes place”. Among the features of an IT the author records: lexical and morphosyntactic interferences, the close relation to the source text (ST) and the event in which it takes place, the use of an international jargon: “The international character of a conference suggests, for example, the adoption of the same terms or of an international jargon in all the interpreted languages, in order to ensure coherence between the language versions produced” (Riccardi, 2001: 22). Based on these features, Riccardi (2001: 22-25) identifies four dimensions along which the performance of the interpreter can be assessed: *delivery* (pronunciation, speed and rhythm, pauses etc.), *language* (morphosyntax, syntax, calques, internationalisms, etc.), *content* (i.e. the relevance of the information conveyed by the interpreter in the given context), and *interpretation* (anticipation, technique, overall performance etc.).

At present, according to Niska (2005: 38), interpreter training is mainly carried out as academic courses in universities. Although “classrooms are sometimes considered by theorists and professionals as artificial settings, and most teachers would agree” (Davies 2005: 71), the alternative, i.e. on-the-job training, is seen as worse, being compared by Davies (2005: 71) to asking medical students or future teachers to learn at a hospital or school with no parallel formal training. For Davies (2005), the solution is to optimize the classroom setting; for this she gives various suggestions, for example, by turning the classroom into a discussion forum and hands-on workshop; or by establishing contact with the outside world through projects which involve professional translators; or by including as many real life situations as possible so that the students get the chance to experience the professional world (Davies, 2005:71).

As far as the process of interpreter training is concerned, Gile (2005) identifies a progression from consecutive interpreting without notes (“memory-enhancement exercises”), to consecutive interpreting with notes (the “true consecutive”), to simultaneous interpreting, seen by students as “the culmination of their training”, according to the author (Gile, 2005: 133). The author also mentions that the use, at all these stages, of audio and video recordings of speeches, as well as of speeches and interviews broadcast on the Internet, on radio or television, is essential. In our experience, “video podcasts are much more useful because they introduce the students to a virtual environment which simulates the real one” (Micu and Sinu, 2012: 119). Among the advantages of using these recorded audiovisual materials is the fact that students are exposed to a variety of voices, accents and other delivery patterns in authentic speeches, that they can transcribe and/or play again the speeches for closer scrutiny of specific phenomena or problematic segments, that instructors have the possibility to acquaint themselves with the recordings prior to exercises, so as to be able to concentrate on the students’ target speeches and detect problems more accurately, etc. (Gile, 2005: 136). However, as long as future conference interpreters train in a controlled environment, the risk of encountering unexpected situations is reduced to a minimum, unlike real life situations where interpreters are often faced with unpredictable conditions to which they have to respond quickly. This is why, in addition to the use of recordings, we suggest that the training of future conference interpreters should also include the use of live conference broadcasts available online, thus simulating conference interpreting. Such an experiment is presented below in the case of the students enrolled in a Masters programme dealing with translation and interpreting from French into Romanian.

3. Case Study: Student Interpreting Training Using Online Live Broadcasts

As previously stated (Micu and Sinu, 2012: 119), interpreting is considered a very challenging type of translation, requiring from the translator “an exceptional language level, excellent vocabulary and a good, functional, decision-making sense”. In order to improve the skills of future conference interpreters we felt that it was necessary to afford students the chance to experience real life situations without leaving the classroom. This is why we decided to organize a simulation using the **DG Interpretation – DG Translation- Universities conference "*Translating and interpreting for our citizens*",** held on the 27th and the 28th of March 2014, in Brussels and which was broadcasted, live, worldwide in French and English. The annual EMT event was part of a joint conference for universities organized by the Directorate-General for Interpretation and Translation. The presentations used in class (See Figure 1, available online at (http://ec.europa.eu/dgs/translation/programmes/emt/conferences/index_en.htm) were focused on institutional and public service translation and interpreting, with examples of best practice in training courses. Thus, they were also informative for students.

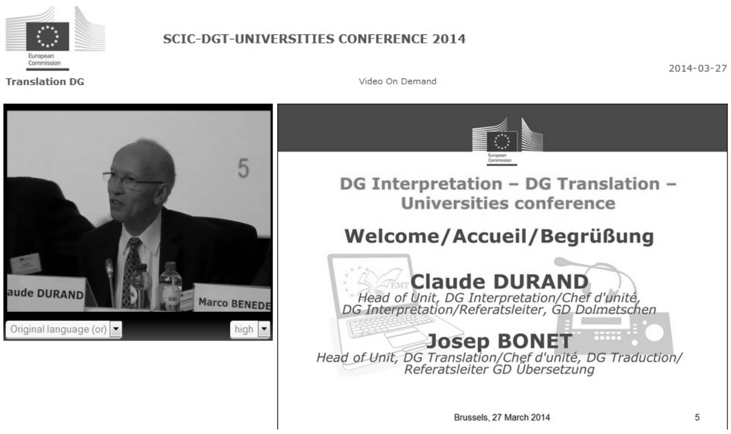

Figure 1. Print screen from the live broadcast used

This interpreting exercise involved the first year students of the Translation and Interpreting from French to Romanian Masters programme (*Traducere şi Interpretariat din limba franceză în limba română*), translating from French into Romanian. It should be mentioned that the students had undergone around 40 hours of previous training in simultaneous interpreting.

Our main objective was to monitor the language and content parameters discussed above, by evaluating the result of the interpreting process, i.e. the Romanian discourse, in terms of correctness, coherence and cohesion. We also wanted to see how students reacted to increased stress, manifest in the delivery and interpreting parameters, as this was the first attempt to use an online live transmission as simultaneous interpreting material. Thus, we monitored elements such as the speed of students' linguistic choices in the target language, i.e. Romanian. By linguistic choices, we understand the use of synonyms in order to avoid repetition, the translation of source language idioms by idiomatic equivalents in the target language or paraphrases, while transferring the whole meaning of the expression.

The interpreting exercise involved a preliminary stage, "Identify and explain", in which student were introduced into the atmosphere of a conference and asked to identify translation difficulties and to find the most suitable solutions for them into Romanian, as to ensure the most appropriate information transfer from a language to the other. In fact, students were supposed to identify and write down short passages from the participants' speeches (each lasting around fifteen minutes), fragments that they considered difficult. We used the coffee breaks, where the broadcast was off, to discuss and solve these difficulties.

Then, students watched and listened to the speeches and translated some parts of them, no more than five minutes each. We focused on the coherence and the cohesion of the result in Romanian. However, due to time constraints from both sides (class and speech duration), this second part was shorter than the previous one.

As a result of this simulation of conference interpreting, in the preliminary stage, students were able to identify all the difficulties occurring in the speeches we listened to and write them down. In order to find the most accurate translation solution we used "brainstorming", sometimes students coming up with two or three suitable alternatives. At this stage, the role of the teacher was to help them decide which might be the best variant.

The actual simultaneous interpreting exercise was more difficult. Some of the students succeeded in providing a proper translation, but most of them experienced great difficulties in doing so. The main cause seems to be the fact that they were stressfully aware of interpreting the "real thing", without the possibility of listening to the speech again. This was not the first time audio-video material was used in interpreting exercises in the classroom (students had at least one previous experience with such material, and with satisfactory results). An assessment of their input reveals the fact that, even if the information was transmitted correctly, the coherence and the cohesion of the Romanian translation were affected. Simultaneous interpreting means right away, so students tried to minimize the time of their translation in order to keep up with the speaker. Sometimes, this resulted in a certain degree of incoherence, lack of cohesion or both. Some of the students experienced blockage at first, before they were able to start translating with satisfactory results. Although most of the participants were not satisfied with their work, in the end, they concluded that it was a useful training experience that should be repeated as often as possible.

After analyzing this translating/interpreting exercise with the students, we spotted some clear advantages of the method, the main one being that, by simulating a real-life interpreting event, we can familiarize students with conditions very similar to those of professional conference interpreters. As a direct consequence, the students' capacity of interpreting improves because they learn to make linguistic decisions faster. Taking into account the fact that the live broadcast cannot be repeated, the reaction time they have at their disposal is very limited; they cannot stop and think of a better translation solution. At the same time, their attention must be much more focused, because they need to hear everything the speaker says and the way it is said in order to translate it properly.

However, there are some disadvantages that cannot be ignored, the one that stands out relates to the high level of stress of the students. Their capacity to translate might and sometimes is affected by the stress of working with a live broadcast. Nevertheless, if one chooses interpreting as a profession, they must get accustomed to this high level of stress. There are also technical problems such as the quality of the live transmission – which depends on the Internet connection -, of the sound system used, etc. The quality of the results of this exercise also depends on how tired or rested students are, on their personalities, etc.

4. Conclusions

In conclusion, interpreting is a very complex activity whose success depends on the acquisition of specific skills (e.g. concentration and attention sharing, speech comprehension and thorough language knowledge, etc.), on becoming familiar with the working conditions and the atmosphere and jargon of international conferences. As we have seen, using a live conference event available through the Internet may prove very useful in training future conference interpreters mainly because it allows them to experience circumstances very close to the working conditions of this profession. The translation of online life broadcasts challenges students, increasing their level of stress, but allows them to improve their interpreting skills in what we may call, proportionately speaking, "battle field" conditions. Despite the fact that it depends on several external/technical conditions as discussed above, this web-based tool, i.e. live online broadcasts, can become a valuable teaching resource in interpreter training.

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The role of Modern Educational Technologies for the education of children with S.E.N (Special Educational Needs)

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Abstract

This article is an argument for increasing the efforts on introducing new technologies in special education and inclusive education in our country. Although there is a material basis in some schools that provide "ICT infrastructure", there was no concern that it would be assistive and effective technologies as educational investment, especially for students with moderate and severe cognitive deficit in special schools but also for students with difficulty in learning in mainstream schools. Multimedia technologies, augmentative and alternative communication devices specific solutions are often not very expensive and give good results in learning for these categories of students. To highlight the role that modern educational technology has in increasing the quality of life of people with special needs, for the quality of teaching, form reducing disparities due to the learning environment and the saving of the educational costs we use secondary analysis of data, and two institutional case studies (a special school and a mainstream school) that will reveal best practices, and also the obstacles encountered by the integration of ICT in the educational process.

Keywords: special educational needs, assistive technologies, special and inclusive education

1 Modern Educational Technologies and the country politics for improvement educational services for people with special needs

In the context of the current technological revolution which determined major changes in our daily life emerges the need to clarify the relation between this and the special needs people. An overview, seen from outside of the issues of the special needs person, shows that in Romania these two realities are perceived as incompatible. Many years passed and the technological revolution did not mean anything for the increase the quality of the life of the people with special needs, while in other states assistive equipment were proving their positive impact on the increase of social inclusion and personal well-being.

It is noted that the development policies on the use of modern educational technologies for children's with special educational needs are deficient both in terms of ensuring infrastructure and on their integration into the educational process in order to facilitate and improve performance. Special schools have been equipped with computers like normal schools, with no concerns of transformation/adaptation of these in learning instruments which would sustain the different work and the personalized approach. The teachers did not get a coherent training program either for the e-skills in this specific domain and there was even less interest in forming e-skills for special needs students.

For the National Strategy for the Digital Agenda for Romania e-inclusion involves providing access to ICT networks and equipment and providing trainings for developing ICT e-skills, but specify that the groups to which this is addressed (poor people, rural population, handicapped people) are considered to be "difficult to adapt to the requirements of modern society" and so it needs additional, but unspecified assistance (page 50). External experiences and tests performed here and there in our country clearly demonstrate that the use of ICT for the disadvantaged categories can help them to overcome the difficulties in which they are located. Unfortunately, the National Digital Agenda does not exploit the huge potential of technology to improve the quality of education and quality of life of people with special needs and neither to reduce financial and social costs due to disparities (and we refer to education) between rural and urban areas, especially on the poor areas from rural.

Romania has ratified in 2007 the United Nations Convention on the Rights of Person with Disabilities and based on the 4th article is obligated:

"(g) To undertake or promote research and development, to make known the offer and encourage the use of new technologies, including information and communication technologies, mobile devices support, devices and assistive technologies, suitable for persons with disabilities, giving priority to technologies at accessible prices;

(h) To provide accessible information to people with disabilities about mobility aids, devices and assistive technologies, including new technologies, as well as other forms of assistance, support services and facilities;

(i) To support training in the rights recognized in the Convention, professionals and staff working with persons with disabilities in order to improve the provision of assistance and services".

These obligations are set out in sections as: accessibility, personal mobility, freedom of expression and opinion and access to information, habilitation and rehabilitation, participation in political and public life and in the definition of "communication". However it seems that it's overlooked to correlate these important aspects with the national strategies and other policies which can lead into practice of these commitments.

It is notable that all the efforts made until now have been reduced to minimal adjustments of the physical environment (the famous ramps) and that there is no public information at the national level about the compliance with national provisions concerning the accessibility of the physical environment, information and communications (Stanciu, M. coord, p.35).

As specialists involved in the education of children with special needs, we request the inclusion of ICT in real life beneficiaries of special education as the only way to compensate for disability which often can make learning inaccessible. How many schools in Romania know, have access and use the assistive technologies to increase the independence and to "allow people with special needs to reach their own potential" (Teles E and Santos, M- "Assistive Technology - Course Manual" developed in the CP-PACK project, 2010)?

2 The role of Modern Educational Technologies in the education of special needs people

Assistive technologies includes any device, system or application/service, starting from simple objects that can facilitate learning (low-tech) to touch devices which can record a verbal message or prosthetics, specific instruments that allow voice commands, complex programs/applications for PC (high-tech). They are improving the participation of people with special needs to the daily activities, to education, to work or can help them to spend free time. Lately more and more specific applications have been developed to compensate different problematic aspects from peoples' lives and, also, we can state that in recent years there is a major concern for research and development of technological solutions which adapt the living environment ("ambient assisted living ") to the needs of people with special needs (especially for the blind and for people with neuro-motor disabilities).

But ICT is, in education, a new component of the curriculum, a valuable set of new resources and teaching instruments adequate to support the learning process. It can be included in teaching, learning and evaluation, but also in improving the management of the educational unit.

In the absence of a coherent policy regarding the inclusion of ICT in the education of children with special needs, the schools have tried to develop solutions to solve these issues (thus promoting an E-inclusion model inverted from bottom to top). The intervention of ICT in the education of children with special needs is is quasi-unknown and we are noticing that it was not approached in the studies from the local literature.

In the mainstream schools, although there are statistics, these do not represent the real number of children that have special educational needs. Proof for this are the major differences in the distribution of these cases on regions (the variation is worrying – from a few dozens to over one thousand), as well as the fact that over two thirds of the total number of children with CES are part of schools in urban environment and almost a third in rural schools (Stanciu, M. -coord, p.18). We need to mention that the reported number represents recorded cases, which are in the records of DGASPC/CJRAE with school orientation certificates. A high percentage of special educational needs (but unknown) is represented by those who's parents don't know/don't accept/don't want to receive these services (last categories due to the social stigma). These children as well the officially the officially diagnosed require adapted educational intervention.

Below we are presenting 2 institutional efforts made to support students with SEN in mainstream school and special school.

The school in question is located in an area with a diversified community, which includes a lot of poor families, with adults without occupation or with illicit occupation, people that have problems with the law, Rroma families. The inhabitancy conditions are most of the times inadequate, in unhealthy houses, with several other families in the same room. At school the children with SEN investigated have a relatively good health condition, with school and learning adaptation problems due to social and family context. They present borderline or easy mental retardation to which associated disorders are added: attention deficit, deviant behavior. Added to the social issues are problems of an organizational nature from the school, like an inexistent fund for textbooks. These are insufficient, very old and never updated with newer editions. Although, through efficient management, it was managed to equip the school with quite a large number of computers, SMART boards, phonic laboratory and high speed broadband connection (wired and Wi-Fi).

These things, along with special training of a few teachers and the integration in the teaching activities of educational software, led to the increase of the student involvement, improvement of the school performances, better inter-relationships.

A lot of the times the textbooks have been replaced with electronic materials, educational platforms were used, libraries, maps, electronic encyclopedias. Using computers during the teaching-learning-evaluation process has had a very important role, as the PC assisted teaching helped with some student difficulties, especially for SEN students who had the possibility to express themselves in order to be understood by the ones around them, to understand themselves correctly a message that was transmitted, to decipher a written text or to realize the act of interpersonal communication and led to a positive change of the nature of the relation between the teacher and them.

ICT applications offered access to a variety of teaching and evaluation strategies for students in general and for those with special educational needs especially. The teachers managed to increase the cognitive, emotional and social autonomy of children in their educational, school and formational activities.

It is indeed more widespread and shared the observation that the speed with which changes occur scientific, technological and social, requires the school to prepare pupils to manage their maximum power range. It should be noted that information technologies as teaching tool are suitable for the implementation of inclusive education concepts and positive approach.

In order to consolidate personal development, the educational initiatives from the inclusive curriculum, the teachers pursued the satisfaction of needs, characteristics and unique abilities of every child which led to positive effects on socio-emotional learning and development of personality, positive effects on children's behavior, increased the interest in learning and improved the social behavior. As a result, ICT becomes a very valuable resource for inclusion.

On top of that, if the resources of the teachers are insufficient, teaching methods facilitated by ICT can help to provide a quality educational process. Because of the striking and highly visible adaptation needs generated by the gravity of the disability in the special school it is needed that the specific technology act both in a didactic way as well as to compensate in order to bring improvements to the autonomy and independence of people with disabilities.

There are assistive technologies for communication imposed here, assistive technologies for mobility, for control of the physical environment (Ambient Assisted Living), as well as for orientation. All these are important in the context of increased proportion of severe or profound mental disabilities, the associated handicaps, and also the behavioral problems in special schools.

Regarding the assistive technologies for communication we are presenting (as part of the initiative team) efforts made by the Special School St. Nicolae from Bucharest and the encountered difficulties regarding the introduction of augmentative and alternative communication in the teaching process for the disabled students (learning disorders, slight, mild and severe mental deficiencies, associated deficiencies like autism and other syndromes, cerebral palsies, emotional and behavior disorders).

The debut of these was in 2005 when in order to find educational solutions for students with severe/associated deficiencies which were increasing fast from one year to another, we initiated the Educational Support for Children program which was financed by the KAP-Matra program in order to elaborate educational materials for students with severe/associated disorders, but also to insure the informational support necessary for the specialists and parents. Within this project we discovered augmentative and alternative communication, the benefits of this for the current status of special education (teaching materials, methods, continuous professional training). With the help of Mrs. Dorothy Fraser (volunteer) we continued these efforts through the partnership with one of the largest companies for educational software from Great Britain – Widgit Software. This offered for free an educational software to the school – Communicate in Print. Step by step this right to use was extended to other 4 special schools in Bucharest at their request, as the benefits in working with children (even autistic children) were obvious. In 2006, the same company was offering a second educational program, Communicate by Choice. The application of these software was limited by the fact that they are edited in English. In 2007, three specialists from the school have the chance to participate at the 6th Conference for Eastern and Central Europe regarding the Augmentative and Alternative Communication. Countries like Russia, Ukraine, Byelorussia already took the first steps in implementing augmentative and alternative communication in their special education systems and Hungary, Czech Republic and especially Poland were really successful. In January 2008, ten Romanian specialists become members of the International Society for Augmentative and Alternative Communication. In 2009 efforts are being made to translate the Communicate in Print program in Romanian language. In 2008 a project is submitted to Sectorial Operational Programme Human Resources Development which will begin to be implemented in August 2012. Through this project the school has own four trainers trained in Poland by the Speaking Without Words Association and in partnership with the Bucharest University, Psychology and Educational Sciences Faculty, Special Psychopedagogy department a training program called "Augmentative and alternative communication. Educational-therapeutic-compensatory intervention strategies". The 166 teachers from special education from Bucharest and Ilfov benefited of training, as well as post-training conducted by trainers, electronically, through the forum of the website www.comunicare-augmentativa.ro. Also, 4 newsletters with information from the domain have been sent to them. One of the indicators of the projects looked into the increase of usage rate of the PC for teaching and around 97% of the participants said within the evaluation questionnaire of the training program that it improved the usage competencies of the PC for teaching purposes.

In all these years we have acquired knowledge, surpassed difficulties and convinced that using this method in working with students with special needs ensures quality and increases the chances that their lives to be real with others. With all these, all this time we could not get official support (other than encouragement and praise from the inspectorate and the ministry through its representatives). The school has minimal adaptations of the environment and, through high efforts, from donations and the described project funds, few low-tech devices for augmentative and alternative communication. Because of the software though, teachers who were initiated in this domain can prepare their materials like communication books, visual schedules and communication passports.

3. Proposals for the integration of ICT in the educational process

Acknowledging the importance of the subject for special education and the major impact for the improvement of the quality of the lives of people with special needs, the UNESCO Institute for Information Technology in Education (UNESCO IITE) and the European Agency for Development in Special Needs Education, created a review of innovative educational practices using ICT. Conjugating these concrete illustrations of the impact of ICT on the quality of life with the needs identified in special schools and mainsteam schools we get the following development directions:

- Equipping school institutions with educational services for children with special needs with ICT tools will reduce the difference between the students creating equal opportunity for education. Now ICT has a major role for prosthetists the learning process. Choosing ICT tools need to meet the needs of beneficiaries because these technologies are used in school, but at the same time in everyday contexts for improving the autonomy. Tablets could be an answer for a lot of the students with easy and medium deficiencies, but for severe cases we would need: touch technologies, new eye gaze technology, adapted and alternative keyboards and mice, joysticks or rollerballs, switch, message communicators and other programmable hardware. The lack of these instruments majorly affects the efficiency of the teaching process by generating lack of involvement in the learning from the students with SEN with major consequences on their social inclusion. Because the costs of the equipement are significant, a lot of the european states offer funds or special programs to be more easily acquired.
- Stimulate the development of resources – educational software, educational platforms adapted and accessible, protected virtual spaces for the communication between the educational communities from the different areas of the country, free virtual libraries, resource-support packages for different types of difficulties/disabilities, digital textbooks adapted to the different types of disabilities, assessment programs tailored to different levels of development of the children, virtual simulations of the different aspects from urban/rural life etc. A lot of children with SEN need more time to work or to get back to a task, educational resources based on ICT are accessible at anytime, as many times needed, offering new opportunities in learning like the possibility of personalizing, increasing involvement and collaboration. Virtual learning is a solution for those homebound, hospitalized and reduce urban-rural disparities. It also is important for compensating the low number of hours of pshychopedagogical support allocated to the support teacher for each case (ecause the norm is made by number of students, no by the complexity of the cases as it should be).
- Ensure communication with parents (by creating special pages, discussion forums, egroups etc.) for involving them in educational process and meantime to increase social

responsibility of the school to the development of new generations in the context of diminishing the role of the family (parents that allocates to their familly a maximum of 3-4 hours / working day).

- Because, as we mentioned, ICT fulfills the function of a prosthesis for learning and life is necessary that both the beneficiary and their family to be informed about these opportunities, to allow them to choose the appropriate device or technology and to be trained to use ICT with maximum efficiency.
- Initial and continuous professional training of the teachers regarding ICT in education is a reason for the lack of ICT integration in education and in the lives of special needs people. The teachers must always be up to date with ICT technologies and projects created to assist teaching, and in this context e-learning is vital. Also, cooperation between stakeholders needs to be stimulated – collaboration of the beneficiaries (students, parents, teachers) with professionals involved in the development of ICT solutions in order to stimulate. There are multiple examples of technologies developed by people with special needs which then proved very to be useful for those whithout disabilities.

Another useful form of learning is represented by knowledge exchange made both at a national level as well as internationally. This can compensate for the high service deficit for special needs children from rural environment which most of the time do not get any form of psychopedagocical support.

These directions are some necessary and possible, they are part of special education and of its preoccupations in all European countries for many years. We hope it can be real for our children with special needs soon.

„This paper is supported by the Sectorial Operational Programme Human Resources Development (SOP HRD), financed from the European Social Fund and by the Romanian Government under the contract number SOP HRD/159/1.5/S/136077”

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Online Cartographic Materials for Geographical Higher Education: Opportunity or Threat?

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Abstract

For Geography as a study subject, student-centered learning is facilitated by the Web 2.0 environment, which brought about not only the opportunity to easily find the necessary maps but also the risk of using and/or disseminating erroneous cartographic materials. In the context of e-learning 2 students are much likely to take advantage of any virtual map, especially outside the institutional framework. A teaching experiment carried out during the academic year 2013-2014, which developed in three stages (initial questionnaire, formative intervention and final questionnaire), focused on the behavior of first-year students in Geography in relation with the online cartographic sources, with the purpose of cultivating a „reflexive" attitude to online maps. The study analyzed the students' cartographic products (digital tourist plans prepared in QGIS based on personal fieldwork, starting from a basemap downloaded from the internet) and compared their answers provided to the initial and final questionnaires. The results obtained at the end of this teaching experiment prove that students have become selective about the web-based maps and have developed a critical attitude towards them, as soon as they realized that not all the maps on the web are entirely correct.

Keywords: Online maps, Errors, Questionnaire, Web 2.0, E-learning 2.0

1. Introduction

Modern cartography reaps benefits from the Web 2.0 „phenomenon", which operates in two directions, thus allowing its users both to visualize the site content and to interact with one another (Goodchild, 2007; Giannola, 2013). This is beneficial not only for traditional teaching, but also for distance learning, e-learning (which has become "e-learning 2.0"; Downes, 2004) and mobile learning (m-learning), which use multimedia platforms with rich digital content (text, video, audio), chat services, forums etc. In this context, the newly developed "Augmented Cartography" adds new information to the elements of space and time that are found on traditional maps, on the one hand, or designs technologies aiming at giving the subject a multisensory perception of reality (Sani and Rinner, 2011), on the other hand. In consequence, this new type of cartography gradually becomes more common for the teaching activities.

The online maps are used both in traditional education, but especially in e-learning and mobile learning. The development of mobile devices (smartphones, tablets etc.) has enabled people to access online data at any moment, provided an internet connection is available: "m-learning is the point at which mobile computing and e-learning intersect to produce an anytime, anywhere learning experience" (Harris, 2001, apud Cinque, 2013). Besides, the various information acessed during informal online sessions, in other words outside the formal or insitutional framework, allows the students to learn without being aware of the effort (De Pietro et al, 2013), as long as the maps are correct. Therefore, teacher's guidance is compulsory, while the student is required to become "reflexive" (Cinque, 2013). Student-centered learning, which focuses on the subject and its formative needs (De Pietro et al, 2013) is facilitated by Web 2.0 environment, as any individual has access to information depending on its vocation, needs, learning rhythm and style etc. Thus, e-learning 2.0 somehow aims at merging the formal and informal sides (De Pietro et al, 2013).

Although the online environment has been a genuine revolution, allowing the preparation, dissemination and use of maps in a different manner than in the past (Fu and Sun, 2010), it also gave the people lacking geographical or cartographic education the opportunity to produce cartographic materials (Buckley and Frye, 2011; Borruso, 2013). Consequently, the virtual environment has been "invaded" by maps containing errors, which can easily mislead those who make use of them without a careful assessment (Osaci-Costache, 2012b). As a matter of fact, the concept of *neogeography* (i.e. "new geography") implies the existence of non-expert users, who prepare, use and share with others their own maps „by combining elements of an existing toolset", using „techniques and tools that fall outside the realm of traditional GIS, Geographic Information Systems" (Turner, 2006). Thus, Web Mapping 2.0 is the concept of neogeography (Haklay et al, 2008), the term itself being introduced in 2006 by Eisnor: „a socially networked mapping platform which makes it easy to find, create, share, and publish maps and places".

The online maps are multi-scale, multi-purpose, interactive and dynamic, and provide information in real time. Most of them are free and available at any moment, inteligent, because allow the user to connect with external data and other information sources, and at the same time can be downloaded in various formats or can be printed or saved (Buckley and Frye, 2011). For these reasons, we deem they are indispensible for student-centered learning, being able to „play many more roles in communicating an increasing number of types of information" (Buckley and Frye, 2011). Digital cartography developed by users through collaborative cartography has both opportunities and threats, as for instance an uncontrolled dissemination of cartographic or geographical contents sometimes of doubtful quality (Borruso, 2010), which are developed by laypersons (Borruso, 2013), who may however dispose of modern software (Bord, 2013).

It is their wide distribution and the ease with which they can be accessed that make the online maps potentially dangerous (Osaci-Costache, 2012b). Here comes the teacher, whose role, according to Umberto Eco (2007), "is not only to inform, but also to form, having the duty to check the information and do what Internet does not: to teach the students to find, filter, select, accept or refuse" the information found on the internet. The objectives of this paper are the following: (1) identifying and analyzing the students' behavior regarding the use of virtual maps in the formal and informal e-learning activities; (2) verifying the efficiency of a number of formative activities meant to change the students' perception towards the online cartographic materials.

2. Materials and Methods

The research started from observing the behavior of a sample of first-year students majoring in Cartography during the academic year 2013-2014. In order to get as accurate as possible results the sample size matched the total population of students who had graduated the course Methods and Techniques of Cartographic Representation. In this way, we obtained a confidence interval of ±0.1% for a confidence level of 99% (the calculations were made by using the online survey software package found at http://www.surveysystem.com/sscalc.htm). The various levels of knowledge, competence and initial formation of the subjects influenced the quantitative results of the research. As the study was focused on a single specialization data generalization is likely to be influenced.

The research started from the hypothesis that by confronting the online maps with the reality in the field the students will change their attitude towards them and will become more and more selective in choosing their base maps. The teaching experiment had several phases.

Phase I. We conceived an initial questionnaire and applied it at the beginning of the academic year with the purpose of getting to know students' perception towards the online maps.

Phase II. Within the formative intervention, students were involved in a two-stage teaching activity, as follows:

a) preparing a tourist plan by mappings in the field starting from a basemap downloaded from the Internet. The students worked in teams of 5 or 6 people, every team having the liberty of choosing the source of the basemap (Google Maps, OpenStreetMaps etc.) for the historical core of Bucharest City, within the perimeter Victory Avenue – Doamnei Street – I.C. Brătianu Boulevard – Splaiul Independenței Avenue. The teams downloaded the basemap from the Internet (in raster format) and printed it on paper. The field activity was accomplished under the supervision of the teaching staff. The students marked on their maps the position, the type and the names of tourist attractions (by adequate symbols), making amendments and completions to the base map, including the name and importance of the streets.

b) developing the digital tourist plan using the Open Source QGIS (http://qgis.org/it/site/) software based on field observations and the online map used as cartographic base. We selected the QGIS because is very convenient both for teaching use in secondary and higher education (Boscaini, 2007; Mastronunzio and Martellozzo, 2007; Osaci-Costache, 2012a; 2012b) and for scientific research (Lami et al, 2005; Osaci-Costache, 2009; 2010). During this stage, the students also checked the colors, the symbols, the accuracy of label positioning on the basemap in the light of cartographic rules etc. Even though the mappings in the field were done collectively by each team, in the end every student developed his or her own map, because a side-objective of our experiment was to develop the students' ability to accomplish a digital tourist plan. However, the detailed explanation of this stage falls outside the scope of this paper.

Phase III. Applying a final questionnaire, meant to highlight the extent to which students have become aware of the errors that virtual maps may contain.

Students accepted to allow the processing of their anonymous questionnaires. Thus, we collected and analyzed, in correlation with the objectives of the present study, both the questionnaires answered by the students and the final products of their activity.

3. Results and Discussion

3.1 Analyzing the responses to the initial questionnaire

Although from the previous teaching experience of the authors follows that most students think that all the maps in the virtual environment are correct, we considered useful to apply a questionnaire with three questions at the beginning of the academic year, with the purpose of understanding students' perception of these cartographic resources.

By centralizing the subjects' answers, we discovered that 76% of the students thought that all virtual maps were correct, 22% deemed that not all of them were correct, while 2% prefered not to answer (Figure 1). Although 22% were not confident in these maps, only 8% of the subjects had noticed themselves a number of mistakes (either of content or of preparation) that occurred on the online maps, so that to feed their distrust in them. The answers to the first two questions confirmed what the authors of the study already knew from experience based on their open discussions with the students. This confirmed a generalized behavior, explained by the students' training level, because Cartography is not a study subject in high school.

The answers to the item "To what extent do you consider that online maps are useful to geography students?" were the following: not at all useful 4%, not very useful 6%, somewhat useful 7%, useful 20%, very useful 33% and extremely useful 30% (Figure 2). It is obvious that the answers mirror what first-year students "believed", as they did not have enough scientific knowledge to confirm their opinions. On the other hand, they were unaware of their utility for Geography and of their potential risks.

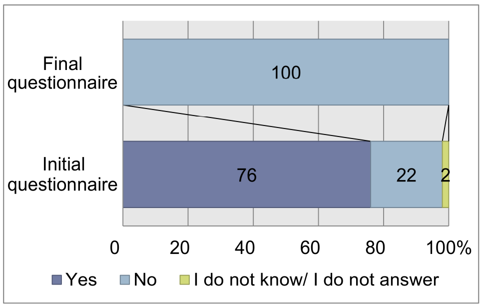

Figure 1. Subjects' Answers to the Question "Do You Think That All Online Maps Are Correct?"

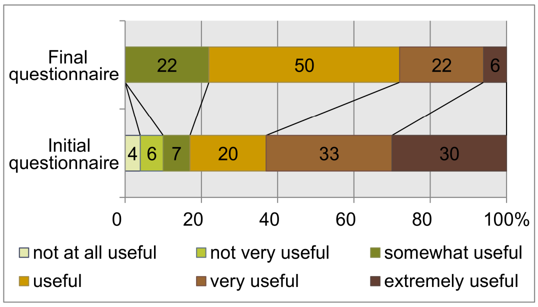

Figure 2. Subjects' Answers to the Question "To What Extent Do You Consider That Online Maps Are Useful to Geography Students?"

3.2 Formative activity

During the teaching activity carried out in the field the students were amazed to find out that many items represented on the map (hotels, cafes, restaurants etc.) had disappeared, other changed their names, other were missing (both from the Google map and OpenStreet map), while many streets had no names. Subjects' reaction was assessed as soon as the field activity ended and the results are given below in correlation with other answers given to the final test.

3.3 Analyzig the responses to the final questionnaire

The final questionnaire (which included ten questions) was applied after the formative activity, including the delivery of digital tourist plans for evlauation.

Three questions were similar to those in the initial questionnaire and they allowed us to assess the extent to which the students changed their perception and attitude towards the online maps. Thus, if at the beginning of the course only 22% of the students had believed that not all virtual maps were correct, at the end of the teaching activity 100% were convinced of that (Figure 1). Simultaneously, the percentage of those who had themselves found errors on the virtual maps they used in the e-learning activities grew from 8% to 83%. Nine students (17%) did not notice any errors, but one has to bear in mind that not all of them had enough knowledge and specific competencies, as the teaching activities of the first semester were not over yet.

As far as the usefulness of online maps for geography students is concerned (Figure 2), subjects' perception changed significantly at the end of the formative activity. If at the beginning 9% had considered that they were not at all useful or not very useful, in the end no student ticked these answers, inasmuch as they became aware of their importance for geographers. Large declines also experienced the categories "very useful" (from 30% to 6%) and "extremely useful" (from 33% to 22%), which is indicative of the fact that students became aware of the errors they may contain and consequently rated them lower. Increases were recorded by the two "middle" categories ("somewhat useful", from 7% to 22%, and "useful", from 20% to 50%; Figure 2), which mirrors an awareness both regarding the opportunity of using these maps and the associated risks that stem from the use of an erroneous map. These last two categories totaled 72% of the answers.

The final questionnaire also included seven questions that had not been present in the initial one, but which allowed us to get a full picture with respect to the students' perceptions and activities (formal and informal) centered on virtual maps, with the purpose of improving our teaching activity in the future.

Student reactions to the errors they found on virtual maps during the field activities were assessed through the question "To what extent were you surprised by the errors identified on the online maps you used?" Of the total number of interviewees, 89% were very much surprised and 11% much surprised. The discussions with the students revealed that these had used to consider Google Maps and OpenStreetMap as "reliable".

The answers to the question "Where did you learn about the online maps?" proved that 87% of the subjects used such kind of maps either at the recommendation of some teachers or on their own initiative. Consequently, in the future, teachers should be more involved in guiding the students to specialized sites, devoted to cartography, and in developing the students' specific competencies, so that to enable them to analyze any online map prior to using it. The students who used the online maps on their own initiative or because they saw other collegues doing so account for 11% of the total, while only 2% made use of such maps at the recommendation of faculty staff.

The answers to the multiple choice question, "What online cartographic sources did you use during the academic year?", revealed that of the 54 interviewees all had used Google Maps, 45 OpenStreetMaps, 27 Bing Maps, 20 Yahoo! Maps, while all 54 had turned to professional sites devoted to cartography (geo-spatial.org, OpenGIS, Philcarto etc.). However, the tourist plans developed by students during the teaching activity relied only on Google Maps (67%) and OpenStreetMaps (33%), which is in accordance with the answers provided in the questionnaire.

When asked, "For what purpose did you use the online cartographic sources", 94% said they did it to learn or to find out an address, 4% replied they did it for learning purposes and 2% to find out an address. Therefore, the impact of online maps on formal and informal activities is significant.

Among others, the questionnaire highlighted the fact that all 54 students had accessed the virtual maps on laptop computers, both at the Faculty and at home, 47 used the laptop and the smartphone and only four used the desktop PC, which is another proof that these sources can be easily accessed anytime, anywhere, making them suitable for mobile learning.

When downloading the maps from the Internet, 56% of the students prefer the raster format, while 44% are in favor of the vector format, albeit at present most of the maps at global level are in vector format (Favretto, 2014). This behavior is also influenced by the inexistence in Romania of professional pages, as for instance a "National cartographic portal", with free downloadable vector layers created by specialists (cartographers and geographers), as it happens in other countries.

At the question, "Are you tempted to use the online cartographic materials as a model for preparing a map?" 51% answered *yes* and 49% *no*. However, by analyzing the tourist city plans developed during the teaching activity we discovered that more students than the questionnaires showed (63% in practice and 51% according to the questionnaires) kept the online colors, while only 37% modified them in accordance with the representation rules they learned during the teaching activities.

4. Conclusions

If accurate maps are used correctly they facilitate metacognitive processes, stimulate curiosity, lifelong learning etc., for which reasons the existence of a rich online cartographic base is an opportunity for the geographical higher education. Nevertheless, in the context of e-learning 2.0 students are confronted, especially during informal activities, with the risk of using any available online maps without paying attention to the errors they may have.

The hypothesis from which we started was confirmed. The teaching experiment proved (through the applied questionnaires) that in the aftermath of an informal intervention, in which a group of students had been asked to confront the maps they found on the internet with the reality in the filed, it was possible to change the subjects' perception of the online maps, so that to become aware of their shortcomings.

Given the wide variety of online sources, it is impossible to make a list with the detected errors and distribute it to the students. The only viable alternative is to develop in them the skills of analyzing the maps and to encourage their "reflexive" attitude towards these sources, so that to use them responsibly and turn them into an opportunity for the geographical higher education.

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The Role of University Professors for the Interdisciplinary Education of the Engineers

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Abstract

The solution of the global problems of the mankind requires and enforces a new look and approach in the training process and education as well as in the field of scientific research activity. The understanding of the problem with the interdisciplinarity in the higher education is a complex system that includes horizontal and vertical integration. The university lecturers play a key role to the preparation of the future engineers who need to be competent not only in traditional and routine activities but also in innovational activities (capacity to synthesize and create), the integration of knowledge in the broad intellectual field (the natural sciences with the social sciences and humanities) designing, global engineering practice (global markets), ability to work in multi-disciplinary teams with cultural diversity and competence to cope with the changing global challenges and opportunities. This requires a change in the educational approaches and technologies of teacher's training, in holistic perception of the world and combining the teaching with the scientific-research activities, with this in real production conditions or inclusion of business representatives in the personnel training.

Keywords: interdisciplinary education, collaborative competensies, problem solving

1 Introduction

European Union policy for the development of society and democratic citizenship and achieving the goals of the Bologna process for competitive economy is associated with:

- orientation of the universities to the practical, entrepreneurial goals that will increasingly engage them in an interdisciplinary world
- remove barriers and create mechanisms for interdisciplinary undergraduate and postgraduate education (Murray, 2004)
- new requirements for educational activities that combine areas for the development of educational activities in holistic territories
- interdisciplinary way of working as a challenge to the organization and operation of universitetie and the academic staff (Barnett, 2003).

2 Theoretical backgrounds

Transdisciplinarity has evolved as a new methodology in its own right, in keeping with empirical, interpretive, and critical methodologies (Nicolescu, 2008). The development of an entire new methodology holds deep intellectual bearing on economics-related, transdisciplinary-informed practice (McGregor, 2009). Not only does the transdisciplinary approach offer an extension and enrichment to already existing traditions but this approach is highly compatible with the current mission.

There are different viewpoints on the issue of transdisciplinarity. It bridges the gap between institutions (universities and colleges), society and private sector. Individuals from many academic disciplines, members of society (civic and corporate) join to a transdisciplinary approach address challenges that transcend any one discipline within the university. So, the university can play an integrative role for an active dialogue with other forms of knowledge.

In exploring the nature of interdisciplinary work, we accept Boix Mansilla, Miller's and Gardner's view of interdisciplinarity: People demonstrate interdisciplinary understanding when they integrate knowledge and modes of thinking from two or more disciplines in order to create products, solve problems, and offer explanations of the world, in ways that would not have been possible through one discipline. (Boix Mansilla, Miller & Gardner, 2000) This definition draws on the cognitive and pedagogical perspective of understanding as a capacity for performance rather than recognition of facts (Wiske, 1998).

Integration in interdisciplinary study is holistic thinking, in which the different facets of a complex reality exposed through disciplinary views are combined into a new whole that is larger than its constituent parts, that can't be reduced to the separate disciplinary insights. The process were called integration, synthesis, or synergy; it is more organic than mechanical, involving coordination as well as cooperation among disciplinary perspectives. It requires an act of creative imagination, a leap from simplified perspectives that give the disciplines to a more holistic perspective.

According Hursh, Haas, and Moore (11, 1983) the interdisciplinary courses are challenge students to operate and spurring them to interrelate multiple disciplinary concepts under “metaperspectives.” Hursh, Haas, and Moore suggest that the center of interdisciplinary teaching include such epistemic features of disciplines as “preferred methods of data collection” and “rules of evidence for asserting fact”.

Transdisciplinarity is not against specializations because they still need to exist. Integral specialist integrates, link, sees connections, coordinates, and communicates across disciplines and with civil society (Turkki, 2006).

A different opinion in the literature is focused on complex societal or technical problems, called problem-centered interdisciplinarity (Klein, 1996). “Mode-2” knowledge work Gibbons et al. (2003) is type of work involves collaboration among different theoretical and practical perspectives, an orientation to application, and societal engagement and accountability. Connections among disciplines have pragmatic effort to address pressing, socially important problems through short-term collaborations among experts from multiple domains.

We accept McGregor's idea, that transdisciplinarity is a huge paradigm shift from interdisciplinarity and especially from multi- and mono-disciplinarity. Our oppinion is the same, that it is imperative reorientation of the whole university, designing new undergraduate and graduate degree programs, the accumulation of funds for research funding and participates in project-oriented university scholarship coordinated with communities and with industry.

3 Research and discussion

The aim of the modern universities is to become an institution which will develop reflexivity and insight and move society in a progressive discourse. The universities are moving toward a broader cultural transformation, new systems of values to become an engine of economic development.

The analysis of the curriculum and syllabi of many universities in the country and abroad allows us to say that yet:

• many of the courses remain within the traditional boundaries;

• academics are trying to protect their own scientific and disciplinary space.

Barnett states that administrators and professors think in terms of "innovation, flexibility and adaptation" (Barnett 2003), Bean in a similar context, uses terms such as efficiency, productivity, accountability, competition, and total quality management "of the activities of the university.The members of the academic staff of the faculty work to cross the borders of their own professional discipline and broadening the scope of knowledge. As a team working in collaboration with other colleagues in order to review the content, formulate goals, choosing tasks and assessment tools. Professors demonstrate unique styles of teaching, ability to deal with group dynamics and achieve balance, which creates an effective learning environment.

In transdisciplinary work, the academic staff and students have to anticipate that there will be a variety of outcomes rather than one right outcome. Each outcome will resonate more or less with different actors involved in the process (academics, students, community members, corporations).

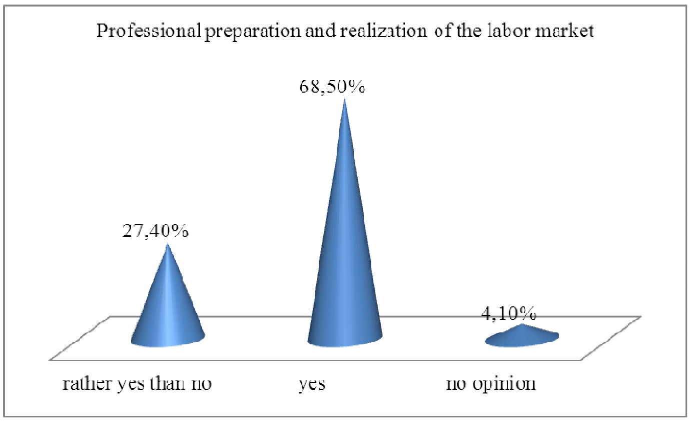

Figure1 Professional preparation and realization on the labor market

We recognize that successful social and professional realization of students in the Faculty of Technics and Technologies – Yambol is a measure of quality education. In the Faculty we prepare students in Bachelor and MasterDegree implemented by horizontal and vertical road training through educational documentation.Students expressed definite opinion that the training in the specialty and professional qualifications in the Faculty allow them successful realization on the labor market.

Faculty conduct policy that supports interdisciplinarity and collaboration of teachers from different structural units (faculties, depeartaments, laboratories, etc.). Implementation of interdisciplinarity is implemented through activities in various research projects financed by European funds, which include teachers and students. On projects BG051PO001 - 3.1.09 - 0015 "Building a sustainable system for training and career development of academic staff in Trakya University" There were several courses, involving most of the teachers. Training includes centered on problem solving teaching, work in interdisciplinary teams in the development of training programs and e-learning.

It is created discussion atmosphere for finding and the organization of the most suitable forms of activity that develop the potential of students and their critical and productive thinking.

We base on the thought of Albert Einstein: "Imagination is more important than knowledge," professors use past experience and knowledge of students to create new images.Another focus of the activities of the the academic staff is to develop thinking and problem-solving concrete problems in their professional field.

Students are prepared:

- to deal effectively with non-standard problems and tasks requiring processing and understanding information;
- problem solving;

- use intuition;
- be persuasive and creative

We accept that the modern technology gradually become part of almost every workplace and replace humans in the performance of routine tasks or activities related to the following of a particular algorithm.This requires the education to be transformed from forming systematic, routine skills to develop the skills to solve complex and unusual challenges, solving problems in high-risk situations for which there are no ready-made strategies.

Analys of Labor market predict that university graduates will have at least three quite distinc careers—not three different jobs in their working lifetimes. University education shouldn't take place in “programs” with a specific focus and culminate in a “major” defined by a departmental silo holding the prescribed knowledge of a single discipline. Our expertise in the training field with a team of professors from engineering and social sciences, as well as the opportunity for further professional qualifications, increase the opportunity for successful professional and social realization of graduates.

Good professors motivate their students to develop competence not only for action in a particular situationbut also the selection of appropriate strategies of action and behavior. Our observations confirm the opinion of Mayer, RE (1998), that effective problem solving include: skill, meta skill and willpower.

Efforts should be focused on developing teaching processes to develop collaborative competencies (knowledge, skills and attitudes) necessary for our current and future professionals to work in collaborative practices. A competency alone is not enough for practice change. Within the workforce there is a need to understand the processes involved at both the organizational and the individual team levels to encourage and sustain collaboration.

The assessment of skills to solve problems focuses on students' ability to think and manage the process of problem solving, putting them in unfamiliar situations. Skills for problem solving are crucial for the future development of the people for their effective and active participation in the community.

These skills not shaped by teaching only one subject area, not limited to a specific content area. They are interdisciplinary and are the product of the overall training.

In their activities professors use different progressive teaching and learning (problem-based training, the research approach, the development of individual / group projects) to enable students to use their knowledge and skills in unfamiliar and unusual situations.

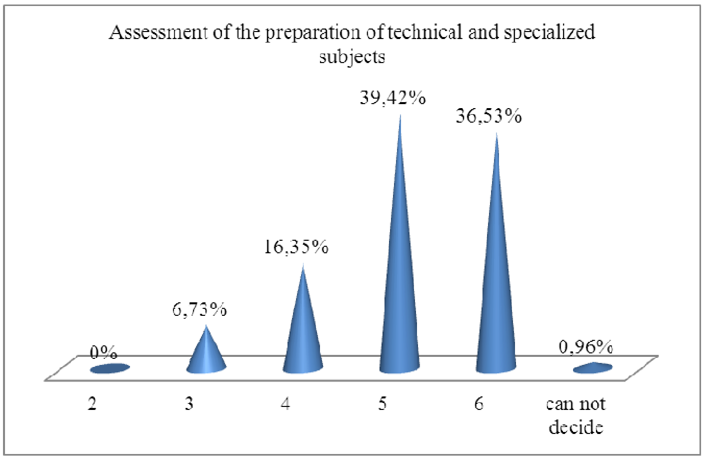

Figure 2. Assessment of the preparation on technical and specialized subjects

The evaluation of skills to solve problems focuses on basic cognitive processes that form the structure of these skills. This is achieved through the use of authentic situations related to real industrial, life problems, using not only specialized and related to the specific subject knowledge.

In the study of new technology or situations in communication between people apply interactive problems where students must first find the necessary information, exploring the problem situation. To mobilize their cognitive and practical skills, creative abilities, motivations, values and attitudes.

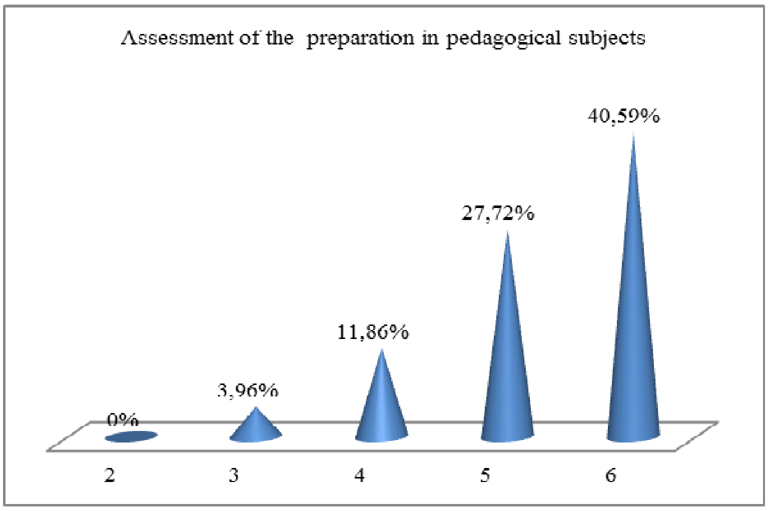

Figure 3. Assessment of the preparation in pedagogical subjects

The process of solving the problem is a kind of research activity that began with the study of the unknown situation, to identify the limits and possibilities for further action.

Interdisciplinary preparation of the students and the development of adjustability, independence and initiative gives them the professional self-confidence to start their own business.Other graduates indicated that they expecte to work as middle managerial personnel and like a managerial personnel.

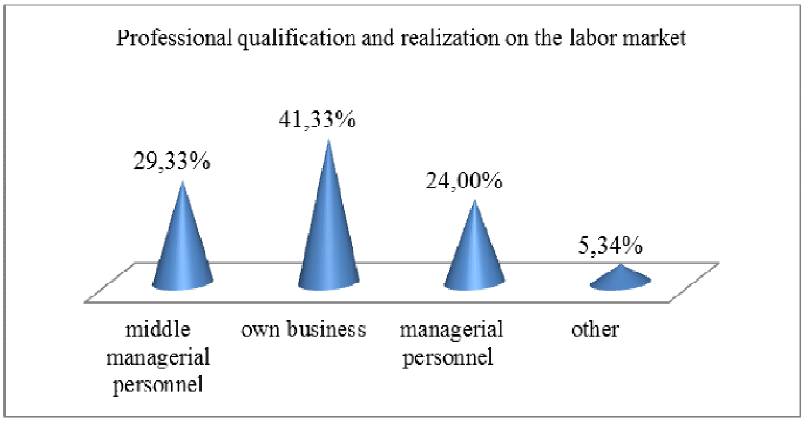

Figure 4. Professional qualification and realization on the labour market

The study confirms the tendency from previous periods that higher is assessed competence in the specialty of academic staff and lower - their pedagogical skills.

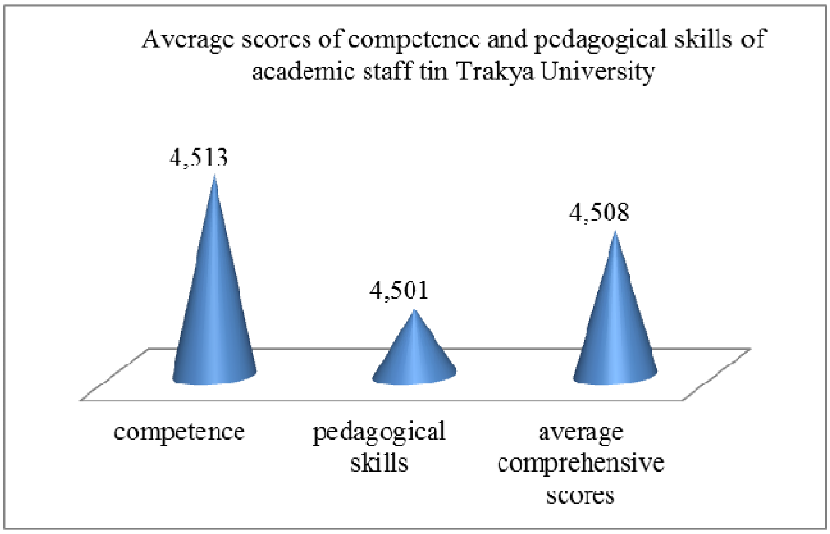

Figure 4. Average scores of competence and pedagogical skills of academic staff tin Trakya University

The data from the study of students' opinion about the quality of teaching at the university, including the Faculty - Yambol for the academic year 2012/13 show that 94.88% of the evaluated professors received very good comprehensive assessment and - 4.83% -goodcomprehensive assessment.

The dynamics of the studentsinterest to other disciplines is evidence for the role of the professorsforincreasing of the motivation and active work of the students.

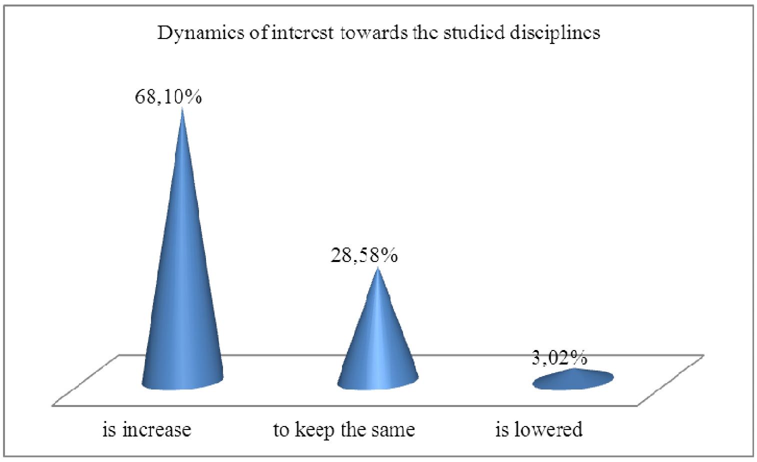

Figure 5. Dynamics of interest towards the studied disciplines

Conclusion

Based on these data, we can conclude that the efforts of academic management of the Faculty to attract the majority of lecturers in qualification courses related to: improving the quality of teaching, research methodology, use of modern methods and evaluation techniques enrichment the cultural with the improvement of the foreign language is a factor for their leadership role in training and participation of the students in research activities.

Professional development and improvement of the professors for the implementation of interdisciplinarity in education and research have a decisive role for the quality of preparation and competitiveness of the students.

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Exploring European Union Teachers' Technological Pedagogical Content Knowledge (TPCK) and Educational Use of Web Technologies

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Abstract

Several studies have been carried out on technological, pedagogical content knowledge and web-based education. In this study, Technological Pedagogical Content Knowledge and Educational Use of Web Technologies (TPCK-W) self-efficacy and attitudes of 33 teachers from 8 different branches carrying on their duties in 19 countries of European Union (EU) were analyzed. In the research, the Technological Pedagogical Content Knowledge-Web (TPCK-W) Survey developed by Lee, Tsai, and Chang (2008) was used. The data obtained in the research were analyzed using SPSS for Windows 17.0 program. As result of the analysis, it was revealed that TPCK-W self-efficacy level of teachers carrying on their duties in EU countries was high; and age, experience, and gender did not affect their TPCK-W self- efficacy levels.

Keywords: TPCK-W, Technological Pedagogical Content Knowledge, TPCK-W self-efficacy, TPCK-W attitude

1 Introduction

The Internet has become one of the indispensable aspects of education as in many other areas of life. Depending upon this, www technologies, other words web technologies, have become frequently used in educational fields.

Since the new generation has witnessed to the development of technology, whereas they adapt to up and coming devices and applications easily, the ones below a specific age have difficulty in adapting to this change. Moreover, several people have been trying to use new technologies and adapt to the technological life. Especially the individuals rendering a service in educational fields have shown efforts to adapt these new educational technologies that emerge through the integration of the pedagogical content with technology and to use in their lessons. Educational technologies have shown a rapid change in recent years and become as web-based; and the obligation for the educationalists to learn and use web technologies together with the educational technologies has emerged.

Having and using the Information and Communication Technologies (ICT) of the countries in the world determine the countries' being an Information Society, and can be considered as an indicator of their using the information and communication technologies for educational purposes. When the 2010 and 2011 data of Information and Communication Technologies (ICT) Development Index (ICT Development Index-IDI), it drawn the attraction that South Korean was on the top;and during the same years, European Union countries have been the most on first 40 ranks of ICT Development Index (http://www.trakya2023.com/, 2013).When the rates of the home users in the countries on the first 10 ranks of ICT Development Index for having a computer and internet access were analyzed, it was noticed that both rates were over 80% (Figure 1). When considered from this point of view, it is indispensable to use web-based technologies in an environment where computers and the Internet have been used so frequently.

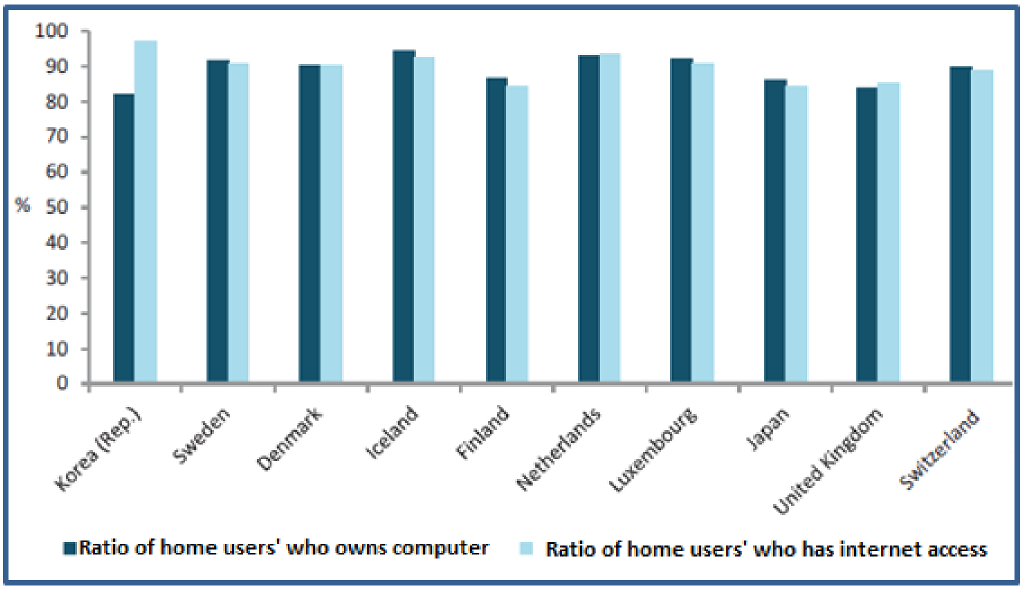

Figure 1. The rates of the home users in the first 10 ranks of ICT Development Index for having a computer and internet access (United Nations Publication, 2012)

Several studies have been carried out to reveal the attitudes and determine the self-efficacy and attitudes of individuals together with the web-based technologies' becoming indispensable to be used in education. In recent years, especially the studies related to the use of web-based technological and pedagogical content knowledge (TPCK-W) have been carried out. Technological Pedagogical Content Knowledge (TPACK) scale developed by Mishra and Koehler (2006) and Technological Pedagogical Content Knowledge-Web (TPCK-W) developed by LeeandTsai (2008) are the ones that have been most frequently used in the literature. Horzum and Güngören (2012)researched web-based Instruction (WBI) beliefs, acceptance of WBI tools and WPCK of pre-service teachers in 2012. Agyei and Voogt(2012) carried out a study to show the potential of TPCK as a new frame for developing pre-service teachers' experiences in technology integration within initial teacher education, particularly in Sub-Saharan African countries. Horzum (2012)conducted a study on determining the effect of web-based instruction on students' web pedagogical content knowledge. Chuang and Ho (2011) aimed to investigate the technological pedagogical content knowledge (TPACK) of early childhood teachers in Taiwan. In a study carried out in 2011, technological pedagogical content knowledge (TPACK) framework was used in order to understand what kind of an attitude the pre-service teachers displayed related to the use of information and communication technologies (Graham et al., 2011). Semiz and Ince (2012), aimed to identify the TPACK of their university lecturers. The theoretical construction, statistical validity, and reliability of a survey instrument designed to measure TPACK of teacherswere described(Albion et al., 2010). Kaya and her friends (2011) aimed to explore pre-service information technology teachers' perception of self-efficacy in web-technological pedagogical content knowledge (Web-TPCK). Lee and Tsai (2010) provided a framework for understanding teachers' Technological Pedagogical Content Knowledge-Web (TPCK-W) while integrating web technology into their pedagogical practice.Yurdakul (2011) studied to determine pre-service teachers` techno-pedagogical knowledgecompetencies and to examine the differences between those competencies, and the level of using ICT.In another study, it was mentioned that TPACK scale has been a valuable tool for the researchers to reveal the TPACK development of teachers and pre-service teachers (Baran et al., 2011). In his study Sahin (2011) proved that TPACK scale has been an appropriate and reliable tool.

2 Material and Methods

2.1 Purpose of The Research

The purpose of the study is to measure the technological and pedagogical content knowledge self-efficacy level of the teachers carrying on their duties in the countries in European Union. As result of the study, the answers to the questions below were searched for:

1) What are the TPCK-W self-efficacy levels of the teachers carrying on their duties in EU member countries?
2) Do the TPCK-W levels of teachers carrying on their duties in EU member countries differ according to age, experience, and gender?

2.2 Research Group

The study group of the research included the teachers carrying on their duties in elementary and secondary education schools of the European Union (EU) countries. This group included the people to whom the researcher met in EU Lifelong Learning Program in-service training courses, contact seminars and study visits he attended in Finland in 2006, in Slovenia in 2007, Lithuania and Estonia in 2008, in Czech Republic in 2009 and in Italy in 2012 and 2013. Within this context, 18 people were contacted as face to face and 99 people through the e-mails. Totally 117 people were asked for their participation to the study. As result, totally 33 people from 19 different countries including Belgium (3), Portugal (3), Romania (2), Luxemburg (2), United Kingdom (2), Poland (1), Turkey (4), Estonia (2), France (1), Finland (1), Greece (3), Slovenia (1), Spain (2), Czech Republic (1), Norway (1), Hungary (1), Croatia (1), Sweden (1),and Netherland (1) participated into the research. And this proved that 28.2% (117) of the targeted people participated into the research. Eighteen (54.5%) of the participants were female and 15 (45.5%) were male (Table 1.).

Table 1. Distribution of the participants according to the gender

Gender	**f**	**%**
Female	18	54,5
Male	15	45,5
Sum	**33**	**100**

Whereas the participants showed a distribution as 4 (12.1%) for 21-27 years old, 10 (30,3%) for 28-35 years old, 8 (24,2%) for 36-43 years old, 8 (24,2%) for 44-55 years old, and 3 (9,1%) for over 55 years old according to the variable of "How old are you?", they showed a distribution as 6 (18,2%) for 1-7 years, 14 (42,4%) for 8-15 years, 10 (30,3%) for 16-25 years, 3 (9,1%) for over 25 years according to the variable of "Teaching experience" (Figure 2). The teachers from the branches of Mathematics, IT, Physics, Literature, Foreign Language, Chemistry, History, and Geography participated into the research.

2.3 Data Collection Tools

In the research, the Technological Pedagogical Content Knowledge-Web (TPCK-W) Survey was used. This survey was developed by Lee, Tsai and Chang (2008) to assess teachers' self-efficacy in terms of web pedagogical content knowledge. The TPCK-W survey was created dependingupon a TPCK-W framework including Web knowledge (WK), Web-Contentknowledge (WCK), Web-Pedagogical knowledge (WPK), and Web-Pedagogical-Content knowledge (WPCK). The fivelikertscale included 5 factorsconsisting of 30 items. These factors were“web general” including7 items, “web communicative” including 4 items, “web content knowledge” including 5 items, “web pedagogical content knowledge” including 8 items, and “the attitude towards the web-based instruction” including 6 items.

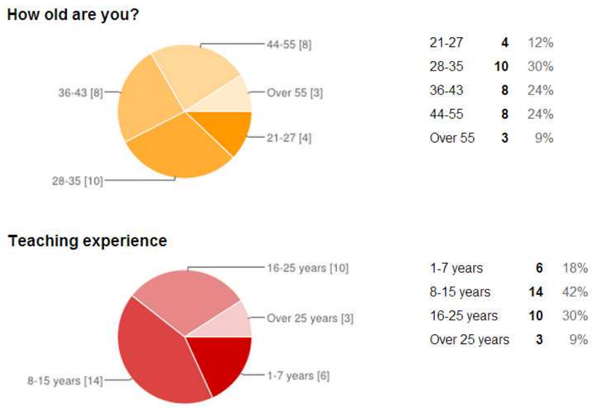

Figure 2. Distribution of the participants according to age and work experience

2.4 Data Collection and Analysis

The self-efficacy and attitude survey used into the research was transferred into web using Google survey tool, and performed to the participants in English. The participants reached to and filled in the survey using the link in their e-mail addresses.The data obtained in the research were analyzed using SPSS (Statistical Package for Social Sciences) for Windows 17.0 program. While evaluating the data, descriptive statistical methods (Number, Percentage, Average, Standarddeviation) were used. For the comparison of quantitative data, Mann-Whitney U-Test was used for the difference between the two groups, and Kruskal-Wallis test was used for the intergroup comparison of the parameters in case of more than two groups. Spearman correlation analysis was performed among the variables of the research.

The obtained findings were evaluated at 95% confidence interval, and 5% level of significance.

3 Findings

In this section, the findings obtained as result of the data collected through the scales from the participants of the research for the solving of the research problem were included. Explanations and suggestions were offered depending upon the obtained findings.

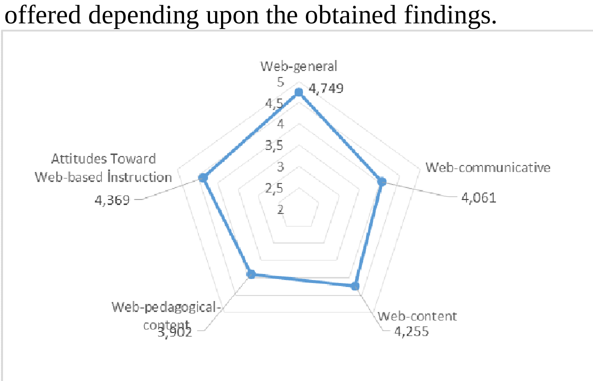

Figure 3. Self-Efficacy levels

Table 2. Self-Efficacy levels

	N	Av.	SD	Min.	Max.
Web-general	33	4,749	0,380	4,000	5,000
Web-communicative	33	4,061	0,852	1,750	5,000
Web-content	33	4,255	0,641	3,000	5,000
Web-pedagogical-content	33	3,902	0,918	1,380	5,000
Attitudes Toward Web-based Instruction	33	4,369	0,515	3,330	5,000

"Web-general" level of the participants was determined as very high (4,749 ± 0,380); "web communicative" level as high (4,061 ± 0,852); "web-content" level as very high (4,255 ± 0,641); "web-pedagogical-content" level as high (3,902 ± 0,918); and "attitudes toward web-based instruction" level was determined as very high (4,369 ± 0,515) (Table 3, Figure2).

Table 3. Averages of Self-Efficacy Levels According to the Variable of "Howoldareyou?"

	Group	N	Av.	SD	KW	p
Web-general	21-27 Ages	4	4,500	0,577	3,161	0,531
	28-35 Ages	10	4,686	0,403		
	36-43 Ages	8	4,839	0,354		
	44-55 Ages	8	4,893	0,213		
	Over 55 Ages	3	4,667	0,459		
Web-communicative	21-27 Ages	4	4,375	0,433	5,441	0,245
	28-35 Ages	10	4,225	0,946		
	36-43 Ages	8	4,094	0,767		
	44-55 Ages	8	4,094	0,731		
	Over 55 Ages	3	2,917	1,041		
Web-content	21-27 Ages	4	3,900	0,683	4,516	0,341
	28-35 Ages	10	4,240	0,430		
	36-43 Ages	8	4,150	0,791		
	44-55 Ages	8	4,650	0,487		
	Over 55 Ages	3	4,000	1,000		
Web-pedagogical-content	21-27 Ages	4	3,125	0,974	4,758	0,313
	28-35 Ages	10	3,925	0,888		
	36-43 Ages	8	3,875	1,171		
	44-55 Ages	8	4,250	0,539		
	Over 55 Ages	3	4,000	1,000		
Attitudes Toward Web-based Instruction	21-27 Ages	4	3,708	0,534	5,784	0,216
	28-35 Ages	10	4,400	0,439		
	36-43 Ages	8	4,542	0,596		
	44-55 Ages	8	4,438	0,308		
	Over 55 Ages	3	4,500	0,577		

According to the results of Kruskal Wallis H-test performed to determine whether the web-general, web-communicative, web-content, web-pedagogical-content, attitudes toward web-based instruction score averages of the participants differ in terms of the "How old are you?" variable, the difference between the group averages was not found as significant (p>0.05) (Table 3.).

Table 4. Averages of Self-Efficacy Levels According to the Variable of “Teaching Experience”

	Group	N	Av	SD	KW	p
Web-general	1-7 Years	6	4,667	0,516	0,543	0,909
	8-15 Years	14	4,776	0,366		
	16-25 Years	10	4,786	0,338		
	Over 25 Years	3	4,667	0,459		
Web-communicative	1-7 Years	6	4,500	0,418	5,898	0,117
	8-15 Years	14	4,018	0,963		
	16-25 Years	10	4,200	0,563		
	Over 25 Years	3	2,917	1,041		
Web-content	1-7 Years	6	4,033	0,599	1,789	0,617
	8-15 Years	14	4,343	0,605		
	16-25 Years	10	4,340	0,660		
	Over 25 Years	3	4,000	1,000		
Web-pedagogical-content	1-7 Years	6	3,458	0,917	3,034	0,386
	8-15 Years	14	3,839	1,123		
	16-25 Years	10	4,225	0,482		
	Over 25 Years	3	4,000	1,000		
Attitudes Toward Web-based Instruction	1-7 Years	6	3,972	0,662	3,068	0,381
	8-15 Years	14	4,476	0,506		
	16-25 Years	10	4,417	0,354		
	Over 25 Years	3	4,500	0,577		

According to the results of Kruskal Wallis H-test performed to determine whether the web-general, web-communicative, web-content, web-pedagogical-content, attitudes toward web-based instruction score averages of the participants differ in terms of the “Teaching experience” variable, the difference between the group averages was not found as significant ($p>0.05$) (Table 4.).

Table 5. Averages of Self-Efficacy Levels According to the Variable of “Gender”

	Group	N	Av	SD	MW	p
Web-general	Female	18	4,770	0,377	132,500	0,918
	Male	15	4,724	0,395		
Web-communicative	Female	18	4,139	0,763	123,500	0,675
	Male	15	3,967	0,968		
Web-content	Female	18	4,211	0,721	125,500	0,726
	Male	15	4,307	0,550		
Web-pedagogical-content	Female	18	3,813	1,131	132,500	0,927
	Male	15	4,008	0,595		
Attitudes Toward Web-based Instruction	Female	18	4,250	0,567	101,500	0,221
	Male	15	4,511	0,420		

According to the results of Mann-Whitney U-test performed to determine whether the web-general, web-communicative, web-content, web-pedagogical-content, attitudes toward web-based instruction score averages of the participants differ in terms of the “Gender” variable, the difference between the group averages was not found as statistically significant ($p>0,05$) (Table 5).

4 Discussion and Conclusion

Technological, pedagogical content knowledge has become one of the important indicators to measure the efficacy levels of educators in recent years. In this research, it was tried to determine the self-efficacy perceptions of teachers from different countries of the European Union, in terms of web-based technological, pedagogical content knowledge. The participants from 19 of 28 European Union countries were included into the research. In previous years, studies have been conducted that analyzed the teachers, pre-service teachers, and faculty of education students in terms of technological, pedagogical content knowledge.

In the literature, the results obtained through the researches carried out on technological, pedagogical content knowledge of individuals were as: Lee and Tsai (2005) found similar results of the TPCK-W survey as in this research; teachers in Taiwan expressed relatively high self-efficacy in terms of their general use of the web. Horzum (2012) showed that the WPCK and attitudes towards WBI did not differ between the experiment and control groups before the experimental procedure. Researchers found that experienced teachers' knowledge self-efficacy is higher than junior teachers. They identified the teaching experience as the major source of developing PCK. However, it was also found that junior teachers were more successful in using PCK with technology and presenting it as web-based (LeeandTsai, 2010). According to another research, the analyses showed that most pre-service teachers had high level of self-efficacy in Web-TPCK. It was found that there was no significant difference in pre-service teachers' self-efficacy in Web-TPCK in terms of their gender except from the sub-scale of Web-communication (Kaya et al., 2011). Yurdakul (2011) showed that, in general, ICT usage level of pre-service teachers is effective on their techno-pedagogical knowledge competencies, and pre-service teachers in the study had high level techno-pedagogical knowledge competency. It was also found that more systematic efforts have been needed to engage pre-service teachers in technology-rich design activities, and to develop their TPCK adequately (AgyeiandVoogt,2012). As is seen, in this study, similar results were obtained as in the previous ones.

In some studies, whereas the TPCK-W self-efficacy levels of the participants were found as different, in this study self-efficacy levels of the participants were found at a close level not depending upon age, experience, and gender. Very high and high self-efficacy levels of the teachers participated into the research from different countries of EU can be considered as an indicator of EU countries' using information and communication technologies commonly in education. Moreover, ICT usage level of the teachers participated in EU education programs were high and depending upon this, their level of using www technologies in education was also considered as being high.

No significant difference between the group averages of participants' TPCK-W self-efficacy levels in terms of age, experience, and gender revealed that TPKC-W self-efficacy levels of participants were at a close level without considering age, gender, and experience. Depending upon this, it can be said that the teachers in EU countries have had high TPCK-W self-efficacy levels, in general.

No significant difference between "web general" and"web-communicative", "web-content", "web-pedagogical-content", and "attitudes towards the web-based instruction"factors revealed that attitudes of participants towards web communication, content, pedagogical content use and web-based education directly proportional with general web technologies self-efficacy.

As result of this study, it was revealed that TPKC-W self-efficacy levels of the teachers carrying on their duties in different countries in the European Union was high. Upon this, further researches can be carried out to make comparisons among the EU countries, EU countries and the other countries. A frame program can be prepared and TPCK-W self-efficacy levels of teachers can be measured through the pre-tests and post-tests, and the effect of the applied framework upon TPKC-W self-efficacy levels of teachers can be searched for.

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S e c t i o n

TECHNOLOGIES

Technologies (TECH):

- **Innovative Web-based Teaching and Learning Technologies**
- **Advanced Distributed Learning (ADL) technologies**
- **Web, Virtual Reality/AR and mixed technologies**
- **Web-based Education (WBE), Web-based Training (WBT)**
- **New technologies for e-Learning, e-Training and e-Skills**
- **Educational Technology, Web-Lecturing Technology**
- **Mobile E-Learning, Communication Technology Applications**
- **Computer Graphics and Computational Geometry**
- **Intelligent Virtual Environment**

Smart surveillance system using Artificial Intelligence

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Abstract

Smart surveillance system using Artificial Intelligence presented in this document is an autonomous surveillance electronic system which recognizes and analyses activities observed via webcams. Then, on demand, it presents the processed information to human operators who can access it via internet on various devices. The motivation of our project was provided by the inefficient way the current surveillance (CCTV) systems work. These systems simply store hundreds of gigabytes of raw images/videos, without using image processing techniques or artificial intelligence (AI). On the other hand, the state of the art in research contains several competing software applications for image processing using AI to recognize and track humans or moving objects. However, they usually require many resources for that. Our solution wants to advance the current state of the practice, by efficient implementations that can run on the powerful, but financially affordable (contest) platform provided by Intel® - Bay-Trail - Intel® Atom™). Technically, in our project, the board records images of different locations from two USB web-cameras. Our AI algorithms use Background Subtraction using Gaussian Mixture Models and object tracking using Particle Filters. Moreover, the board is also used as a web server that hosts a web application that allows users to easily interact with the surveillance system. Some of its features include live streaming, GPS location, remote settings, analytics, and access to relevant video recordings.It is a user-friendly device more powerful than most commercial ones, keeping the price very low. Furthermore, the system sets the foundation for a range of applications in the surveillance domain, such as suspicious human activities in public areas, shops, banks, airports, or traffic surveillance on highways or even mice behavior analysis in the biology labs.

Keywords: autonomous surveillance systems, Artificial Intelligence, Particle filters, image processing, electronic device, background subtraction, image analysis, GPS location

1 How does the system work

We start by giving the overview of our system depicted in Figure 1 below. The Intel Bay-Trail contest platform is connected to two webcams, one GPS and to the Internet. Our software processes the stream of captured images using Background Subtraction algorithms to detect the moving objects and using Particle Filters in order to track these objects.

1.1 Comparison between our solution and existing systems

There are a several features that distinguish our system from the existing commercial available on the market. We give below two important ones:

Storing only the relevant data. Most of the CCTV/surveillance systems usually store huge amount of data on connected hard-disks. Thus is an important disadvantage, because a lot of storage space is required for good results. A common CCTV surveillance system usually needs almost 2 terabytes in two weeks. Moreover, if such space is not available, the length of video recording is then limited. Instead of recording and storing the entire information (even blank images on night) we could store only the images that present **interesting activity.** Our system processes the recorded data with Artificial Intelligence in order to retrieve as much as information it can extract from images and store only the essential ones that may be interesting or suspicious. Through this mechanism it is easier for security teams to analyze the images. For instance in a library maybe in one day there will be 10 people who come to borrow books and instead of storing ~ 2,592,000 of high resolution frames (~ 30 frames * 60 seconds * 60 minutes * 24 hours) we can end up in storing ~ 15,000 high resolution frames where something suspicious or interesting happens.

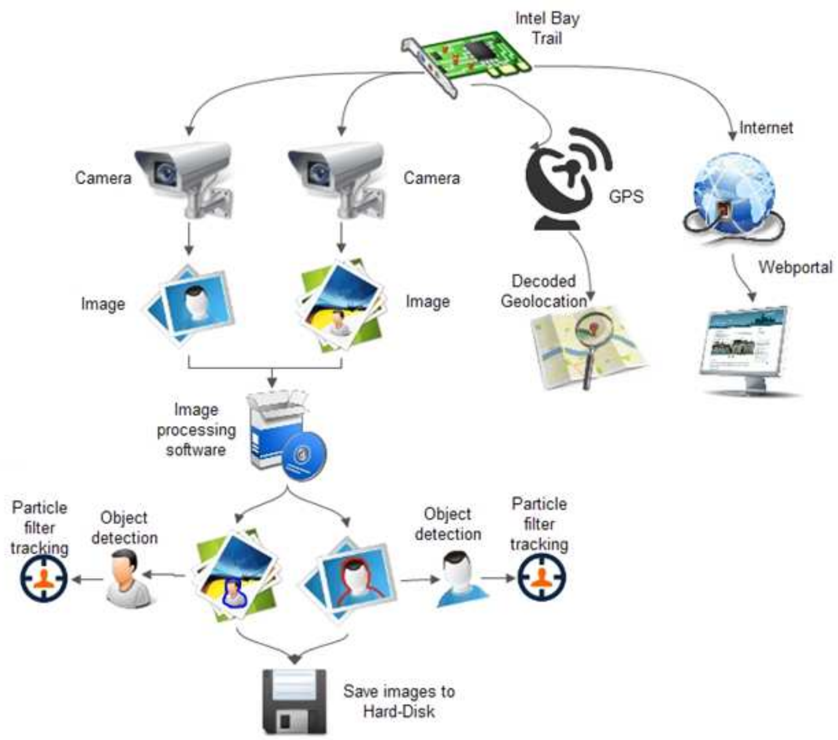


Figure 1. Diagram of tour automatically surveillance system

Statistics. Our software is able to calculate statistics such as: the number of people that entered a location in a given period of time. Using the developed web application hosted by the electronic board, anyone who is authorized is able to view statistics about how many people entered the room and what is their common trajectory. This is an interesting information for shop owners, which can use this information to optimize their business.

2 Image processing

As we already mentioned, the main strength and differentiator for our system is given by the image processing capabilities. The implemented image processing algorithms (see references at the end of the document for existing image processing algorithms) take images from two different webcams. In our application, the RGB colors represent redundant information because the image can be represented equivalently into a Gray-Scale image, which takes less space to be saved and contains all the relevant data for the monitored activities. In order to convert the image into a gray-scale picture, we use the following function to extract better the brightness

$GrayScale(R,G,B) = 0.21R + 0.72G + 0.07B$. The video surveillance is based on the idea that the webcam is static (it has the same angle). The algorithm tries to identify (i.e., learn) the background, which is given by all objects that are static and do not move over the time. When an object appears in the image, it is above the background (i.e. foreground) and it can be simply retrieved by calculating the difference between the background and current image.

For retrieving the foreground using the Background Subtraction method, our image processing software calculates the static background β. The software can compute the foreground and background using **four different methods**: Frame differencing, Running Average, Gaussian Running Average and Gaussian Mixture Models, which are shortly described below:

Frame differencing. The simplest and with the least performance method of calculating the background is to subtract the current frame from the previous frame. It depends basically on object speed, luminosity and frame rate. The difference between background and image, denoted by Δ represents intensity for the pixels locations that have changed in the last few frames.

$\Delta_i(x,y,\delta) = |I_i(x,y,\delta) - I_{i-1}(x,y,\delta)|$, where I_i is the frame from the time *i*. In order to compute the foreground, we check if the difference $\Delta(x,y,\delta) \geq \theta$, where θ is the foreground threshold.

Running Average uses a linear approach to identify the static background. For color images with 3 δ channels - (RGB) the equation can be written as follows: $\beta_i(x,y,\delta) = (1-\alpha) \cdot \beta_{i-1}(x,y,\delta) + \alpha \cdot I_i[x,y,\delta]$ where α is the learning rate constant, for which we used 0.05. $\Delta_i(x,y,\delta) = |\beta_i(x,y,\delta) - I_i[x,y,\delta]|$. In order to compute the foreground, we check if the difference $\Delta_i(x,y,\delta) \geq \theta$, where θ is the foreground threshold. The biggest problem of the running average method is that α is a constant and when an object enters in the image the algorithm tries to learn him although in the next few frames it moves or disappears.

Gaussian Running Average. This method calculates the Gaussian probabilistic density function of the most recent n frames, which is characterized by mean of μ_i and variance σ_t^2. The initial values are $\mu_0 = I_0$,$\sigma_0^2 = 0.5$. Because the background can change over time, mean μ_i and variance σ_t^2 can be updated by the following equations:

Updating the mean $\mu_i(x,y,\delta) = \alpha \cdot I_{i-1} \cdot (x,y,\delta) + (1-\alpha) \cdot \mu_{i-1}(x,y,\delta)$

Updating the variance $\sigma_i^2(x,y,\delta) = \alpha(I_{i-1}(x,y,\delta) - \mu_{i-1}(x,y,\delta))^2 + (1-\alpha) \cdot \sigma_{i-1}^2(x,y,\delta)$, calculating the difference $\Delta_i = |I_i - \mu_i|$. In order to compute the foreground we check if the difference $\frac{\Delta_i(x,y,\delta)}{\sigma_i} \geq \theta$, where θ is the foreground threshold. We used $k = 2.5$

Gaussian Mixture Model is extended to fit a vector of unknown parameters or multivariate normal distributions. In a multivariate distribution (i.e. a vector *x* with *N* random variables) may be modeled by a vector of parameters (several observations) using a Gaussian Mixture Model prior distribution on the vector of estimates by the following equation: $p(x) = \sum_{k=1}^{K} \pi_k N(x|\mu_k, \Sigma_k)$. Here we have a linear mixture of Gaussian density functions. $N(x|\mu_k, \Sigma_k)$. The parameters π_k are called mixing coefficients, which must fulfill and given $N(x|\mu_k, \Sigma_k)$., $\sum_{k=1}^{K} \pi_k = 1$ and give $N(x|\mu_k, \Sigma_k) \geq 0$ and $p(x) \geq 0$ we also have that $0 \geq \pi_k \geq 1$.

3 Desktop software

In this short section we give a glimpse of the (desktop) software that can be used to control the operation of the whole system. Our surveillance algorithm can be configured quite easily using the dedicated desktop software. Moreover, it can also connect to the GPS and use Google Maps API to plot the last device locations on the map. The surveillance system main software was intended to be very flexible in easy configurable to change different algorithm parameters for the recognition and the computation the statistics. It was designed to be more like an interface between the user and the device surveillance algorithms. The different options can be view in the screenshot below. In following figure anyone can see most of the image processing and surveillance features like the GPS location, statistics, client socket for Node.js, Server Socket for streaming and the MySQL client.

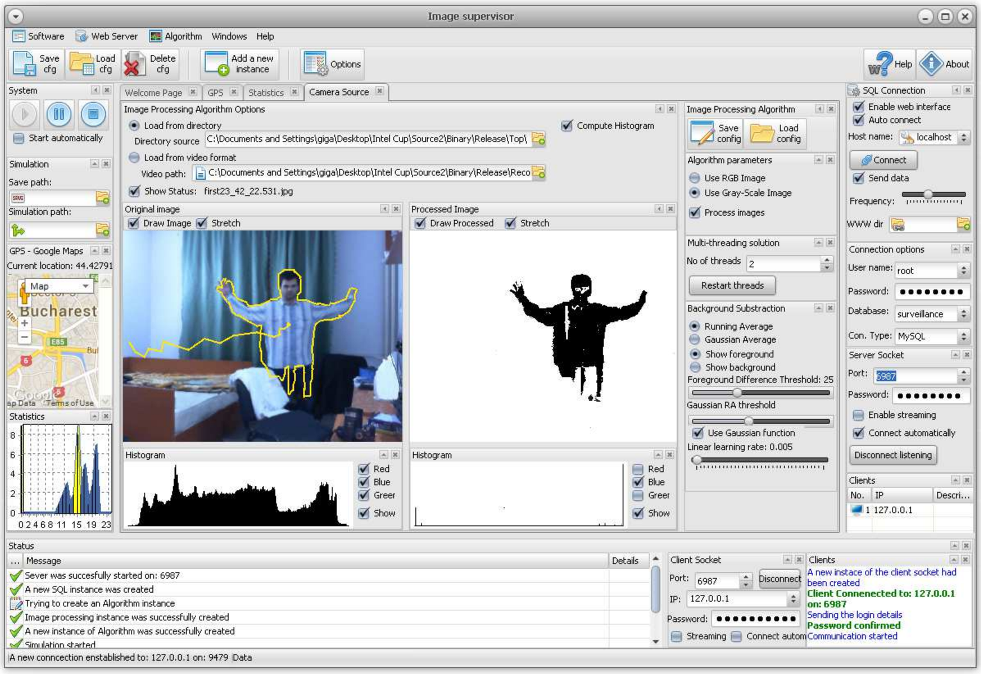


Figure 2. Screenshot of the surveillance system software.

3 Surveillance system output

Below we give a couple of screenshots of some experiments we performed in real environments, exemplifying different stages of the image processing algorithms.

Figure 3. Background Subtraction.

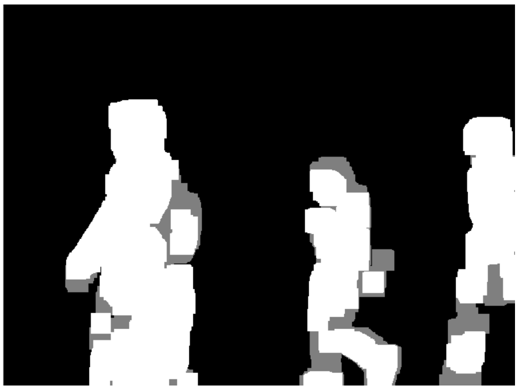
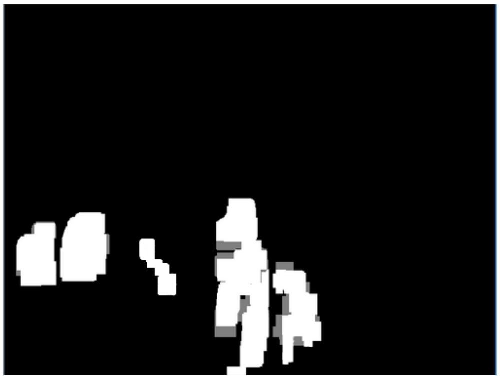


Figure 4. After erosions and dilations

Figure 5. Output of the surveillance



We provide below a couple of detail for the developed web server. The webserver it is an http server based on Node.js, which is a perfect solution for easily building fast, scalable network applications. Node.js has been installed on the Intel Bay Trail board. The communication between the software and the Node.js module is made using the client-server on port 6987. Through the web portal, logged users who are **administrators can change different software parameters** in order to improve the detection quality.

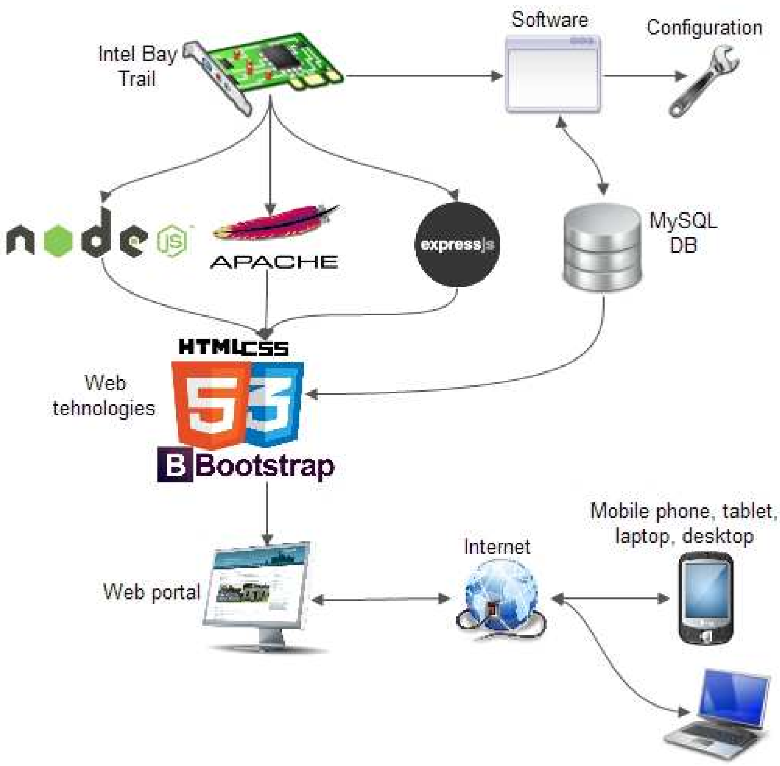


Figure 5. Diagram of the http web application which is able to be run by various machines

4 Conclusions

We presented what we think it is **a very interesting system with a lot of potential.** Although it is still a prototype, most of the components work seamlessly. Thus, the device can be placed anywhere (indoor, outdoor or in an area of interest) and it is able to recognize using different image processing techniques and Artificial Intelligence multiple objects and track them over time. The **device it is also able to compute statistics** on how many people had been seen by the cameras and what their common trajectory is. Moreover, the image processing software enables the device to only store relevant footage and thus save a lot of space, the storage drive being easily upgradeable if necessary.

Moreover, one does not need to be physically near the device in order to connect to it or control it. Anyone (authorized) with a device that supports web technologies can connect remotely to the system using the implemented web interface. Modern web technologies allowed us to create a **scalable web application capable of remotely offering streaming and valuable data**.

Overall, we have managed to create a reliable surveillance system richer with respect to features than most commercial systems available. All of the above running only on the Intel® Atom™ powered Bay-Trail platform, makes the system a breakthrough in price to features ratio compared to the CCTV ecosystem.

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An aproach to teaching Machine Tools using Virtual Reality technologies

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Abstract

This article addresses the problem of learning the basics of mainly CNC machine tools used in industry. The research is based on the fact that usually, for educational issues, in high schools or universities, there are maximum 1-2 machine tools, and working group is relatively large (20-25 students) which involves problems during the teaching process. For the introduction classes with the purpose of learning the basic knowledge of machine tools, we propose an interactive virtual environment that contains 3D models of machines tools. The advantage of using this approach is the possibility to create an intuitive personal environment controller of a machines tool that can run on every common computer used at the class. The article describes aspects related to development of the interactive 3D virtual environment model and the mainly functionalities.

Keywords: Machine Tools, Teaching, Virtual Reality, VRML

1 Introduction

In order to use numerical control (NC) machine tools, currently there are three methods of learning. The first method involves direct learning using real machine tools. But to have access to a real machine and / or experienced technical personnel is not a good choice, considering the costs.

The second method focuses on using dedicated CNC software. This method is mainly used for learning the CNC programming concept and is not complete. It only allows to a person to get used to the real machine, learn the physical process of calibration, fixing part to be machined and touch the panel control.

The third method is based on the combination of the first two methods presented. The machine tools are integrated into an interactive and educational 3D virtual environment that allows getting access to a complete learning experience on how to operate a machine tool without the need to have access to a real machine. This concept takes advantage of the recent developments on the Virtual Reality technology. This third concept was used in the present paper for learning the operation of NC machine tools. The advantage of the presented solution is the possibility to offer a complete learning experience which tightly integrate the user with the virtual and physical worlds by providing an integrated user interface and allowing the user to directly manipulate the objects from both worlds.

The main objective of the presented research was to develop a Virtual Reality (VR) application for a CNC machine. Specific objectives were: modelling of the machine virtual models; development of the interactive virtual environment; integrate events for user interaction through keyboards; modelling an animation of the CNC cutting process. The first step was to create the 3D models of the machine tools. After that, the 3D models were integrated into dedicated virtual reality software that allows the interaction with the virtual machine using keyboard or virtual buttons. The result was a running virtual machine that allows learning basic commands of a NC machine and CNC programming.

2 Literature review

In literature there are many approaches to this subject. Virtual simulators are developed for a variety of areas: training in surgery, clothing test, in automation (Garcia and Alegria, 2013), driving cars (Gavish et al, 2011; Haffner et al, 2013) or driving industrial vehicles – excavator (Ni et al, 2013), for training in maintenance (Gavish et al, 2011), training in machine tools (Kadir et al, 2010; Neugebauer et al, 2012; Purwoko, 2010; Purzel et al, 2013), manufacturing processes (Hu et al, 2014; Mary and Kirubakaran, 2013; Olive and Thouvenin, 2011) or accidents in industrial processes (Manca et al, 2012), applications in the construction of tunnels (Jardon et al, 2012). For training of industrial equipments are presented simulators that can be carried out in a face-to-face interaction or for remote programming of robots or CNC machine tools via Web (Cerezo et al, 2005).

Also, for training in industrial applications was used the Augmented Reality (AR) technology, that overlaps the same image information from the real world and virtual information environment (Dangelmaier at al, 2005). These simulators mostly use an interactive 3D virtual environment that uses various VR interaction equipments (VR gloves and motion tracking sensors). The visual perception of can be achieved using desktop PC displays, head mounted displays (HMD) or advanced CAVE-like visualisation systems. The advantage of using the VR interaction equipments is the possibility to increase the immersion and presence in the training virtual environment. But the high cost of these equipments limited the use of these technologies for learning process in high schools and universities. In the presented research is presented an approach that is based on using common desktop interaction devices for development of the interactive learning 3D virtual environment.

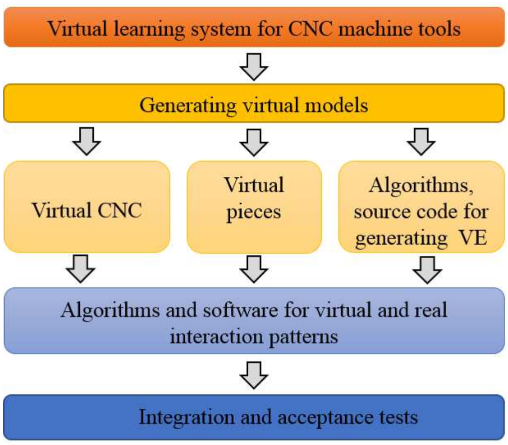


Fig. 1 Development process of the virtual machine tool environment

3 Development of the virtual environment for learning of machine tools operation

The development process followed the schematic diagram presented in *Fig. 1*. The first step was the 3D modelling of the CNC machine tools. The second step was development of the scripts for interacting with virtual machine.

3.1 Modelling of the 3D virtual environment

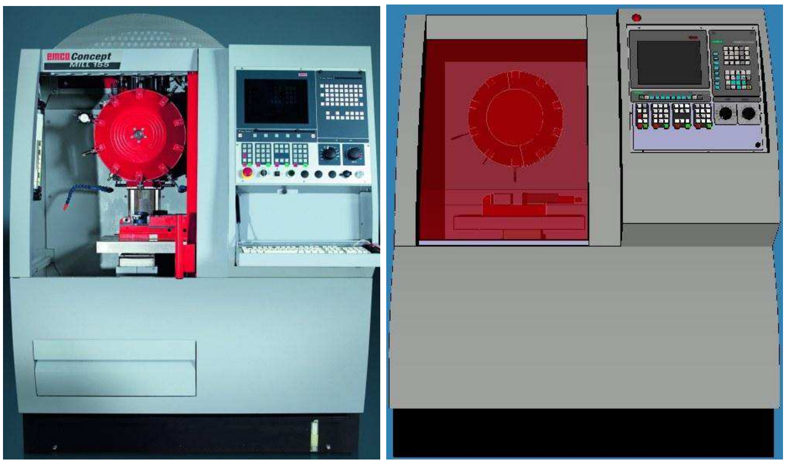
The 3D model of the machine tool was created by using CATIA 3D CAD software (www.3ds.com). In order to obtain a 3D model identical to the real machine was required to measure the dimension of the real machine.

The machine was grouped into sub-components, as simple as possible, and finally all the components were joined into a single 3D assembly. After creation of the 3D CAD models components, we obtained several virtual environments by exporting assemblies from CATIA into the virtual reality programming language (VRML) neutral format. Finally, it was necessary to bring together all the VRML files to obtain CNC machine tools virtual environment. It should be noted that even the control panel is designed as an assembly of several components (buttons, display, potentiometers) which can react independently to user interaction. *Fig. 2* show a comparison between the real and the virtual model (machine designed in CATIA). It can be seen that the virtual environment has some shortcomings, but contains the main elements of the real machine: housing, vise, tools turret, control panel, start / stop button, door.

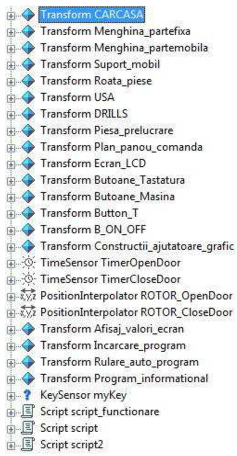
3.2 VRML programming

After modelling of 3D structure using CATIA, the virtual environment is created using the Instant Reality virtual and augmented reality framework (www.instantreality.org).

A virtual environment is not just a 3D model, but also a way to insert the individual operator in the virtual world by providing the possibility to interact with the virtual environment elements.



a. c.



b.

Fig. 2 CNC machine tools EMCO MILL 155 (a. Real, b. Virtual, c. VRML structure)

The entire assembly, CNC machine is fully controlled from the control panel, so the user can only interact with these components and other few buttons. The main problem is to create the connections between the buttons from the buttons from control panel (activation functions, starting the machine) and the mechanical parts of the machine (translating the position of the work piece), and between. These interaction events were implemented using VRML routing nodes and custom functions JavaScript functions. Based on the steps described earlier, we obtained a virtual environment with structure, variables and functions listed below:

No.	JavaScript Functions	Description
1.	button_T	Turn ON button T
2.	TurnON_OFF	Start / Stop machine
3.	set_aux_on_off	Start / Stop auxiliary mod
4.	OpenDoor	Set status to open door
5.	CloseDoor	Set status to close door
6.	ToolTurretRotation	Rotating tools turret
7.	OpenClamping	Unlock workpiece
8.	CloseClamping	Lock workpiece
9.	select_ModeSelector	Select potentiometer ModeSelector
10.	Mode_FreeJog	Enable / disable keys FeeJog
11.	select_FeedSelector	Select potentiometer FeedSelector
12.	Feed_Mode_controll	Set mode_value
13.	ApproachingReference	Position reference point
14.	MoveZ_UP	FreeJog Z
15.	MoveZ_DOWN	FreeJog Z
16.	MoveX_LEFT	FreeJog X
17.	MoveX_RIGHT	FreeJog X
18.	MoveY_INAINTE	FreeJog Y
19.	MoveY_INSPATE	FreeJog Y
20.	start_documentatie	Start learning modul
21.	start_documentatie_masina	Display machine control information
22.	start_documentatie_panou	Display information from control panel
23.	afisare_puncte_referinta	Display machine reference points
24.	afisare_axe	Display machine axis system
25.	citire_informatii	Read file documentatie.txt
26.	afisare_informatii	Display information
27.	informatii_RefM	Selecting the information displayed
28.	informatii_RefW	Selecting the information displayed
29.	informatii_RefN	Selecting the information displayed
30.	informatii_RefR	Selecting the information displayed
31.	informatii_Axe	Selecting the information displayed
32.	activare_TS_Panou	Enable touch sensor control panel
33.	informatii_B49-B110	Selecting the information displayed

4 Using the virtual envirment and the results

The main purpose of the developed system is to provide an interactive environment that allows to the user to learn the key elements of the EMCO MIL 155 CNC machine and how to use the machine by defining the functionality of all buttons on the control interface.

4.1 Virtual learning system

Fig. 3 shows the functional block diagram of this system. This is just an information system, but it is still possible to operate the machine to better understand the functionality of each button.

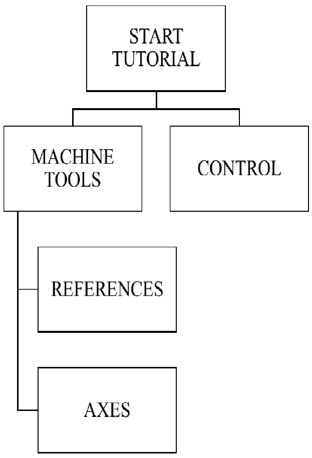


Fig. 3 Block diagram of learning items

The tutorial is starting by pressing the red button above the control panel (Fig. 4). Once the system is active, the user is given the opportunity to select the type of information. The *Machine* button will open the dialogue between the user and the main elements of the machine. All this information is presented to the user by displaying a 3D text on the left rectangular panel of the machine when the cursor is passed over one of the elements.

The second information module is accessed by pressing *Control* button. This module presents information on the role of each button on the control panel. For further information, the user can operate the buttons.

All information is stored in a text file, where each row represents information about a single item. Depending on the selected item, it is called a unique function for each element, which stores in a variable the line number where the information about the item is located. For a structured classification in the display panel area, in the text are inserted items -using *$* symbol, which are interpreted as functions *Enter*.

It should be noted that, when pressed *Start Tutorial*, the entire text file is loaded and the information is sent to the virtual scene and stored in a variable of type array of Strings, where each line represents a vector iteration. To show the text on the control panel, it used a second vector of Strings consisting from a line of the previous vector. Iterations of this last vector are incremented when reading character - *$*.

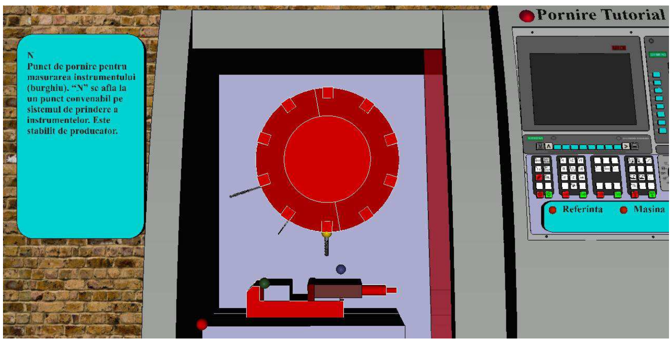


Fig. 4 Virtual learning system of the CNC machine

4.2 Virtual testing system

The second main function of the entire virtual system involves a deeper understanding of the real machine operating mode and is intended for users who have learned and passed the first training system.

Starting the Auxiliary Mode (Fig. 5) will activates auxiliary drivers and allows the movement of the work piece assembly on the reference position when pressing the button *Reference Position*. If any of these steps is omitted or not followed in that order, when the user press any other button up to 5 times, the digital display will show an error message. To reset the boot process of the machine, the user has to press the stop button and restart the machine.

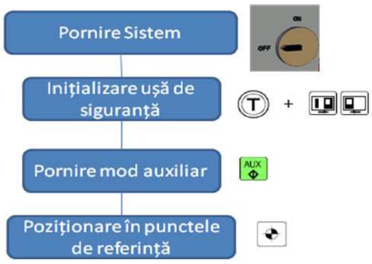


Fig. 5 Functional diagram of the virtual machine start up

Fig. 6 Manual operating of CNC machine tools

Machine tool presents five operating states. These states can be observed on the *Mode Selector* button indicator, right control panel:

	Reaches references point		Automatically mode
EDIT	Editing mode		Half-automatic operation mode
	Manual control mode (*Fig. 6*).		

When choosing *Manual Control* mode, it can be seen on the virtual machine that the buttons which control the machine axes are enabled (actually observed by the activating of the lights and touch sensors enabled the virtual scene).

All things presented in this chapter were made using VRML JavaScript and allows to simulate closely actual functionality of the CNC machine. For each CNC operation an item on the control panel is enabled of disabled. A JavaScript function was used to change the value of transparency, according to the state of the LEDs, or change the image on the screen control panel. When the machine is starting, it can be seen that only certain elements of the machine are enabled. This function involves enabling or disabling certain sensors in the virtual scene.

4.3 Case studies, tests

In order to check if the user follow the flow of machine operation a log file (history) is created, in which all user operations are stored and can be analyzed. Log window looks like in *Fig. 7*. From the analysis of this history, it can easily determine if are any errors in the program and the mistakes are made by the user. Also it can be use to generate an evaluation score for every user. The system can automatically check the following errors: rotating turret in the current position and not in the reference position; rotating and moving the turret at the same time with the tools; when starting the machine, some buttons are wrong activated; lack of control variable initialization, reset the state machine; in the tutorial module, the inability to exit from the tutorial at any stage the user would be; display incorrect information in tutorial mode; operation of the machine with the door open protection; manual operation of the machine only as Free Jog mode.

At present, this system can virtual simulate the functional operations presented in *Fig. 8*. All of the above features, even though they are independent, they are linked through the control panel. Each function has a state variable that can completely influence other functions buttons (complete elimination of functionality) or partial change of function (partial function), but in the end, all functions exactly simulates the function of the original system.

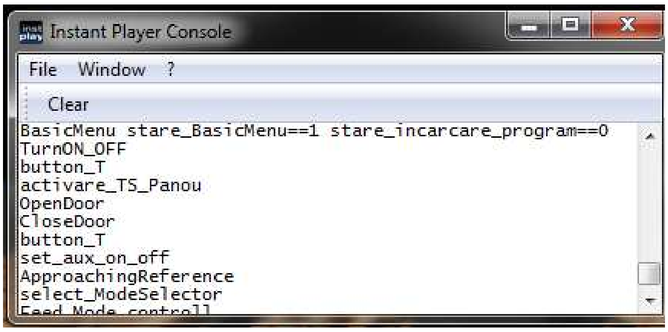


Fig. 7 Log file

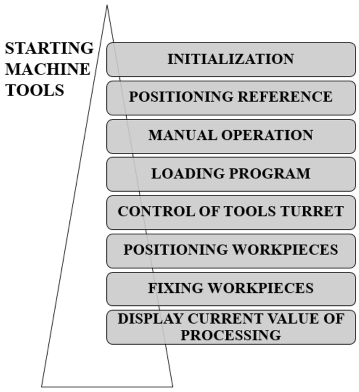


Fig. 8 Functional operations

5 Conclusions

Experimental study of the use of the developed virtual environment revealed an increase educational interest and learning efficiency, but can not completely eliminate an instructor in the learning process. In addition, this is a safe and inexpensive training system, because is not necessarily the use of the real machine. The simplicity and the training module make this program easy to understand and use by the students.

Although this training virtual environment presents only the elements necessary for minimum operations, it is the starting point for students who want to learn how to operate a CNC machine, thanks to a rich information system able to inform the user about all the components of the machine and how the CNC machine operates. The software architecture based on the Instant Reality framework (www.instantreality.org) allows improving the interaction functionalities of the training system by using a joystick or VR gloves and 3D stereoscopic visualisation, thus increasing the level of detail perceived by the user. Also many other features in addition to those presented so far can be implemented, such as: module for writing machine programs using G code; simulating the full functionality of the machine screen; manual positioning of the work piece; adding a larger number of tools; implement a smooth motion simulation of mobile elements; serial communication module with the real CNC machine.

In conclusion, the developed virtual environment training system is an excellent starting point to learn how to operate the CNC machines tools. In the future, this application can be used as a model for development of more complex systems capable to simulate any functionality of MILL 155 ECMO machine and even software WinNc Sinumerik, in order to ensure two-way communication between virtual and real machine.

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Developing Blended Learning University Environments Using Moodle – A Case Study

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Abstract

This case study evaluates the challenges encountered in the Blended Learning development using Moodle Virtual Learning Environment in the context of TEMPUS CRUNT elearning inter-university network. The paper examines a variety of determinants that influence technology acceptance and successful implementation of the VLE in the educational field. The study begins with an examination of Moodle Virtual Learning Environment, which can provide course materials such as handouts, lecture notes and PowerPoint presentations to the students. Moodle can be used in more interactive ways, which require input from the students. Such as discussion forums, chat rooms, quizzes and assignment drop boxes. There are analyzed the technological factors influencing technology adoption including issues surrounding acquisition, management and support of a VLE in secondary and high schools. We explore teacher level factors of Moodle VLE acceptance and how teacher attitudes to such platform are developed. The findings show that there are specific technological, teacher level and school level factors influencing Moodle acceptance. They also show that teacher attitudes to the implementation of the Moodle in the school are tied to their attitudes and responses to national objectives in education and national strategies for reshaping learning. Although the number of distance courses has risen significantly over the last years, mixed modes of delivery, with face-to-face settings supported by online tools, remain the dominant form of online learning. There is clearly a need in the literature for greater exploration of flexible modes of learning, including e-tools, especially when teaching computational skills to engineering and university students. Moodle logs and statistics were examined along with documentation relating to this VLE.

Keywords: blended learning, TEMPUS CRUNT elearning inter-university network, e-learning designs, teacher education, managed learning environments, virtual learning environment, Moodle

1 Introduction

The usage of Learning Management Systems (LMSs) such as Moodle has been widely integrated in the higher education process. It is normally utilized as a supplemental learning platform to traditional learning education, which is known as blended learning environment or hybrid learning environment. Many universities have practiced and have been committed to blended learning approaches. The transition to a mixed mode learning environment at higher institution is related to four imperative reasons namely the rise of lecturer-student ratio due to the growth of students enrolment and low staff resources; course modularization that increases the pressure to share materials; information technology that satisfies user expectation and consumer expectation on educational technology in higher education institution. Learning engineering, applied sciences and technology is challenging to students in that they require thinking and visualizing scientific concepts. Due to the abstract concepts involve in engineering, applied sciences and technology, many students fail to visualize and translate the interplay between the scientific concepts at several levels. Support of educational technology has been developed and found to be very useful for teaching engineering, applied sciences and technology to large groups of students. In this context is necessary introduction of a Moodle learning on a first year engineering, applied sciences and technology programme in order to motivate and improve students' learning through virtual learning approaches. Students' feedback revealed the appreciation on the flexibility of the system where they showed confidence in learning engineering, applied sciences and technology and less anxiety about the exams. Many research papers examined the interaction of first year undergraduates with Moodle system and it was found that students who were stimulated to use the online resources did better in their examination than those who were not. In general, the use of e-learning especially in higher engineering, applied sciences and technology education provides flexible learning environment that helps students to learn and improve their performance in engineering, applied sciences and technology especially in the freshman year.

2 Blended-Learning Pedagogical Model for Teaching and Learning Through an Virtual Learning Environment (Moodle)

2.1 Blended-Learning: Background and Definitions

Blending is an art that has been practiced by inspirational teachers for centuries. It centres on the integration of different types of resources and activities within a range of learning environments where learners can interact and build ideas.

In the context of this paper, the following conceptions are acceptable pertinent frames:

Blended learning is the combination of different training "media" (technologies, activities, and types of events) to create an optimum training for a specific audience.

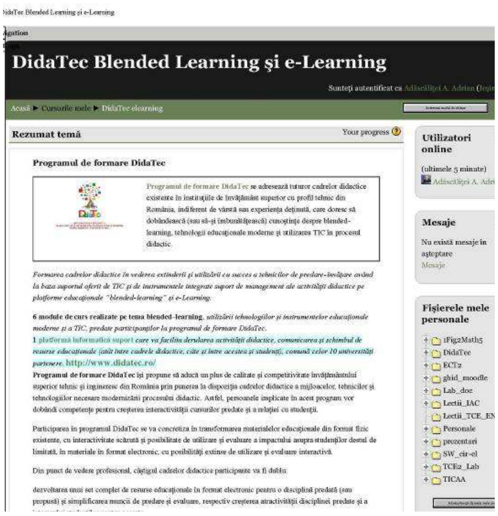
The goal of blended learning is to synthesize training media into an integrated mix – one you can tailor to create a high impact, efficient and exciting training program".

2.2 Blended Learning (CAI) Course Syllabus

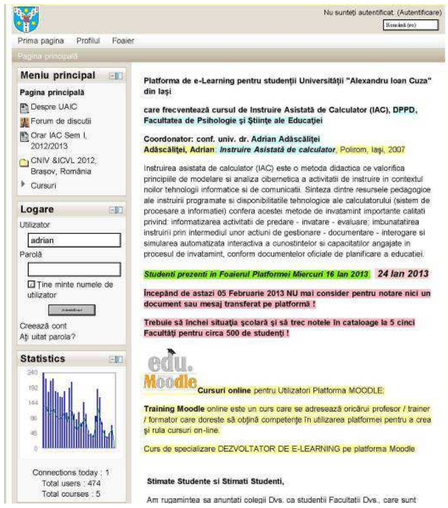
A topic-based, learner-centered curriculum has been designed to meet learners' needs and interests. Syllabus content has been developed taking account of the target learners' profile. This profile included information about learners' personal motivation to learn Computer-Aided Instruction (CAI). They also reported on their expectations for a Blended Learning (CAI) course and their perceptions of a good teacher.

2.3 Online Tutor

As online tutors, teachers help learners build their confidence as they get used to working independently online. They post messages to the group as a whole—and to each student individually—to meet their need for support. They may post explanations to guide learners in more complex tasks, encourage them to communicate, do their individual assignments, and use all the platform tools they have at their disposal to facilitate their work. Tutors check and mark the online assignments, fill in learners' progress reports, and write feedback on their performance in their online portfolios. They continuously track learners' improvements and give encouragement when motivation begins to falter. They have to encourage learners to carry out their collaborative work tasks, which is usually difficult because of the students' different schedules and the fact that they are not used to working collaboratively to achieve language-learning tasks. Being teachers and online tutors has introduced beneficial qualitative changes in teachers' roles, but it has also meant a quantitative increase in the number of hours dedicated to learners. Teachers spend only 2 hours a week in face-to-face classes, but they spend a larger number of hours managing learners' work in the online environment.



Blended Learning developed at the „Gheorghe Asachi" Technical University of Iaşi (http://moodle.ee.tuiasi.ro/)



Blended Learning developed at the „Al. I. Cuza" University of Iaşi (http://www.moodle.ro/uaic/)

Figure 1. Blended Learning developed at the „Gheorghe Asachi" Technical University of Iaşi and at the „Al. I. Cuza" University of Iaşi

3 CAI course (BLOnline)

In the following you will find detailed *guidelines for formatting your paper*. These guidelines include complete descriptions of the fonts, spacing, and related information for producing your proceedings manuscripts. Please follow them and if you have any questions, direct them to **vlada[at]fmi.unibuc.ro**.

3.1 The institutional and curricular context

The course can be described as follows:

• learning spaces: university seminar, e-learning platform, school classroom

• participants: students (e.g. learners as moderators or as student teachers), university professor, tutor, outside experts

• materials: video recordings, reader, textbook, learning modules

• methods: lectures, discussions, video-recorded classroom observations, reading tasks, learner diaries, mini-practices, e-interviews

• content: theory and practice

Students were organized (grouped) in the course according to their specialization:

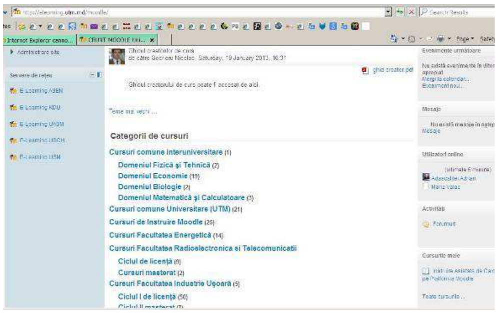
Each student received as project work, to be realized by using VLE Moodle platform (www.moodle.ro/uaic/ platform), a web lesson to complement traditional lesson materials that Student has sustained in the pedagogical practice (Figure 1).

Each student must enroll and must participate in activities in a course conducted by another colleague of the group to which he belonged. A student is simultaneously a course creator and a participant in three courses realized by three colleagues who are part of his group.

After hearing the current lesson during the computer-assisted instruction, each student connects to the course version with the same title on the Moodle platform.

Content lessons from the CAI course (BLOnline): 1. The Design of Computer Assisted Education (CAI); 2. Learning and Teaching CAI; 3. Delivery technologies for teaching materials;

4. Blended Learning; 5. Virtual learning environments (VLE Moodle); 6. Structure and organization of courses delivered online; 7. Realizing CAI projects by using Interactive Multimedia Technologies.



Blended Learning developed at the „Gheorghe Asachi” Technical University of Iaşi (http://elearning.utm.md/moodle/)

Content lessons from the CAI course (BLOnline)

Figure 2. Blended Learning developed at the Technical University of Moldova Chişinău, Moldova, (http://elearning.utm.md/moodle/)

Also, each student must understand the contents of study materials needed to carry out practical laboratory activities (seminar) material called Moodle VLE-use.

Theoretical materials for Laboratory Tasks are as follows:

1. Introduction to IAC course structure; 2. Strategies for instructional design 3: Techniques for using Internet services for information and communication; 4. Creating Educational Web Pages, 5. Making multimedia teaching materials, 6: Using learning management systems (LMS) for teaching (Moodle); 7: Developing learning communities (Virtual class).

Students must connect on the Moodle platform to both the CAI course and the Moodle VLE Laboratory.

In this Moodle VLE Laboratory supplement of CAI course students learn to manipulate Moodle features that will be used in creating web support for teaching lessons within their own disciplines.

2.2 Student blended learning course worked examples

Preparation of design and construction of Student Course work is conceived as a sequence of steps, according with e-learning instructional model.

We will mention only design, development, implementation, execution, and evaluation.

In the Design phase student learn ‘how’ to teach using BL. The outcome from analysis of the learning characteristics and needs of the learners is used to create a blueprint for the instruction, where the learner’s learning process, defining the learning approach, the structure of the information to be delivered (facts, concepts, processes, procedures, and principles), standards to be used, execution criteria, and achievement expected of the learner are specified.

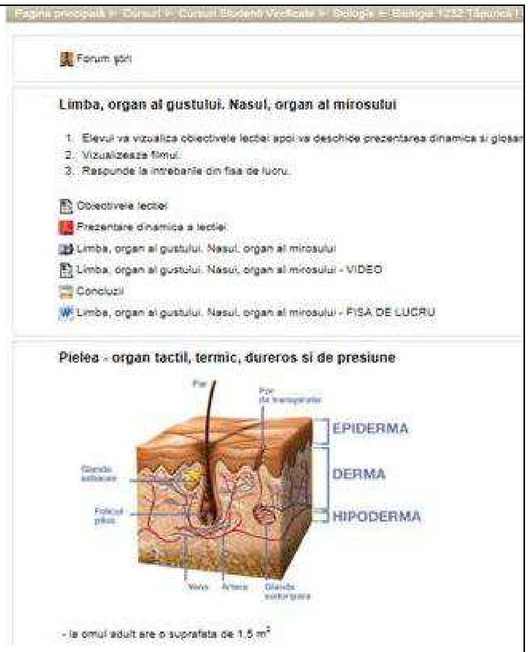
Development phase describes the tools used to teach, the materials, strategies, event sequences, and necessary resources.

In shown examples where presented some of models used by our students in specific disciplines, as well as captured images from lessons realized on the Moodle platform.

Four hundred and ten students, enrolled in the”Al. I. Cuza” University in the 2013/2014 scholar year, represented the study’s experiential and control groups.

These students who will obtain diploma from Department of Teacher Education are from following faculties:

1. fifty six Students from History,
2. eight Students from Romano-Catholic Theology,
3. sixty four Students from Philosophy,
4. two hundred forty Students from Letters and Languages,
5. forty four Students from Biology (Figure 3.).

<table>
<tr><td>Sadava, Life: The Science of Biology 9e
Student Centre
(http://bcs.whfreeman.com/thelifewire9e/):
Lesson 2: Small Molecules and the Chemistry of Life
Flashcards
Key Terms
Animated Tutorials: Chemical Bond Formation
Activity 2.1 Electron Orbitals
Chapter 2 Interactive Summary
Chapter 2 Suggested Readings</td><td rowspan="2">
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<tr><td>Interactive Summaries
Animated Tutorials
Activities
Interactive Tutorials
Working with Data
Experiment Links
Flashcards
Key Terms
Suggested Readings</td></tr>
<tr><td>Example of Biology online Lesson</td><td>Biology online Lesson created by a Student</td></tr>
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Figure 3. Lesson created by a Student from Biology

In the university year 2012 / 2013, four hundred and seventy four students from the same faculties participated in the blended course activities.

4 Standards for Blended Learning Teachers

The International Association for K-12 Online Learning (iNACOL) released their National Standards for Quality Online Teaching. Online teaching is different than blended teaching—but so many of the standards apply directly to teaching in a blended or hybrid learning classroom.

What skills do you need to have to teach in a blended or hybrid classroom?

1. **Meet your state professional teaching standards** or have academic credentials in your instructional area. You need to know the content you will be teaching. And you need to know how students learn.
2. **Have or get technology skills.** You will need to know some basic application skills, like word processing, spreadsheet and presentation software, internet browsers, email applications.

You will also need to know how to use discussion forums and chat-tools effectively. If you are using a Learning or Lab Management System (LMS), you will need to know it well. And make sure you know basic troubleshooting skills, like how to mute audio or change student passwords. Plenty of resources are available online to learn how to use the tools—and your school most likely provides professional development opportunities in these areas too.

3. **Encourage students to interact, work together and be active participants** in both the online and face-to-face portions of the class. You will need to facilitate and monitor student interaction and build a community of learners. Your warm and inviting classroom skills will transfer into the computer portions – but you may have to consciously work at them.
4. **Be a leader who provides clear expectations and regular feedback.** Your communication skills will help your students, as will your strong leadership.
5. **Use technology in an ethical and safe way.** Your students will look to you as a guide for how to act ethically and what rules to follow. You must make sure they understand the consequences for improperly using the technology tools—as well as provide instruction on the differences between proper and improper technology use.
6. **Be a student in an online or blended classroom.** Being a student changes your perspective and allows you to better anticipate the problems your students may encounter.
7. **Respond to students with special needs.** Your students will have a varying set of talents and skills. You need to be comfortable with a wide variety of strategies to help them learn, including adjusting activities and addressing skills levels.
8. **Create valid assessments.** Your assessments need to be fair, reliable and consistent – and they need to cover the content they are designed to measure.
9. **Deliver and assess progress of standards-based learning goals.** Assessments should be authentic and allow students to show their understanding, rather than isolated testing, and should be continuous.
10. **Use data from assessments to modify instruction.** As your students are learning, you will need to be able to switch gears and respond to the way they understand. Sometimes students will not develop deep understanding immediately, and you will need to change your delivery to help them develop deep understanding.
11. **Give opportunities for students to pre-assess and self-assess.** Students can help you find out if they are ready for the course content and delivery. And with your help, they can independently define learning goals and monitor their own progress.
12. **Work with your colleagues.** You are not alone. You will need to work with a team of colleagues and develop networks with other instructors involved in blended learning.

For the detailed standards and performance scale, see iNACOL’s National Standards for Quality Online Teaching.

4.1 Example of an engineering, applied sciences and technology courseware structure
ENGINEERING, APPLIED SCIENCES AND TECHNOLOGY

Name of the case: Engineering, applied sciences and technology

University, department & Country: Technical University “Gh. Asachi” Iaşi / Technical University of Moldova Chişinău, România/Moldova, Faculty of Electrical Engineering, România / Moldova

Study context (level of studies, topic): Bachelor-level introductory course in engineering, applied sciences and technology

Target group: Second-year students specializing in engineering and having engineering, applied sciences and technology as minor specialization subject

Description: The aim of this course is to introduce the basic principles of engineering, applied sciences and technology and give an overview of the most important scientific and technologic concepts. The practical section introduces the principle techniques used in engineering and applied science.

Objectives of the course: This course briefly revises the basic of engineering, applied sciences and technology.

Syllabus: Lesson structure. The scientific literature: primary and secondary sources, patents. Bibliographic search.

Laboratories and/or exercises: Laboratory experiments, mini project, exercises

Pedagogical approach: Because of the high level of abstraction of the subject matter it is difficult to implement active learning methods (like discussions, role plays and online collaboration) in this course. This is why the course is mainly based on individual assignments.

As an E-learning environment, the Moodle VLE forum is used for discussions about the practicum experiments. The students have an opportunity to compare their results and discuss why some experiments were successful and others were not.

The students must write a written term paper that will be peer-reviewed by the fellow students. Every review must have a different approach.

Use of technology: Most of the functionalities of Moodle VLE LMS are used in the course: blog, discussion forum, individual and group portfolios, quizzes, and wikis. Computers were also necessary for presentations and getting literature.

In order to pass the course successfully, the students had to use the free modeling software, which was possible to download from e-learning environment Moodle VLE.

Text-, video- and software installation files are provided on CD-ROM for each student who does not have fast access to the Internet.

The students had a possibility to ask the instructor for technical help, the Moodle VLE user manual was also helpful.

Blending method: The engineering, applied sciences and technology course is partly Web-based, a significant amount of learning activities takes place in Moodle VLE Learning Management System. It is suitable for the students who study at university, but also for people whose work is connected with this subject and they need some extra knowledge. Participation in the course requires knowing a lot of facts and it is also important to have abstract thinking and a good memory.

The course is a combined course, there are two hour lectures (introductory, materials were in learning management environment Moodle VLE), three hour seminars (presentations and other students' reviewing) and practicums (in engineering, applied sciences and technology it is not possible to do engineering, applied sciences and technology practicums in a Web-based format).

The learning resources are mainly in *.pdf format or PowerPoint presentations. A lot of colorful illustrations, schemes, diagrams were used – it makes printing difficult for students. Students receive a CD-ROM with video materials.

Outcomes and evaluation results: In order to get marks, the students must take two short Web-based tests (10%), one short term paper (10%), and they must prepare a presentation (10%). In addition students must defend their laboratory protocols (15%) and to do a written test about the laboratory protocols (15%) and finally must do a school-based written test (40%). Active learning in the Moodle VLE environment might have a good influence on the students' grades.

Links to additional information and references: *http://elearning.utm.md/moodle/*, *http://moodle.ee.tuiasi.ro/* and *https://www.moodle.ro/uaic/*,

user: ****

password: ****

5 Conclusions

The program presented here is the result of Iaşi ”Al. I. Cuza” University and ”Gh. Asachi” Technical University of Iași blended learning project (with the support of Moodle Romania) and *TEMPUS CRUNT elearning inter-university network* project to innovate pedagogical practices using ITC technology. As a starting point, we advocated to a tertiary education learners’ needs analysis with the hope to create a pedagogical model to more efficiently meet those needs. We then engaged in the selection of ICT resources for Blended Elearning Theoretical Fundamentals, in syllabus and courseware materials design and development, in teacher training envisioning ways to creatively put theoretical principles into practice, in devising and developing balanced tests to objectively and coherently assess the communicative goals set. At the same time, we designed, created and judgmentally evaluated the pedagogical materials, supervised technical implementation, and managed the utilization of the system of our end users. The project provided student teachers the opportunity to assume new roles: to become CAL (Computer-Aided-Learning) material designer and developer, script writer, manager and producer of media resources, work flow manager, online tutor, manager of the language learning environment, and mediator to open communication channels with a multidisciplinary team.

The blended-learning pedagogical model implemented combines: (a) Learners’ independent work with CAL tasks for developing language skills in a network-based interactive multimedia environment, (b) online tutoring in web portfolios, (c) online interaction with global/local community, (d) online and face-to-face tutoring by CAL teacher-tutors, (e) face-to-face classes with CAL teacher-tutors.

BLOnline is a blended course, in which students work 80% of the time in the virtual classroom and with their tutors. The students work on weekly online activities in online teams.

The laboratories are face-to-face and students have the option to also attend a weekly in-person tutorial. Lab debriefings, test prep, and an International student debate activity use a web videoconference system just introduced at the university. Each of these activities is intended to actively engage students in their learning and to give students at a distance equal access to all course resources. Other online components include weekly discussion questions, simulations, video clips, Tweets, and wikis. All teams work together in blogs.

The instructional design encourages student interaction and analysis. The student centered approach helps students develop socializing, presentation, and analytical skills. Engineering, applied sciences and technology was specifically chosen to demonstrate the applicability of online teaching for the *hard sciences* and for *first-year students* with limited computer and Internet skills. A common complaint from science faculty is, “Online may work for social sciences, but it does not work for the hard sciences.” This course is designed to dispel this myth.

BLOnline is the model for the university. To assist faculty to grasp the educational approach and how to use the educational technology and the Net as a learning tools, the project has created a video *Teacher Handbook*, This video documents all course components, as well as research results and student comments.

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"Effective Informations" Against "Incomplete Informations"

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Abstract

Existing competition between higher education institutions involve sustained efforts to adapt to the demands of modern society .The educational offerings must address the new challenges that require flexibility, speed, complexity and provide students both the skills and tools for effective work.Through the research conducted we aimed to identify perceptions of the students and the teachers from "Alexandru IoanCuza" University of Iasi, but not only, on the usefulness and acceptance of new forms of e-learning, existing resistance to the implementation of new methods, existing motivations and limitations, the preference to use a particular type of teaching and learning (formal methods, e-learning, blended) and the way in which the students get to understand the assessments of gained knowledge through the use of new information technologies.

Keywords: Blended learning, E-learning, Media Learning Tools

1. Introduction

Globalization and information technology have amplified the market of higher education. Currently, there is a greater competition between higher education institutions to provide quality information, attractive packages and make them available in a manner required by students. Through the internet-based learning and through the building process of the "e-university", education and training are more accessible to a global audience. Credentials, certifications and degrees can be acquired outside the traditional educational system. More than ever, the knowledge and the learning "are an opportunity."

In a world dominated by repeated changing of education, the universities must integrate and adapt their offerings to support the new generation, updating the aims and needed resources to meet new challenges and, at the same time, provide to the persons involved in the educational system skills and effective work tools. The changes in the curricula, the changes in the curricula's contents, in the forms of organization and all other aspects of material resources are relatively easy to implement and control.But, the human resources modeling is a difficult and lengthy process (here comes mentalities, labor skills, strength in the face of change and other factors that may brake this approach).Currently, the implementation of Internet-based educational technologies, generically called e-learning, is a key component in both directions: in the preparation of the students, but also in the continuous development of the teachers.

2. Objectives And The Research Methodology

The research was made it to develop this study aimed at identifying the perception of the students and the teachers of the „Alexandru Ioan Cuza" University (UAIC) about the online education.

2.1 The Objectives Of The Research

The objectives of the research, subordinate to the purpose who was mentioned above, are:

O1. the acknowledgement of the real existing level of informational technology in educational systems, from Romania and abroad;

O2. the knowledge of the real existing level in which UAIC students are supporting the new methods of e-learning and are interested in using them in the learning activities during the period of the university studies;

O3. identifying students' perceptions about the advantages and disadvantages of learning based on existing platforms in UAIC (server for broadcasted materials, server for content management, virtual library for scientific works, and others);

O4. the gathering of students' opinions about the level of understanding of the teached or applied subject if both, him and the teacher, are using the e-learning technologies.

O5. understanding the relationships between: students, socialization needs, long distance and real time teamwork, results expectations;

O6. the gathering of views of the students and the teachers about the infrastructure needed for e-learning systems that are already built in UAIC.

O7. the gathering of students' suggestions regarding the use of various presentation forms for courses materials, or various methods to teach to the students (e-learning, traditional, mixed, other).

2.2 The Research Methodology

The methods used in the undertaken research were varied and consistent with the established aims.

Those methods are:

M1. documentary study is based on bibliographic documentation from specialized sources, romanian and foreign;

M2. qualitative methods who are based on observing the mode to understanding and implementing of e-learning methods;

M3. quantitative methods based on obtaining data through the method query/response or through the method of self-analysis using as data collection tool the online questionnaire, who was applied to the students, the teachers and not only them.

3. The Design Of The Questionnaire

The questionnaire was created in line with the objectives set, including 19 items. The firsts of them are filter type to get realistic and appropriate answers. The questionnaire contains queries and self-assessment items, with closed or opened methods of answer.

The questionnaire was created in its initial form by the engineer Petru-Adrian Istrimschi and elearning analyst Lucian Berechet. He suffered, after consultations with the others two authors of this article and exposed for the critical review of lecturer dr. Adrian Labar, a process of rewriting the original texts in one form, easy to read for non-technical people. Any objectives aimed to be reached by any of the studied items was not changed through the process of the text's correction and also the order of the studied items was not changed.

The answers were coded and centralized in a database. The charts presented have been made with the help of Microsoft Excel.

4. The Assumptions And The Results Of The Study

The study has as starting point the assumption, based on the authors' observations, that students, who are at the age when readily accept new technologies, are the first who want to be informed about new technologies and are those who "lose" the most of the time on the Internet (are often expressed complaints against ones who don't read books or ones who don't socialize otherwise than over the internet etc), are those who will join more easily to new learning methods.

Also based on the information, was complaints about the fact that, the teachers are ones who hardly adapt to the new society based on the Internet and are the first who want to keep the "status quo". This was not, however, an objective of the present work.

4.1 The Assumptions

The Assumptionson thefoundationof this researchare:

I.1. Students are interested and they readily accept to use the new e-learning technologies

I.2. Students meet and use during the learning process the new e-learning technologies.

I.3. Students do not take the fact that missing the direct communication with the teacher and peers as a problem in using software for e-learning methods for taught courses and applications.

I.4. Students prefer to communicate "face to face" and they want to "meet" for working in teams in order to achieve tasks and to get better results. Any of methods is used to achieve those goals, but quicker and "trendy" is the Internet.

I.5. Students want a mix of educational systems: formal and e-learning.

As a result of processing the information from the survey based on the questionnaire we positively achieved the assumptions mentioned above and the general conclusions who highlight the acceptance and use of new methods of online learning by most of the respondents.

4.2 The Results Of The Study

At the questionnaire were recorded a total of 477 responses.From personal information requested in the questionnaire we counted that 24% of those who responded are male and 76% female, 48% are aged between 20 and 25 years, 13% between 25 and 30 years, 16% between 30 and 40 years, 12% over 40 years and the remaining 10% have up to 20 years. Only three respondents don't wanting to declare their ages.57% said they are students or master students in traditional form programs (the presence "in person" is mandatory), 22% are students or master students to "distance learning" form (ID programmes), 10% are employees of the institution (of which 80% of them are university's didactic staff), 7% are visitors on university's website without involvement in the educational system of the institution, 2% are doctoral students, 1% are students or master students to "low frequency" form (the presence "in person" is mandatory but with low frequency), in UAIC learning programmes this is refered as IFR programme, and just three of them don't want to reveal their level of involvement.47% have completed the high-school with degree, 45% have bachelor degree (22% of them have already completed at least a master's program and 7% already have a PhD title), 5% have not completed the high-school and 12 persons did not want to declare the studies already achieved.

At the question `How frequently you visit www.uaic.ro or websites from its subdomains?` were selected as response the following options (fig. 1):

- `„Never”or„only by chance”`: 17 selections
- `„During exams”or„before enrolling in college”as the case`: 20 selections
- `Once a month to see if are news, I don’t like to receive them automatically`: 62 selections
- `Once a month, but I have subscribed at the news feeds from UAIC`: 43 selections
- `At least once a week`: 188 selections
- `Quite often, kind of every time I get on the Internet`: 144 selections

The conclusion of this distribution is that the majority of respondents in a percentage of 78.62%, are visiting with high frequency www.uaic.ro or other websites from uaic.ro domain or are already subscribed at news feeds from the uaic.ro domain, in search of useful information. This mean that they are familiar with the new methods to deliver usefull informations.

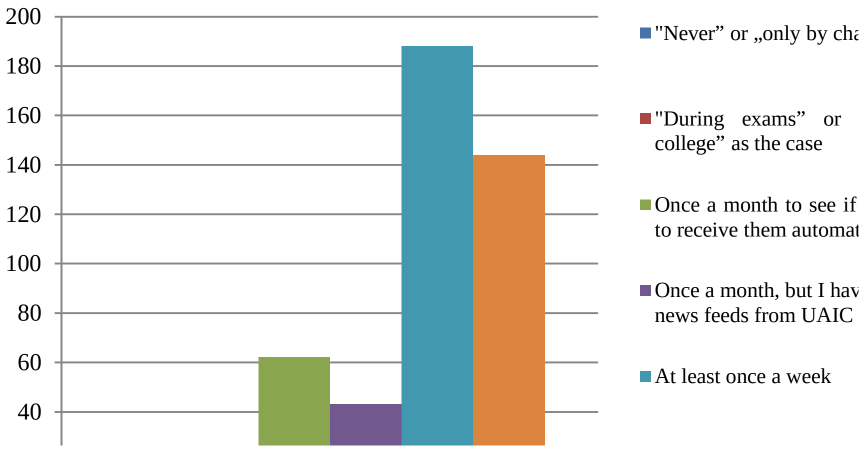

Figure 1 Distribution of selected answers at the question `How frequently you visit www.uaic.ro or websites from its subdomains?`

At the item `Of the time used for the independent study, you make internet searches in a percentage of approximately:` were selected as response the following options (fig. 2):

- no selection made: 2 persons
- `10%`: 8 selections
- `20%`: 16 selections
- `30%`: 44 selections
- `40%`: 44 selections
- `50%`: 94 selections
- `60%`: 65 selections
- `70%`: 67 selections
- `80%`: 84 selections
- `90%`: 39 selections
- `100%`: 14 selections

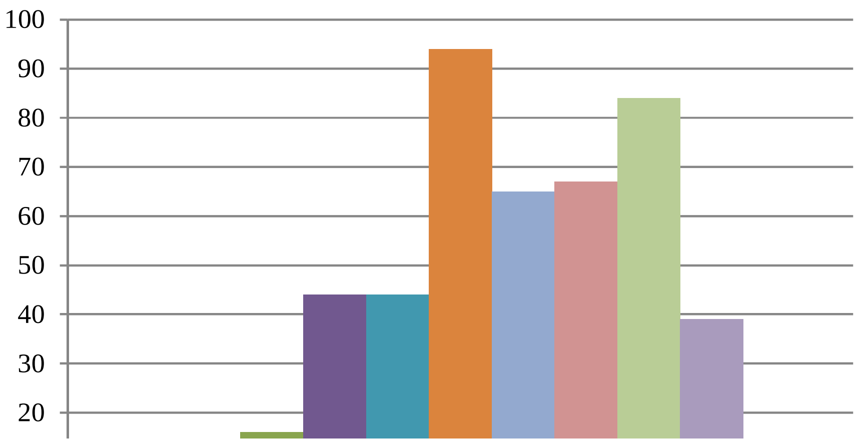

Figure 2. Distribution of selected answers at the item `Of the time used for the independent study, you make internet searches in a percentage of approximately:`

Of the time used for individual study, "searching over the Internet" is the method most often used in search of useful information. This showing that informations on the Internet are easy to find for at least 76,10% of respondents and also that at least 50% of the total time allocated to individual study is used for searching the Internet for those 76,10%.

At the question `How often do you use search engines over Internet in search of useful information to improve your knowledge?` were selected as response the following options (fig. 3):

- No selections made: 6 persons
- `Never`: 2 selections
- `Uncommon`: 19 selections
- `Average`: 98 selections
- `Often`: 181 selections
- `Always`: 171 selections

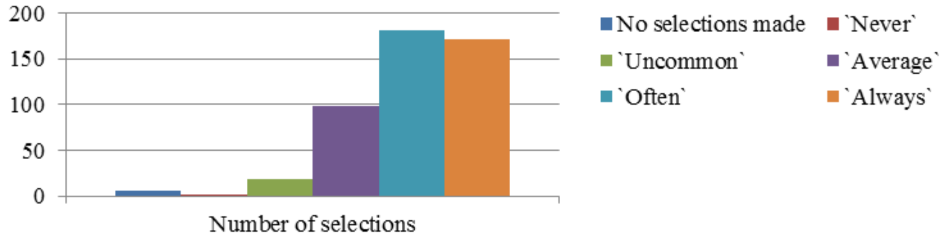

Figure 3. Distribution of selected answers at the question `How often do you use search engines over Internet in search of useful information to improve your knowledge?`

When they want to find useful information the respondents uses search engines over the internet. They use this method `always` and `often` in percentage of 73.79%. 20.55% uses search engines over the Internet in 50% of the cases, while only 4.4% uses `never` or `uncommon` this type of Internet service. 6 people did not want to answer to this question.

At the question `How often do you use online tools (software tools, gadgets)?` were selected as response the following options(fig. 4):

- No selections made: 10 persons
- `Never`: 48 selections
- `Uncommon`: 99 selections
- `Average`: 126 selections
- `Often`: 139 selections
- `Always`: 55 selections

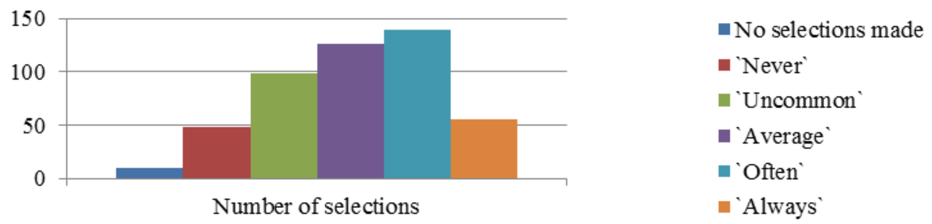

Figure 4. Distribution of selected answers at the question `How often do you use online tools (software tools, gadgets)?`

We observe in the selected answers to this question that the vast majority of respondents, in percent of 87.84%, uses at least rarely the gadgets or the tools that provide for them access to various information and useful data. The percent of those who use `Often` or `Always` the instruments of this kind is 40.67%, 26.41% are those who uses such instruments as average level. The proportion of 30.82% of the selections for `Never` or `Uncommon` shows us that such tools are still fairly unpopular. 10 people did not want to answer this question.

At the item `On electronic communications with other people, you use usually the method:` were selected as response the following options (fig. 5):

- No selections made: 2 persons
- `E-mail`: 227 selections
- `SMS / MMS`: 72 selections
- `Forum / Discussion group`: 57 selections
- `Chat`: 119 selections

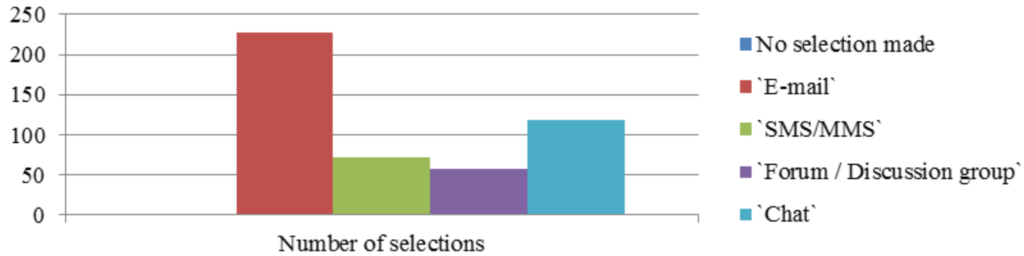

Figure 5. Distribution of selected answers at the item `On electronic communications with other people, you use usually the method:`

The methods `E-mail` and `Chat`, being with a known number of "readers" and clearly their selection is made by "sender", have a high percentage of use as main method of electronic communication, 72.54%, while the `Forum / Discussion group`, being accessible to an unknown number of "readers" and not all selected by "sender" was selected as the main method only in a percent of 11.95%. SMS and MMS, which are usually more expensive than others mentioned there, are used by a small number of people as the main method of electronic communication, 15.09% of the selections, but also she have a small „+" being perceived as a secured method to communicate "secrets". 2 people did not want to answer this question.

At the question `You already used a application for managing access to the educational content (Moodle, Blackboard, Google Drive, Office365 etc.)?` were selected as response the following options:

- `Yes`: 279 selections
- `Not`: 192 selections
- No selections made: 6 persons

This distribution of selections, 58.49% / 40.25%, it is interesting if we consider that 57% of respondents are students in educational programmes which use the traditional, formal methods to teach. The form of education require to students to be present "in person" in the classroom with high frequency. So, was not mandatory to use a „to distance" method in accessing the course materials. Those data, related to each other, show that a use of the applications for content management (ACM) it is perceived as appropriate to achieve certain educational purposes in any form of education.

At the question `Did you considered that it is sufficient the dissemination / the distribution of the courses in digital form to optimize the discipline's learning by the student?` were selected as response the following options:

- `Yes`: 269 selections
- `Not`: 202 selections
- No selections made: 6 persons

This distribution of selections, 56.39% / 42.35%, higher in favor of the sufficiency, it is interesting in comparison with the results to the previous question (In figure 6 are designed in two columns, the values being divided into two areas of interest, according to responses to the previous question: ` You already used a application for managing access to the educational content (Moodle, Blackboard, Google Drive, Office365 etc.)?`). So, 43.01% (a high percent) of those who use content management applications think it is an insufficient teaching method to disseminate electronic teaching content, while 58.33% (also high) of those who have never used this kind of applications think that it is enough for them to have access to electronic teaching materials and documentation to improve their own understanding of the discipline. 6 people did not want to answer this question.

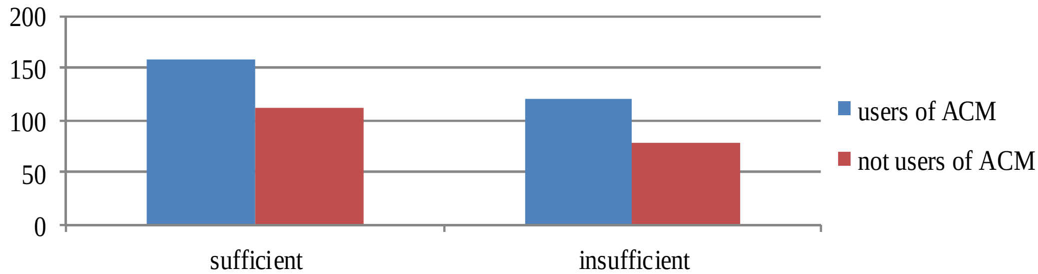

Figure 6. Distribution of selected answers at the question `Did you considered that it is sufficient the dissemination / the distribution of the courses in digital form to optimize the discipline's learning by the student?`

Also, a interesting distribution in terms of the 57% by respondents, those who said they are students or master students in the programs organized in traditional form (the presence "in person" is mandatory). To this category it is not necessary to use of ACM to disseminate learning materials in electronic format.61.85% of them believe the use of ACM it is a good method, sufficient in their opinion, to increase their efficiency in understanding the discipline.Only one of them did not want to express his opinion in this regard.

At the question `Do you think that the students fail often to reach at activities of course / seminar?` were selected as response the following options:

- `Yes`: 144 selections
- `I will use "occasionally" rather than "often"`: 220 selections
- `Not`: 107 selections
- No selections made: 6 persons

If the question not have the word "often" in the line of text, would mean that at the question "Do you think that the students fail to reach at activities of course / seminar?" the answer would be "Yes" in a percent of 76.31%. 39.56% of them believe that this situation is common, while 60.44% consider it is occasionally. 6 people did not want to answer at this question.

At the question `How would you rate the physical presence of students at didactic activities?` were selected as response the following options:

- `Efficient / Useful`: 338 selections
- `Irrelevant as efficient / useful measure`: 69 selections
- `Futile`: 59 selections
- `Bootless`: 7 selections
- No selections made: 4 persons

70.86% of the answers show that the physical presence of students at the didactic activities is mainly considered efficient and useful in terms of quality of the material assimilation by the student. 4 people did not want to answer to this question.

At the question `Which method of presentation of the course materials you think it fits your's style of learning?` we offered four possible answers.For any of the answers, a level could be selected to match the text item. The possible answers and levels of matching with the text item are:

- `Being in person in the classroom when the professor explain his course materials`: `None` 12 selections, `Partly` 78 selections, `Average` 106 selections, `All right` 249 selections, `I do not need anything else` 20 selections, 12 people don't do any selection to this item;
- `Receiving in the mailbox the didactic material in printed form or as burned compact disk`: `None` 107 selections, `Partly` 84 selections, `Average` 94 selections, `All right` 147 selections, `I do not need anything else` 27 selections, 18 people don't do any selection to this item;
- `Remotely access to didactic materials in digital form, whenever I need`: `None` 13 selections, `Partly` 45 selections, `Average` 81 selections, `All right` 238 selections, `I do not need anything else` 90 selections, 10 people don't do any selection to this item;
- `Remotely view the recording of the presentation made by proffesor to educational material, whenever I need`: `None` 28 selections, `Partly` 53 selections, `Average` 73 selections, `All right` 225 selections, `I do not need anything else` 81 selections, 17 people don't do any selection to this item.

It is easy to discover a slight increase of students confidence to understanding the discipline if is used a method by which the didactic materials can be accessed / viewed whenever it is needed. So, if we add the percentages of respondents who representing the selections of the answers 'None` and `Partly`, respectively to those who representing the selections of the answers 'All right` and `I do not need anything else`, will result the graph designed in Figure 7.

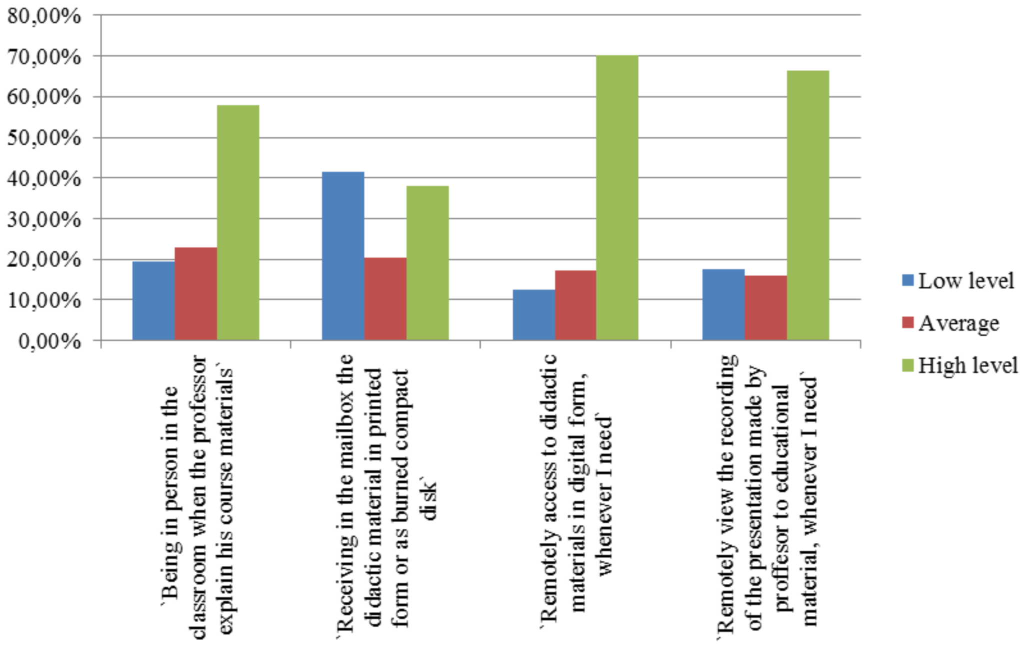

Figure 7. The level of confidence expressed by the respondents about their level of understanding the discipline if they are faced with various methods in which the professor could present the didactic materials

At the item `If a course is delivered simultaneously "in presence" and "to distance", will be requested by:` were selected as response the following options(fig. 8):

- `a almost equal number of students than if will be delivered only "in presence"`: 111 selections
- `a greater number of students than if will be delivered only "in presence", but there will not be a significant difference`: 122 selections
- `a significant greater number of students than if will be delivered only "in presence"`: 234 selections
- No selections made: 10 peoples

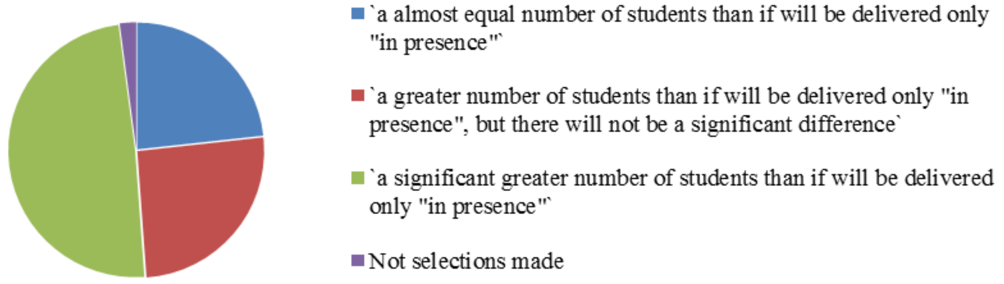

Figure 8. Distribution of selected answers at the item `If a course is delivered simultaneously "in presence" and "to distance", will be requested by:`

The percent is 74.63% for the answers who mentions an increase at the students number who will request courses materials in two forms of delivery, "in presence" and "to distance". From that percent: 65.73% consider that the number of students who will apply to the courses delivered in those two manners will be significantly higher than otherwise. 10 people chose not to answer to this item.

At the question `If a course is recorded in video form and offered to students, do you think this will increase their learning ability?` were selected as response the following options (fig. 9):

- `Yes`: 378 selections
- `Not`: 92 selections
- No selections made: 7 persons

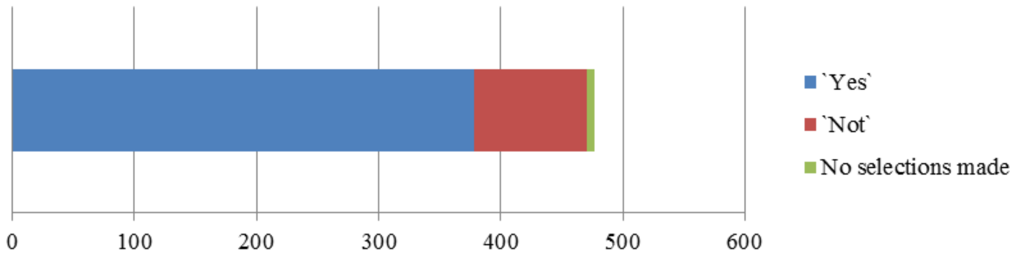

Figure 9. Distribution of selected answers at the item ` If a course is recorded in video form and offered to students, do you think this will increase their learning ability?`

The distribution of the selections to this question show that respondents consider in a percent of 79.25%, that learning is positively influenced if the student would have access to didactic materials presentation in recorded form, whenever it is needed. 7 people did not want to answer to this question.

At the question `For the forms of education from UAIC, ID / IFR, will increase the number of students if are used the technical equipments, didactic materials in video-recorded forms, online broadcasting methods?` were selected as response the following options (fig. 10):

- No selections made: 9 persons
- `Not`: 80 selections
- `Yes`: 388 selections

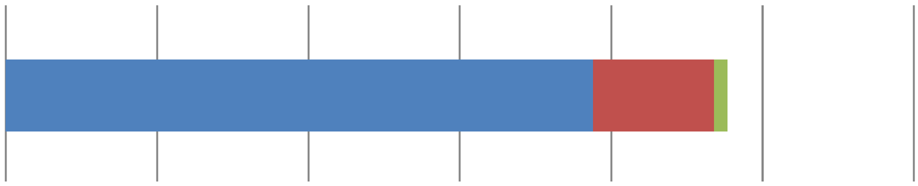

Figure 10. Distribution of selected answers at the question `For the forms of education from UAIC, ID / IFR, will increase the number of students if are used the technical equipments, didactic materials in video-recorded forms, online broadcasting methods?`

The distribution of the selections to this question's responses show that the respondents consider, in a percent of 81.34%, that learning is positively influenced if the student would have access to video-recorded course materials, whenever it is needed. 9 people did not want to answer to this question.

At the question `Which of the following options on the recording and distribution of study materials it is more efficient from the costs point of view?` were selected as response the following options(fig. 11):

- No selections made: 6 persons
- `Materials for courses and seminars printed individually to each student and delivered by postal services`: 47 selections
- `Materials for courses and seminars burned on CD / DVD, delivered individually to each student by the postal services`: 52selections
- `Materials for courses and seminars, posted in a distance learning application [database server], common to all the students, with personalized access based on user name and password`: 372selections.

The distribution of the selection show that respondents, in percent of 77.99%, consider that the dissemination with an application for didactic materials management it is more economically efficient than other methods.6 people did not want to answer to this question. The others, almost equal digits, 9.85% and 10.90%, are the percents in order for the others two possible answers.

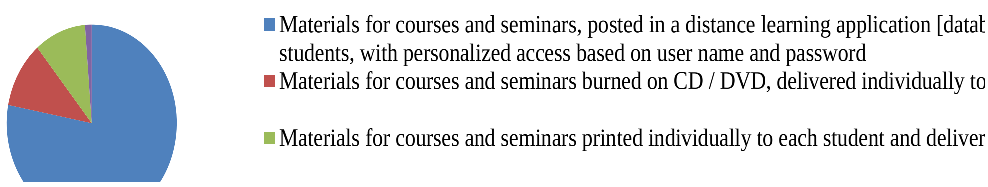

Figure 11. Distribution of selected answers at the question `Which of the following options on the recording and distribution of study materials it is more efficient from the costs point of view?`

5. Conclusions

After analyzing the distribution of selected responses we reached the conclusion that the 8 chosen hypotheses are correct. Following the same analysis we believe that the objectives followed by this research are achieved.

The study shows the changes that have occurred in education in recent years, due to globalization and to explosion of the information technologies, especially over the Internet. The learning methods based on information technologies are numerous, constantly developing, but his results have let us to think that it is still a period of searching of the best and complete methods.

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Eye movements and gaze detection, mechanisms to analyse the learning level and the perception degree

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Abstract

In the era of computers, electronic devices that makes transmission, storage and playback of information (video, audio or text) cause a change in how information interacts with human subjects. Any form of emotional behaviour manifests through the adjustment of physiological acts of some components from the visual system. Thus, the systemic analysis of these adjustments through different methods allows the establishment of some connections between the level of emotional state and non-verbal communication. The experimental research is based on the biomechanics analysis of the binocular vision and on the correlation of means to make a visual and a non-verbal expression, with a degree of visual stimulation respectively (through chromatic, illumination, movement, form and sizes). Dynamic response of eye movements and gaze direction of the human visual system can be quantified and can establish, by correlation analyse, the degree of perception and learning level due to the effects of visual stimuli.

Keywords: eye gaze, learning level, biomechanics of vision

Introduction

Verbal and non-verbal communication consists of the ways in which human subjects interacting with each other or with the environment, establishing communication channels and using all sensory psycho-physiological factors. Nonverbal communication is an accumulation of messages that are not expressed in words and which can be decoded, creating different meanings. These signals can repeat, contradict, substitute, complement or enhance the message conveyed in words. The importance of non-verbal communication was demonstrated in 1967 by Albert Mehrabian. In one study, it was concluded that only 5% of the message is conveyed through verbal communication while 38% is transmitted by voice and 55% by body language.

Nonverbal communication is *un-intentionally*, it betrays emotion or attitude even if you want it, so it need to realize that sometimes nonverbal messages contradict what is said. Nonverbal communication consists of a number of separate codes to be learned how to be used.

Some nonverbal codes are universal, as is understood in different cultures, but nonverbal communication ability increases with age, with experience. Those who communicate well verbally mastered equally nonverbal codes and usually are those who succeed best to communicate with his peers or the environment. Messages sent through nonverbal communication provide information about different issues or about relationships with other individuals.

There are currently defined a number of functions of nonverbal communication. In this sense, nonverbal communication (nVC) is designed *to enhance verbal communication,* thus strengthening the importance of certain parts of the message. nVC can complement verbal message conveyed by adding the contents of the message a certain gesture or behaviour and nVC can deliberately contradict certain aspects of verbal communication, especially in the context of a particular critical action, ironic or even negative.

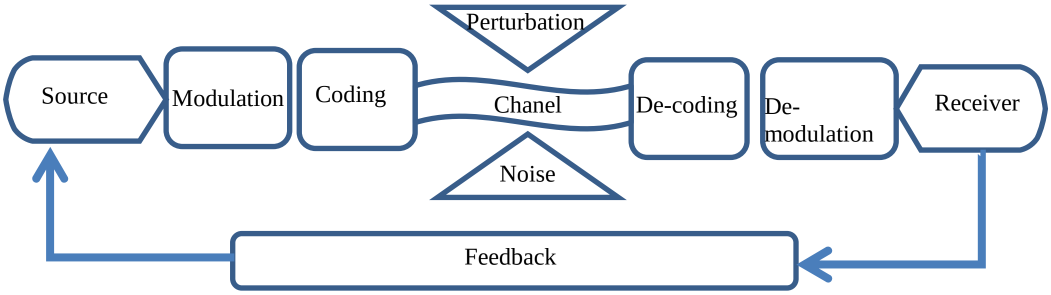


Fig. 1 Block diagram of informational communication model

Another function of nVC is to regulate the flow of communication and dynamic weighting own verbalized communication, nonverbal communication or refreshed repeated verbal meaning, giving in this way, the communication receiver to identify in real time a call was in the "back" of statements. [1]

Non-verbal communication (nVC) is very expressive from an emotional point of view and that is why, by externalizing them, sensory systems are involved (especially the visual system), the gestures, the posture or even the eye movements, the head or the body. The facial expressions represent dynamic traits that communicate the attitude, the emotions or the intention of the speaker, and our face is the primary source of emotions (smile, frowning, raised eyebrows, yawning, etc.). The eye movements represent an element as important as non-verbal communication, and they can be interpreted differently, depending on the culture, the physiological or the neurological state in which the human subject is found. Head movements, facial or eye movements "contain", in their dynamics, a range of information needed nVC and have an essential role in the social interaction. For example, people in a dialogue look into the eyes 25-75% during of conversation time. Eye gaze goal is to receive additional visual messages to complete words or to find other feedback in eyes, a reaction to the assertion.The visual contact can suggest an increased interest towards the other, as well as boredom or lack of sincerity. That is why, a series of forms of visual contact can be non-verbal expression strategies of some emotional or communication states (looking directly into one's eyes, as this gesture can be interpreted as openness or candor; looking down is a sign of modesty, etc.). Recent researches have established that some facial areas can express feelings or emotional states better (the eyes, through the dilatation of the pupil, increasing the glow of the cornea and even increasing the palpebral fissure can express happiness, sadness or even surprise). On the other hand, the forehead and eyebrows can best express anger, anxiety, nervous irritation states.[4] Eye movements, fixed positions or the combination of physiological changes of the visual system with the gestures and the facial expression represents the analysis elements in non-verbal communication, on a direct line (as it is mentioned in fig. 1), but also on the feed-back reaction, due to the interaction with the surrounding environment. In this sense, it is useful to develop a mechanism that highlights the physiological reactions of the visual system, due to the influences of the environment (chromatic radiation with the same intensity), set of information necessary for the education etc.). [2] Based on the words of the great philosopher Constantin Noica, understanding is completed which is not expressed in the words, that meant nonverbal communication. So, communication contains man, and man "depicts or hide" through communication, verbal or nonverbal. It is known from the literature (M. Roco, 2001) that tests conducted on more than 7000 people in the United States and 18,000 in other countries have found the benefits of the ability to interpret feelings through nonverbal cues, including better emotional adjustment, a greater popularity and openness.

Ocular movements used for eye tracking analyze

In the literature, eye movement is analyzed in terms of the mechanical motion of a solid fixed point as the rotation center and subjected to the laws of dynamics and statics mechanical.

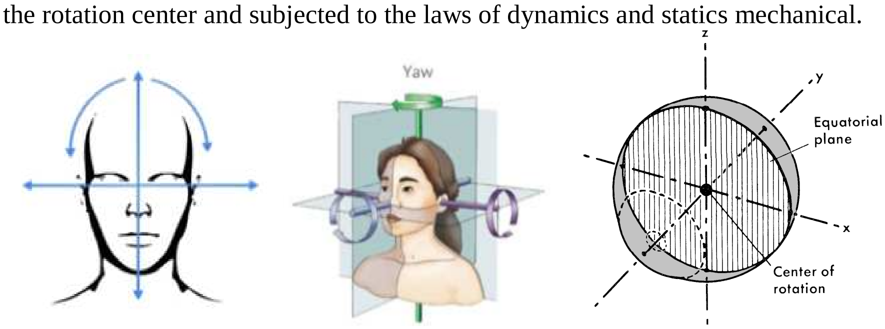


Fig. 2. Movements axis of the visual system and center of rotation [3,4]

As shown in [4] “The eye movements, as mechanical events, are subject to the general laws of kinematics. Although a detailed knowledge of this subject is not required for the understanding of the clinical facts, a few basic concepts must be discussed. Any movement of a freely suspended spheroid body can be reduced to a combination of one or more of the following six movements. This body can move sideways, up or down, and forward or backward (*translational movements*), or it can rotate around a vertical, horizontal, or antero-posterior axis (*rotary movements*). If a translational movement takes place, the center of the body moves with it. In a pure rotary movement the center would not shift its position; it would have zero velocity”. Also, author from [4] affirms that “the eye performs rotary movements around a center of rotation within the globe and this center of rotation has been assumed to be fixed, but newer experiments indicate that this is not the case. The center of rotation of the eye does not have zero velocity; it moves in a semicircle in the plane of rotation. Thus, even seemingly simple eye movements are complex. However, from a practical standpoint the translator movements may be disregarded. In primary position the center of rotation is located about 13.5 mm (in myopia, 14.5 mm) behind the apex of the cornea on the line of sight, which places it 1.3 mm behind the equatorial plane. For practical purposes, one may assume that a line connecting the middle of the lateral orbital margins goes through the center of rotation of the two eyes if they are emmetropic or not highly ametropic and have normally developed orbital fat”.

In the first phase, in the procedures for analysis of eye movements should be established the positions and the normal monocular and binocular motion in order to be considered like origins of procedures for determining the ocular abnormalities and dysfunction.

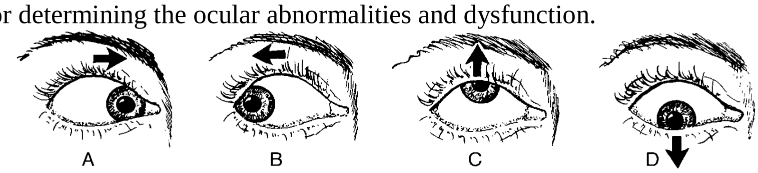


Fig. 3 Ductions. Secondary positions, right eye. *A*, Adduction. *B*, Abduction. *C*, Sursumduction (elevation). *D*, Deorsumduction (depression) [7]

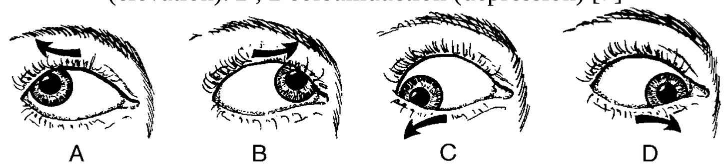


Fig. 4. Some tertiary positions, right eye. *A*, Gaze up and right. *B*, Gaze up and left. *C*, Gaze down and right. *D*, Gaze down and left [4]

In case of experimental determinations, knowledge of these positions is important to assess the influence of environmental stimuli on physiological behaviour of subjects and also to assess changes due to variations in levels of emotional states or processes of assimilation of external information (learning, reading, perception etc.).

Experimental analysis follows monocular or binocular recording trajectories of eyeballs of subjects in various states of activity and correlation of their parameters with previously defined ideal trajectory.

Also, the analysis can be divided in two directions: the first one uses a random trajectory to be followed by bright stimuli of the same intensity and the second direction, when the subjects have to travel a static image with some positive emotional load, which is viewed at first glance. These two directions of registration are analysed, both in terms of the trajectories of the two eye pupil centers, as well as the duration evolution and scroll speed of space viewed.

Experimental setup

Experimental system uses a structure for image acquisition and processing of eye movements made by subjects when watching a set of bright stimuli, and when undergoing static image, specially designed to induce a positive emotional state.

In a first phase, subjects are instructed on the steps of recording and explain to them the steps you need to perform them during the experiment. In the second phase are provided and verified environmental conditions for the sample of five subjects used can be recorded without being influenced by random environmental parameters (temperature, humidity, pressure, noise, vibration, etc.).

To trigger recording operations it is necessary to determine to each subject the dominant eye, because all other records must start from this part.

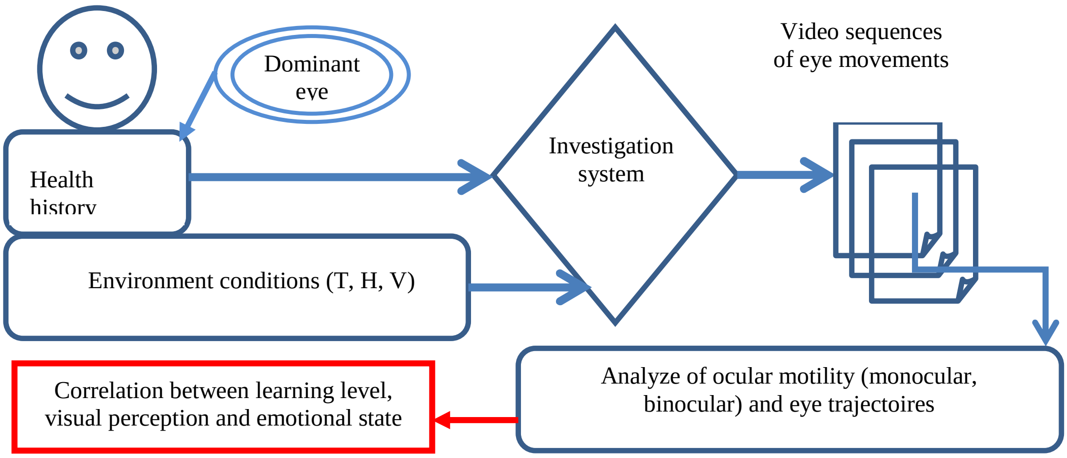


Fig. 5. Experimental setup schema

In the initial stage, eye movements (monocular and binocular) of human subjects, were recorded using a system of visual stimulation, to achieve an ideal trajectories of eye movement of each of the participants (the structure of the LED flash is random for the 5 human subjects, each human subject has a different initial structure to avoid "learning" subconscious and forecast future movements).

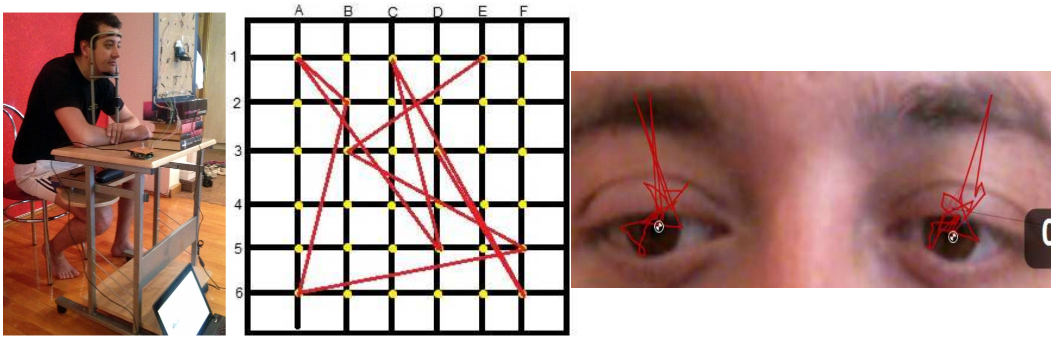


Fig. 6. Experimental system, random ideal trajectory and image recording [6]

Results and conclusions

Images of stimulation process and the following of emotional reactions, at ocular level, were acquired and processed by Kinovea software module. [5] In this way was possible to obtain the ocular movement trajectories, also the information about instantaneous speed or pupilar center position on Ox and Oy axis (eg. in Fig.7)

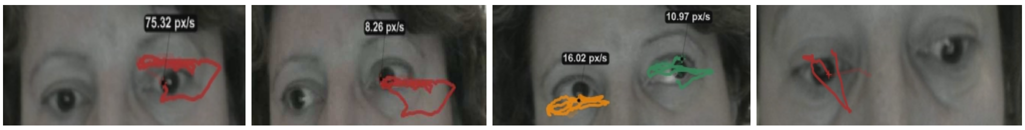
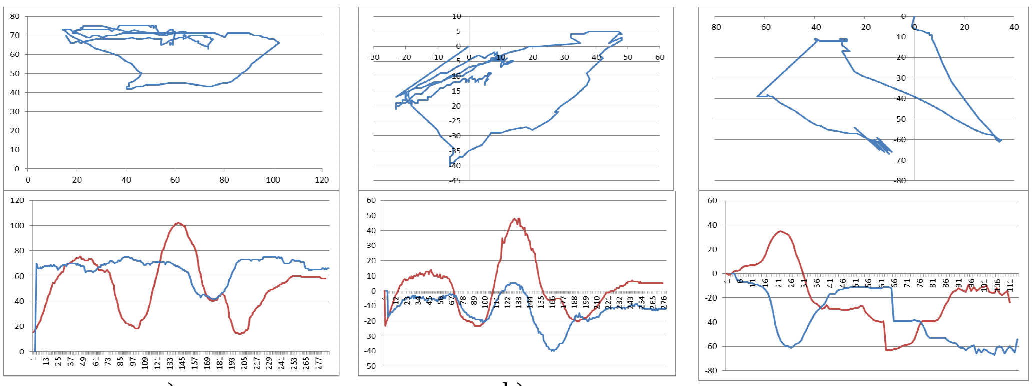


Fig. 7. Eye movement trajectories (monocular, binocular)



a) b) c)

Fig. 8. Eye movement trajectories, full field (top) and on Ox (red) and Oy (blue) (bottom) for: a-emotional state; b-following the visual stimulus; c-moment of visual perception of unexpected information

As shown in Figure 8 the recordings of the investigations, made on a subject under three main states analysis, reveals: induction of emotional states, tracking a visual stimulus and the occurrence of unexpected visual information differs full-field trajectory shape, and variations on the two axes, but more importantly highlights the very different movement speeds. Thus, when the emotional state was at a high level, the speed of movement indicates interest, emotional participation and therefore exceeds the values in some points even *75 px/s*. When the activity was one of routine, without emotional impact (tracking stimuli) was observed that the speed of the pupillary center (monocular and binocular) fall in values between *5-20px/s*, indicating even preventive delay to make the next move. In case of unexpected stimuli, when eye movements are more extensive at first, after which the visual system has adapted to this stimulus, entering a state of relaxation in both directions, Ox and Oy.

These observations indicate that our visual system is constantly adapting to the structure of the stimuli, and the informational content. The main applications of this type of determination are to establish the level of perception/adaptation to visual information and the degree of learning/memory thereof. This level could be determined by measuring the average speed of movement of the pupil centers and their correlation with structure information set (dense/easy, positive/negative, clear/ambiguous etc.).

Following these determinations established an *average correlation coefficient* for the analyzed sample of *0.64*, a value that indicates a good correlation between dynamic response of the visual system under the influence of visual stimuli and stimulus modules informational and emotional components of learning/adaptation.

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Software application for biomechanical motion tracking

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Abstract

Biomechanics of the human body can be analyzed by acquiring successive images of the relative position of the loco-motor system structure and then extract the information about trajectory, velocity or acceleration.
The application is based on using a set of three video cameras connected to a computer system that allows the acquisition, storage, processing and playback of images taken in three-orthogonal system of loco-motor system of human subjects.
The analyzes can lead to the development of training procedures, recovery or fundamental biomechanics analysis in order to understand and learning new mechanisms for obtaining performance or comfort.

Keywords: biomechanics, human body, software, motion tracking

Introduction

Biomechanics is the science concerned with the internal and external forces acting on the human body and the effects produced by these forces. Kinematics is the branch of biomechanics concerned with the study of movement from a geometrical point of view. Kinetics is the branch of biomechanics concerned with what causes a body to move the way it does. [1,2]

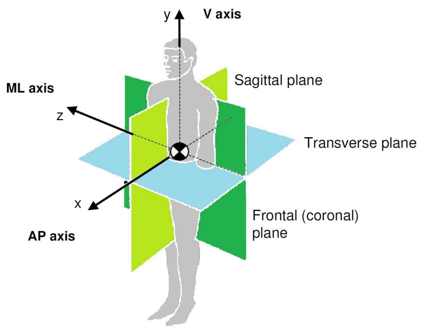

Fig. 1. Biomechanical planes for human body [1]

There is a wide range of software modules that can be used for the purpose of biomechanical analysis that shows a number of common characteristics, but also some characteristics that differentiate them in facilities, opportunities for development and interconnection of several equipments for collecting data. These kinds of software can be used in various applications, such as normal or pathological gait analysis (in all its forms), biomechanical analysis for sports, anthropometric and ergonomic analysis and many others having stronger or weaker features. In addition to software modules for static, kinematics or dynamics analysis there is a wide range of software for modeling and simulation in the coming support complex and complete researches.

These software packages are designed and constructed so as to ensure different requirements that research into biomechanical request them.

Thus we can enumerate the following versions of software accompanied the equipment necessary for developing procedures: *Vicon, SIMI Motion, Contemplas, Quintic v.2.6, C3D-Motion, Dartfish v.7, SportsCAD v.9.0.9,* or software packages that enable modeling and simulation procedures, such as: *OpenSim, SimTK, LifeModeler, AnyBody, SIMM, Arena-Motive, AnimatLab v.2.0, ArtiSynth v.3.1*, *FEBio* etc. All software packages taken together or differentially is based on information acquisition from signals transmitted by the sensors recording equipment (force plates, electromyography system, accelerometer) and on images taken with normal speed video systems or high-speed.

In some cases these signals are synchronized and analyzed for better interdependent phenomena biomechanical analysis (*Vicon* system, *SIMI Motion* system, *Contemplas* system etc.). In complex analysis from biomechanical field there are some support systems that complete synchronized systems by using freestanding equipments, such as thermal imaging cameras, facial analysis systems and system eye tracking type etc. (fig.2). [1]

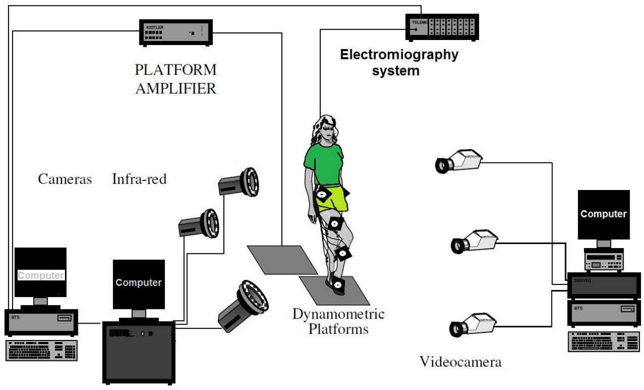

Fig. 2. General schema of biomechanical information acquisition [1]

Software packages for modeling, simulation procedures establish a model of the human body (more or less detailed) that can be customized by the introduction of individual anthropometric measurements and then used for kinematic and dynamic analysis in connection with the environment or other elements involved in movement biomechanics.

Inverse kinematics analysis is a method often used in simulation-modeling procedures to track the evolution of the component parts of the human body model in different actions (*AnyBody*, *LifeModeler*). Thus, a very important application is the analysis of interactions between the human body (model) with action environment, as mentioned, even by the developer of this software package *AnyBody*. “Workplaces with elements of materials handling or lifting are among those with the highest propensity for injury in back, shoulders and arms. The overall explanation is that any repetitive work task that degenerates tissue faster than it can be repaired will eventually traumatize the human body. Our muscles typically have much smaller moment arms than the exterior loads, and therefore small differences in the working postures or loading parameters can cause large differences in the tissue loads. Musculoskeletal modeling is the ideal tool for these situations because it allows for a quantitative comparison between different working situations and can assess the consequences of prospective interventions. The *AnyBody Modeling System*™ allows for detailed analysis of a particular work task and for assessment of the consequences of a change in the workplace design”. [3]

Also, the use of software packages for modeling, simulation is appreciated by manufacturers of various prosthetics, orthotics, equipment rehabilitated/recovery or other products that interact with the human factor (shoes, household items, sports etc.) because the lower costs production and increase product quality. As mentioned manufacturer package of software *LifeModeler*: “with *LifeModeler’s* biomechanical simulation software, *LifeMOD*, medical device makers now have a faster, less costly, and more complete method of product development. Five of the six top U.S.

orthopaedic companies use *LifeMOD* extensively in the design of artificial joints, realizing productivity increases up to 20% and decreases in development costs by up to 40% while enhancing innovation and reducing risk”. [4]

Another method often used in software packages for modeling is the finite element method (FEM), especially in technological applications for the design and simulation of implants and prostheses (FEBio software).

According to what the developer says: “*FEBio* (finite elements for biomechanics) is an opensource software package for finite element analysis and was specifically designed for biomechanics applications. It was developed at the Musculoskeletal Research Lab at the University of Utah and software *FEBio* offers modeling scenarios, constitutive models and boundary conditions that are relevant to numerous research areas in biomechanics. Users can solve 3D large deformation solid mechanics as well as solid-fluid (as in porous media) problems and *FEBio* supports both quasi-static and dynamic analyses”.[5]

Developing a system for analyzing locomotor movements

The software application developed in this research is based on *Contemplas* system and software package *Contemplas Templo* “which offers individual solutions for everyday problems. Efficiency and easy handling are more important than an accumulation of functions, which may be interesting for others but fail to meet one’s specific needs”.[6]

As the developer of this system mentions: “*Contemplas* has set new standards in the market of gait analysis, providing an easy to use system for 2D motion analysis through its software *Templo*, which meets the users' requirements perfectly and provides them with highly appropriate and ready-to-use solutions. The software takes advantage of the rich expertise of the people working for *Contemplas* as well as that of its cooperative partners in the markets of biomechanics, sports and medicine”. [6]

In this sense, for monitoring and analysis of movements made by a human loco-motor system into movement of running on the treadmill, an acquisition structure images using 3 high-speed video cameras (120 frames/sec) Basler type with a computer system for capturing and processing images (Figure 3) was designed and put into action.

To obtain a correct record and best to process it took some adjustment procedures and parameter adjustment positioning, recording and storing images such as light intensity adjustment, camera focus, optimal adjustment of the tripod so that obtain a recording of the subject's field of view cameras (setting tripod, spirit) and stabilization parameters related to ambient lighting.

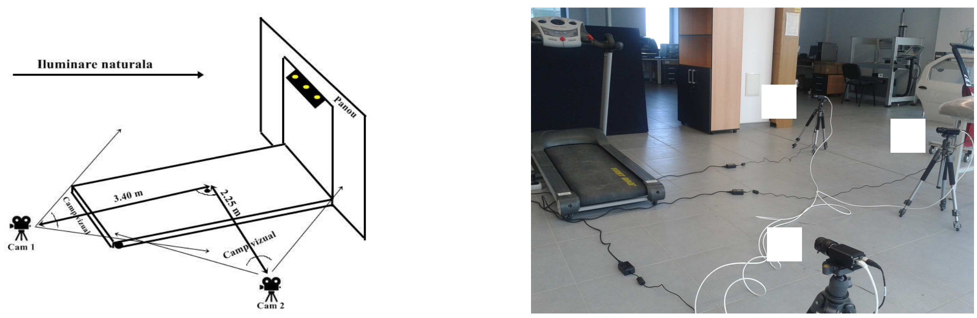

Fig. 3. Schema of location of high-speed cameras Basler type

In order to realize the experimental part on the treadmill, the subject has undergone several cycles of running with different types of work equipment. During recordings were used several types of clothing, normal and sport, these steps aimed at achieving optimal processing video frames (high contrast, high brightness). An important role in the analysis and video processing have markers that allow obtaining the software analysis *Contemplas Templo*, of trajectories, angles, distances, etc.

They are of two types: *virtual*-you can put by the software *Contemplas Templo*, the areas already marked on the subject or *normal*-having different shapes and sizes and is bonded directly to the body, on the desired area.

Fig. 4. Choosing variants and positioning markers on points loco-motor system analysis

During computer analysis of the subject due to low contrast of the marker on the body were met problems automatic recognition markers, trace the desired trajectory respectively. Due to various problems openly contrast the markers, their visibility and brightness during the following video was chosen to mark the areas of interest with a direct marker for a much better contrast (Figure 5). As work areas marked with good contrast for video analysis were chosen knee and rear side; lateral ankle and heel. The markings were made for both the left foot and the right foot.

General analysis software module for movement is a base module and with this software any motion sequences can be captured and analyzed. It features an entire set of sub-modules for the recording, viewing and analysis of different types of activities video driver and others.

All data of human subjects and their measurement data are saved in a database type *MS-Access*. This always allows quick access to all user information providing an overview of existing analyzes. Video recording and editing software *Contemplas Templo* provides an analysis module specially designed to measure various parameters during exercise biomechanics of human locomotion.

Fig. 5. Problems for plotting markers by software

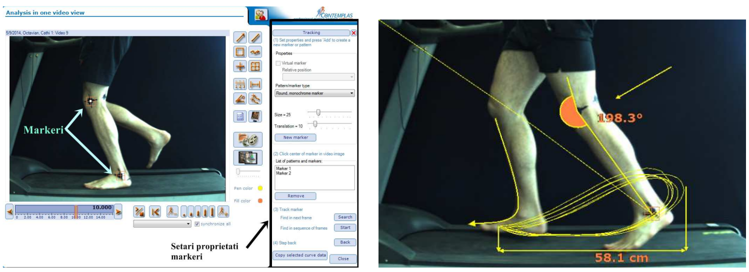

Fig. 6. Records video processing options

This process can process multiple records at a time (selectable video or other data) from a single perspective (Analysis in one video view). [7]

Among other very useful options, there are other modules like: *Draw arrow, Draw line, Draw rectangle, Draw curve, Draw crosswire, Draw grid, Calibrate, Measure distance, Measure angle, Tracking, Create report* (fig.6).

Results and conclusions

To achieve video analysis of the subject and obtaining trajectories TRACKING option measurements were made for both, left foot, side and rear view and right leg (same position). To establish trajectories were used following settings available in the menu bar option: Type of marker-Round, monochrome marker, Size marker-25 for left foot, 15 for right foot, Translation-10 for the left foot, 5 for right foot. Recordings were made with two cameras placed at the side of and behind the subject aimed at determining tracts markers are on the left foot, right foot respectively. The third videocam was used to control the optical perspective. Running treadmill was done with default program P3, lane 2 ° tilt, speed 4 km/h, duration 8 minutes

Using motion analysis equipment *Contemplas*, locomotion kinematic analyzes were performed for movement on the treadmill that is a cycle with preset program running on a single human subject without pathology in the musculoskeletal system. This analysis was based on data obtained by means video acquisition cinematic study of the lower limbs.

In terms of hardware this device can record video sequences with three high speed video-cams (up to 6 video-cams) that can play up to 120 frames/sec with a 640x480 pixels resolution. In terms of software, *Contemplas Templo* gives: Intelligent adjustment of cameras; Automatic synchronization of cameras; customized analysis schemes; adjustment function rooms rotation position; triggering video recording by scheduling it in automatic mode; video capture sequences through direct assignment recorded in database software.

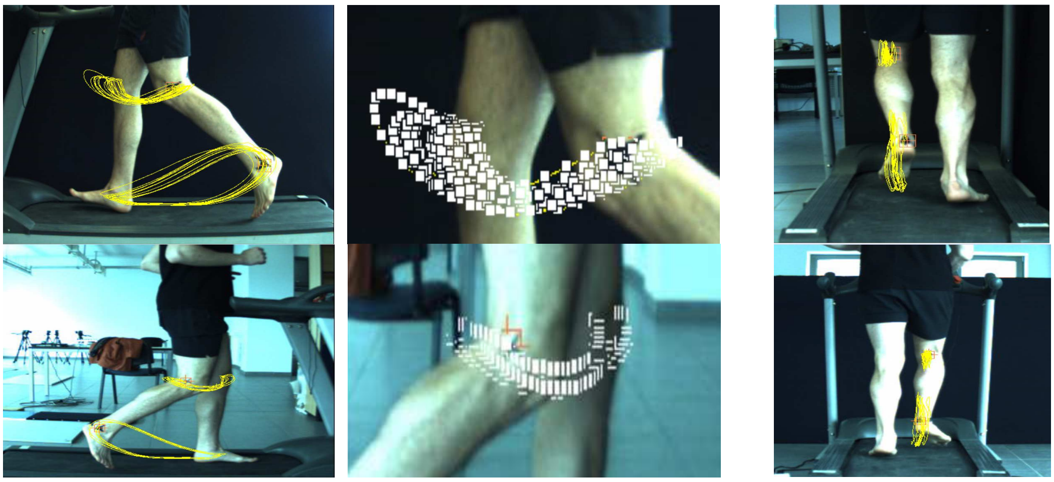

Fig. 7. Markers trajectories from knee and ankle, lateral, back, left leg (top) and right (bottom)

There has been some variations in the angle frames in the sequence by identifying the position of each marker attached to the center of the joint structure of the human musculoskeletal system. The software allowed the definition of analysis schemes, marking or demarcation of specific points on the human locomotion system specific software tools, video synchronization, position tracking, and automatic or manual tracking markers on the system studied. The software allowed the export results in *.xls* format can be viewed using *MS Excel* software. Joints trajectories centers were easily obtained (knee, ankle and foot). Data exported to MS Excel allow various analyzes such as analysis of the influence of a visual stimulus, auditory or vibratory cycle of running (method of verification of a running type sports training cycle) or export data report form, with extension PDF (fig. 8).

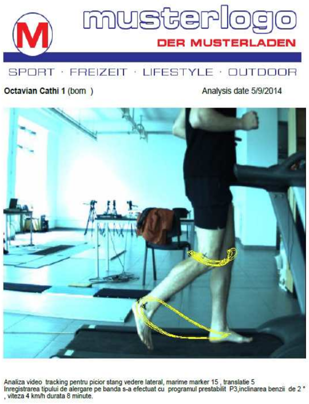

Fig. 8. Final report

Acknowledgement

These researches are part of the current researches in Applied Optometric Laboratory and *Advanced Mechatronic Researches Center* from University Transilvania Brasov.

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Cloud computing healthcare service for optimizes patients virtual monitoring

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Abstract

In this paper is presented a computational model for healthcare services integrated in cloud computing system. By using cloud computing its obtained multitenancy, independence (devices – wearable sensors for patients, platform with data collections from sensors for medical staff and location), performance and costs reduce. The objective is to optimize healthcare service based on software application, data loggers for biosensors, and platform infrastructure with patients' database. By using virtualization, data available in network can be used for improve the health state patient evaluation and predict, based on similar cases, disease evolution and optimize medication prescription.

Keywords: Cloud Computing, Wearable, Sensors, Virtualization, Optimization

1 Introduction

Due to pervasive communications, Web, mobile smart devices and cloud integration sensors have increased capabilities. Cloud computing technologies provide increasing data storage, processing, aggregation, visualization and all capabilities. Cloud-based software applications can be easy integrated with popular sensor platforms, like Arduino.

Sensors measure a variety of chemical, biological, and physical quantities using a wide range of sensing techniques. The sensing action generate output signal, by transduction process. This signal must be processed and transmitted to another device for acting something useful. The combination of hardware and software enables signal conditioning, data processing, transmission, storage, and display of the sensor measurement.

The Internet of Things (IoT) is based on interconnection between many devices from fitness devices to advanced device for human health state monitoring. This connectivity required a connection to the Internet, even if data are routed and processed at a local network stage before being passed to the Internet. It is a correlation between sensors' network topology of the sensor network and type of applications (for example – personal area network stream data from all sensors to a single central aggregator (star topology and a home monitoring network can use self-healing mesh topology.

Sensors network topologies related to nodes complexity are:

- Point-to-point topology (figure 1. a)
- Bus topology (figure 1. b)
- Linear topology (figure 1. c)
- Ring topology (figure 1. d)
- Star topology (figure 1. e)
- Tree topology (figure 1.f)

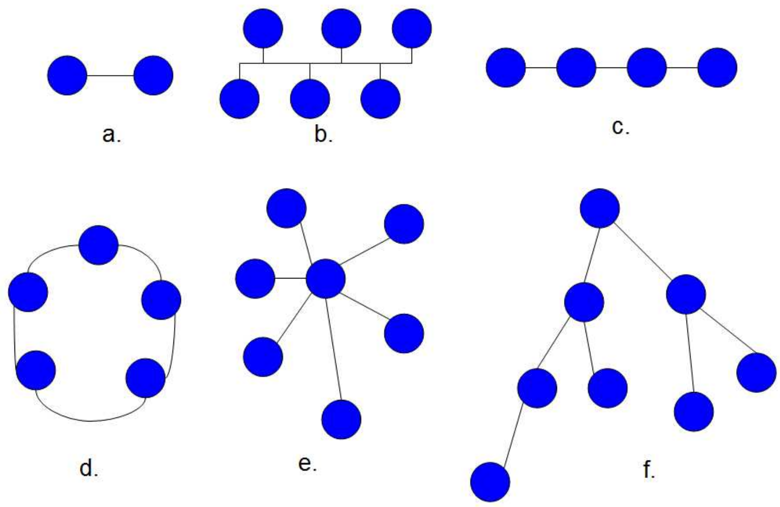

Figure 1. Sensors network topologies

2 Methods and discussion

For monitoring health state of the patients can be used personal area network (PAN) transfers personal data by using a star network topology and wireless communication.

It is approved a specific frequency for the implementation of medical body area network (MBAN) systems. Devices communicating on this protected spectrum allocation (between 2360–2400 MHz) experience less interference from ubiquitous unlicensed radio devices, such as Bluetooth, Zigbee, or Wi-Fi. For acting in WPAN must be wearable and is important to be integrated in wearable clothing structures or flexible bandages (figure 2).

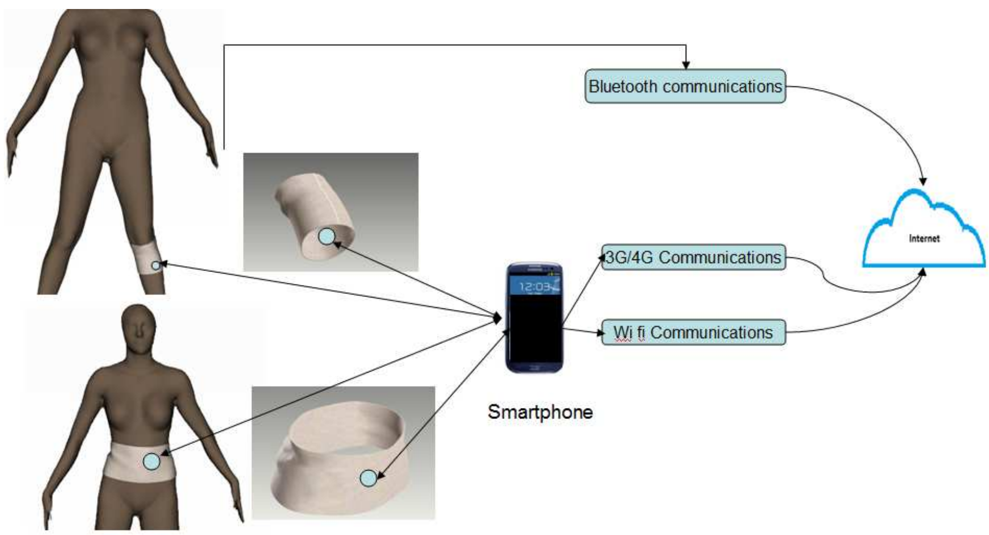

Figure 2. Wireless personal area (body) network

Software application for sensors is pervasive at all levels of a sensor network.

Application services display the data from the aggregation devices (Smartphone) on a computer application, web page, or Smartphone app (figure 3).

By using cloud computing based application for sensors, the patients may be in different location (home, hospital or outside) and due to the virtualization functions, medical staff can have access to patients health state data (temperature, pulse, skin moisture) in every moment and from every location.

The software for each sensor in sensor network hierarchy contains features: communications, messaging, processing, storage and manageability (figure 4). Cloud computing can provide storage, processing, and visualization capabilities for sensors and sensor networks.

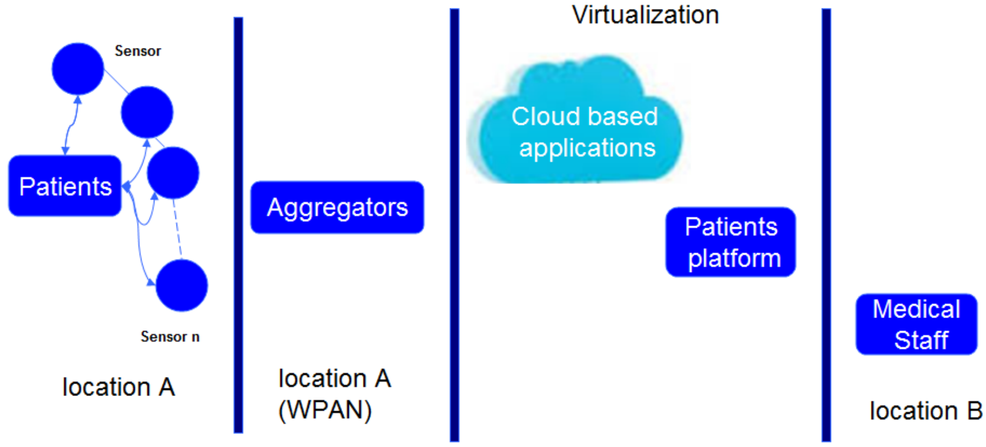

Figure 3. health monitoring model based on cloud computing

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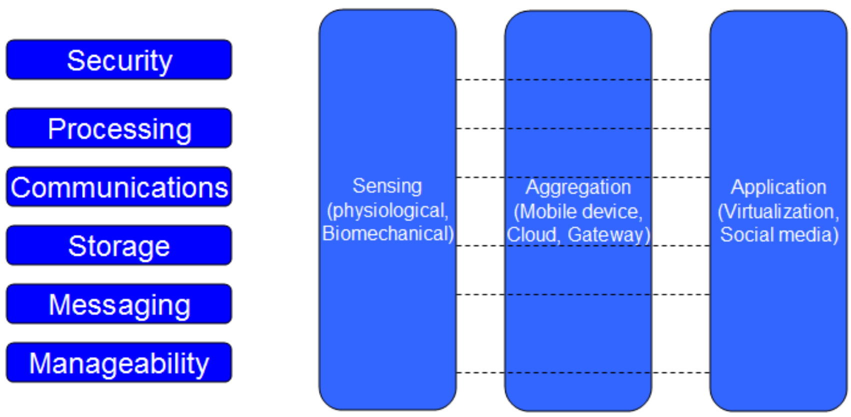

Figure 4. Sensors network features

3 Conclusions

A cloud computing application can reduce the cost for sensor deployment and consumption of resources. Clouds services for sensors are models based and allow application optimization and resolution of data against cost.

Commercial software as a service (SaaS) solutions for sensor data are already starting to emerge, including the SensorCloud system from MicroStrain.

The cloud computing can be used to create virtualized sensors that can be accessed by any user or other application (medical platform for patients monitoring).

By using cloud services is not important the physical location of sensing resources when using cloud-based virtualized functions.

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Providing Alternative Vocabulary Learning Method in Teaching Solar Energy

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Abstract

Environmental damage caused by non-renewable fossil fuels makes people prefer the use of renewable energy resources, especially one of the important one, solar energy. Hence, at high school level, there is a need to design better method of teaching solar energy and mechanism of solar cells. Because of the limited lessons, teachers rarely include science vocabulary instruction which makes students gain the sense of text. However, we can achieve our goal by teaching some specific terms related to solar energy to understand the text easily. Computer-assisted vocabulary learning is the effective option for students due to the limited class time and the large amount of vocabulary. Furthermore, this method supplies immediate feedback to students, motivate them to learn via games and promote academic success. In this study, we provided 150 most used solar cell terms with their definitions, images and simulations. Two groups of students from 11th grade participated in this study. Multiple choice items, matching words together with their meanings were administered as pre- and post-test. The results showed that there was no statistical difference between computer-assisted group and paper-based group. However, we found that the computer-assisted group was more interactive and showed more interest in the lessons.

Keywords: Solar energy, Computer-assisted learning, Quizlet, Vocabulary

1 Introduction

Because of the increase in environmental pollution, governments start to invest on alternative energy education and support renewable energy industries a lot over the last years. Moreover, harmful effects of environmental pollution changed people' idea around the world and they have accepted the production of energy from fossil fuels and nuclear energy has to be decreased as much as possible.

There are many alternatives to produce energy like wind, geothermal, hydropower and solar energy which is one of the best, because it is incredibly powerful and can be accessed in everywhere. The amount of solar energy reaching on the earth in one year is almost twice than amount of energy produces from all non-renewable resources (Berkooz, 2008). Also, unlike fossil fuels, solar energy is a renewable, abundant in almost everywhere, clean and free resource.

To use this important resource effectively technicians, engineers, designers, and students who want to use solar technology as a professionally or personally have to understand the basics of solar cell. Also they should consider precaution in dealing with environmental pollution problems. (Berne & Blachowicz, 2008).

It is necessary to design a better method of teaching solar energy and a mechanism of solar cells to make the future engineers of solar energy have a vigilant eye and arouse their curiosity. At high school level the students have really less curiosity for learning science, because there are lots of scientific terms which are difficult and not familiar with them. Unfortunately, most of the schools has limited or no renewable energy lessons. Due to this fact, teachers mostly explain text and can't focus on meaning of scientific concepts which makes students gain the sense of text. So it is important to teach meaning of scientific terms with an effective method to understand scientific texts easily.

There is a widespread use of computer and internet all around the world and students like to use computer. So Computer-assisted vocabulary learning (CAVL) via web-based instruction can be effective option for students to learn in school time, repeating or testing at home and to trace students' progress from statistics. Also, computer-assisted method gives feedback to students quickly, motivate them to study harder with games and promote academic success.

The purpose of this study is to see effects of computer-assisted vocabulary learning in comparison with students who study the words by paper-based method.

2 Vocabulary

To understand solar energy texts easily, firstly we must know the meaning of solar energy terms. According to the researches, increasing in vocabulary knowledge increases reading comprehension (Baumann & Kame'enui, 2012; Herman et al., 1987).

It takes a lot of time and effort in school time for science instruction. However, teaching scientific terms with an effective method can increase not only students' comprehension, but it also decreases teachers' instructional time. With this method teachers can improve their scientific glossary too because according to Wellington and Osborne (2001), "Learning to use the language of science is fundamental to learning science." When teachers and students learn scientific concepts, they can communicate better while doing science.

We use oral language that enables us to speak to one another easily because people prefer to use limited and frequently used words, on the other side learning academic language is harder because it involves abstract literacy tasks and language is not used often in daily life (Zwiers, 2007). Academic language is like a second language, due to this fact people who would like to understand academic content must learn it (Solomon & Rhodes, 1995).

In order to develop scientific literacy, we need to improve knowledge of science content, terms and practice scientific habits of mind. So, modelling and knowing science concepts support the development of these understandings. Science teachers should consider their self as a language teacher. Wellington and Osborne point out, "science teachers are (among other things) language teachers."

3 Quizlet

Quizlet is a very useful website for teaching and learning solar energy terms because it is online learning tool that allows users to choose any kind of activity around solar energy terms.

With Quizlet student can generate different tests which contain written, matching, multiple choice, true/false questions, or any combination of them. The good part of this online website is that students can take tests on a computer or smartphone in everywhere and score appear immediately to see results. Teachers can print out these tests and distribute in class too. Students can evaluate themselves with this test which is critical in building robust long-term memory of learned vocabularies (Karpicke & Roediger, 2008), so it is important to test them often to increase performance in the future.

Students can listen the pronunciation of the word and its meaning to facilitate learning in Quizlet. This online vocabulary learning website can generate interactive games to help and motivate students to study solar energy course vocabularies.

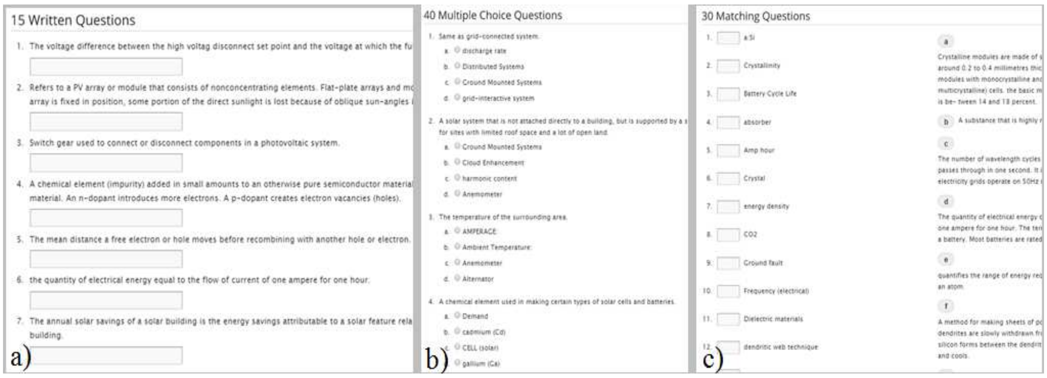

Figure 1. Self-assessments

a) Written questions, b)Multiple Choice Questions, c) Matching Questions

Figure 2. a) Interactive game, b) Pronunciations of terms

Teachers and students can generate paper handouts, flash cards, or game materials in any set. They can reorder different card sets together to form a personalized deck. Teacher can generate a group or class for his students on Quizlet to check their progress.

4 Computer-Assisted Vocabulary Learning (CAVL)

Computer-assisted programs or online educational websites are designed to facilitate the learning of science to students and teachers in a practical way by integrating with new pedagogical methods and necessary curricular requirements. As we know teachers have limited classroom time to concentrate on science vocabulary instruction, but different approaches or educational methods in improving student vocabulary can improve student comprehension and literacy across all disciplines. Research has shown that academic success related with students' vocabulary levels strongly (Baumann & Kameenui, 1991), and due to this fact CAVL is an important method for improving achievement levels for all students.

Unfortunately, there are no effective and systematical teaching methods at most school, in spite of the obvious advantage of vocabulary instruction (Hirsch, 2013). According to researches the minimum way to learn vocabulary is through a systematic method that complements curriculum, and that students should focus on the words that they are encountering.

The game part of CAVL keeps internal motivation of students, increases competences and knowledge can be promoted. Enjoyable characteristics of the game play a key to effective learning over time.

One of the most advantages of computer-assisting learning is that when students give answer to questions they immediately receive results to see their progress on learning vocabulary. Programs can follow students' trouble words, making it possible for students and teachers to see a list of those words and review them.

Through CAVL's tracking tools for educators, teachers see not only how much work the students have completed, but also which words are especially challenging to master, so that they will know which words to focus on during class time.

Previous researches has generally supported the idea that computer assisted vocabulary instruction facilitates vocabulary acquisition and has provided us with some practical and theoretical insights to understand computer assisted vocabulary instruction (Koçak, 1997).

5 Method

Before the intervention, teacher randomly assigned 36 students to one of two groups, computer-assisted vocabulary learning (CAVL) which used Quizlet online educational website as an instructional tool and paper-based flashcards which was instructed the same words by their teacher in an interactive classroom atmosphere, to teach 150 solar energy vocabularies from the photovoltaic topic. Multiple choice, written and matching vocabulary quizzes were applied at pre-, post- tests.

Students in the CAVL (n = 18) independently worked targeted solar energy vocabulary as an online from Quizlet website as in Figure 3. Students in the paper-based group (n = 18) used paper flashcards that contained the same tests with answers. Students used their assigned cards daily to study and potentially master targeted vocabulary words.

No control was used, because all students are supposed to learn the key words assigned as part of solar energy the course.

The quantitative and qualitatively data collected from the vocabulary achievement test were analyzed by SPSS 21 software. Firstly, the scores of pre- and post-tests were compared for each group according to solar energy vocabulary test. Then, the results of post-tests for both groups were compared through t-test.

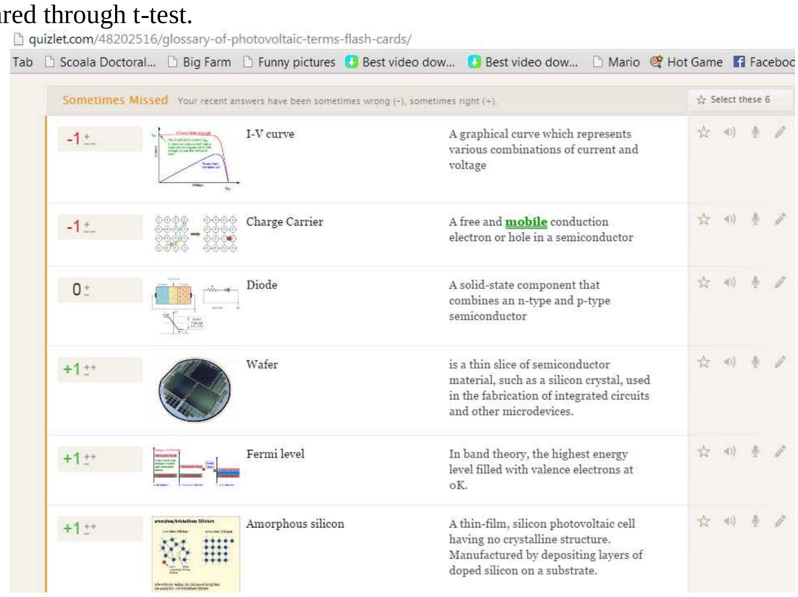

Figure 3. Examples of solar energy vocabulary
(http://quizlet.com/48202516/glossary-of-photovoltaic-terms-flash-cards/)

6 Results

Table 1 shows the results of the pre-test for both groups which has close mean scores, CAVL is 9.00 and paper-based is 10.28. These results showed that the students' target solar energy vocabulary knowledge were almost the same before the intervention. According to statistical analysis there is no significant difference between the groups, the results of pre-test (p= 0.21>0.05) which is higher than 0.05.

Table 1. The Comparison of the Pre-test scores of the two groups

Test	Group	N	Mean	Std. Dev.	-t-	-p-
	Paper-based	18	9.00	2.5		
Pre-Test					1.27	0.21
	CAVL	18	10.28	3.3		

Teacher analyzed whether there is a significant differences or not between pretest and posttest for same groups. The pre-test and post-test results of the CAVL and paper-based groups were compared through paired-samples t-test. The statistical findings regarding the paper-based group are presented as in Table 2:

Table 2. The Comparison of Pre- and Post-test Scores of the paper-based group

Test	N	Mean	Std. Dev.	-t-	-p-
Pre-test	18	9.00	2.5		
				15	0.00
Post-test	18	19	4.08		

The paired-samples t-test analysis of the pre- and post-test for the paper-based group was computed as .000 at the .05 level of significance. This shows that there was a significant difference before and after the intervention in the paper-based group (p<.05). In other words, the group's vocabulary knowledge increased after the intervention when we consider the mean scores.

In order to discover whether the computer-assisted group's target vocabulary knowledge increased after the intervention, the pre- and post-test scores of the CAVL group were compared as seen in Table 3.

Table 3. The Comparison of Pre- and Post-test scores of the CAVL group

Test	N	Mean	Std. Dev.	-t-	-p-
Pre-test	18	10.27	4.8		
				13.3	0.00
Post-test	18	21.05	3.3		

According to result, the mean score of the computer-assisted group was 10.27 for pre-test, and as 21.05 for post-test. The result showed that there was a significant difference between the pre- and post-test scores of the CAVL group (p<0.05) in terms of their target vocabulary knowledge. It is also clear that computer-assisted vocabulary teaching helped the students to increase their vocabulary knowledge.

Finally, in order to find out whether CAVL group learned more vocabulary than the paper-based group, both groups were compared according to their post-test scores. Table 4 shows the results of the post-tests for both groups:

Table 4. Comparison of post-test results of the CAVL and paper based groups

Test	Group	N	Mean	Std. Dev.	-t-	-p-
	Paper-based	18	19	4.08		
Post-Test					1.38	0.17
	CAVL	18	21.05	4.8		

Results showed that (p=0.17>0.05) showed that there was no significant difference between the post-test scores of the paper-based and CAVL groups. Therefore, results showed that both instruction types were successful in teaching solar energy vocabulary and teaching methods didn’t make any significant differences.

The results of ANOVA analysis showed the fact that there was no significant difference between the pre-test scores of the two groups before the intervention (p= 0.21>0.05). After the intervention, there was no significant difference between the groups in terms of vocabulary development (p= 0.17 >0.05), either.

Although there wasn’t significant differences between two groups, CAVL group students learned more terms, they were more active in class and enjoyed learning solar energy terms via interactive games and tests. “For me, it helped a lot since it showed which words should be repeated” Radu said. The other student said “I like computer-assisted learning because it is not boring and I learned lot vocabularies really fast with matching and games”. Most of the students commented that science teachers should make vocabulary learning interesting so that for each vocabulary we shouldn’t search from Google Translate or dictionaries.” Iulia pointed out “I enjoyed studying using the Quizlet website rather than reading or writing on paper because I enjoyed being on the computer. I can access to site in the classroom, at home, or its mobile app”.

7 Discussion

The aim of this paper was to reveal whether computer-assisted vocabulary instruction is effective on teaching solar energy vocabulary according to achievement of high school students. Results showed that CAVL could be a useful aid to the science vocabulary learning. This study provided evidence for facilitating effect of CAVL instruction on high school students’ vocabulary learning. Thus, it can be recommended that science teachers can use such available CAVL software or websites to enhance learners' vocabulary knowledge in a computer-based environment. As CAVL is attractive, accessed in everywhere, practical and time-saving, also teachers do not need to waste time for preparing documents for vocabulary instruction, test, quizzes, matching, games and true false questions.

Students during the interview said that the use of the computer-assisted learning was enjoyable, helpful and supported their vocabulary learning. One of the students directly said “This type of learning was helpful and it really helped me a lot without getting bored.” Most of the students interviewed commonly said that this method motivated and supported vocabulary learning.

It was clear that both groups' mean scores were increased significantly. But CAVL group learned more words than paper-based group. It can be said that learning can certainly occur no matter what the instruction type is (Gagne et al, 2005).

Contrary to popular belief, the result highlighted the importance of the fact that computer-assisted instruction may not always facilitate learning to students with respect to paper-based vocabulary learning. Teacher factor is also important and computers cannot substitute teachers (Tokaç, 2005).

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Data Acquisition Physics Experiments Using LabView

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Abstract

A data acquisition device (NIDAQ6008) in a school physics laboratory has a positive influence on the quality of the student applied projects. Based on a set of sensors, this device enables the signal acquisition from the external environment – acoustic, electromagnetic, thermic signals etc. – which can be converted into digital signals. These are then processed with the help of specialised software applications designed with the graphical programming environment LabView. In this paper we will illustrate the way in which such a data acquisition device produced by National Instruments can be used for the temperature measurement (using a thermistor), for the study of the characteristics of a photoresistor and of a semiconductor diode.

Keywords: NIDAQ6008, LabView, Thermistor, Photoresistor, Diode, Microphone.

1. Introduction

In order to enhance the quality of the learning process and bring it on a new level of efficiency, the modern physics laboratory needs to be endowed with powerful data acquisition devices, besides the common experimental kits found in schools. Such devices, along with a set of sensors and a software application for data processing have enabled us to achieve, in the educational institutions where we teach, an objective that we have long strived for: the integration of the virtual experiment, alongside the real one, in the Physics lessons. Based on our work experience with the data acquisition device NIDAQ6008 and with the graphic programming environment LABVIEW, we synthetized in the present paper a few interesting aspects from a few school experiments that we performed. What we want to demonstrate is the fact that a data acquisition device is very useful for any physics teacher who wants to develop computer-assisted experiments, a feat which, as some authors (Briscoe and Dufee, 2009; Lauterburg, 2001; Moriarty *et al*., 2003) point out, gives the lessons a engaging and comprehensive aspect.

2. Monitoring the environment temperature with a thermistor

This laboratory work was designed to monitor the temperature of some objects and of the surrounding environment using a thermistor as a sensor connected to a data acquisition device (NIDAQ6008).

The acquired data was processed with a specialized software created with the graphic programming environment LABVIEW. We used a NTC (Negative Temperature Coefficient) thermistor with a reference resistence $R_{ref} = 33k\Omega$, measured at the temperature $t = 25°C$.

It is known that the value of the resistence of the NTC thermistor varies with the temperature, according to the relation: $R_{th} = R_{ref} \cdot \exp[B \cdot \left(\frac{1}{T} - \frac{1}{T_{ref}}\right)]$, where the material constant B has the value $B = 4350$, $R_{ref} = 33k\Omega$, $T_{ref} = 298K$, T being the value of the current temperature, measured in K.

From the former relation, we infer that:

$$[1]\quad T = [\frac{1}{T_{ref}} + \frac{1}{B} \cdot \ln\left(\frac{R_{th}}{R_{ref}}\right)]^{-1}$$

Through a Kelvin-Celsius scale conversion, we obtain the relation:

$$t(\circ C) = T(K) - 273{,}15$$

Therefore, if we can determine the value of the resistance R_{th} we can calculate the value of the temperature T.

The electric circuit schema designed to determine the value is to be found in Fig.1.

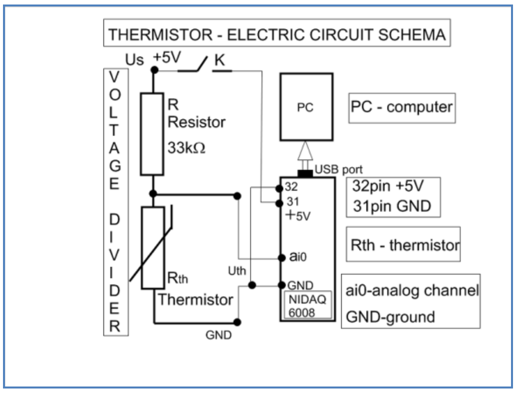

Figure 1. Thermistor – Electric Circuit Schema

In this schema we find a voltage divider according to Fig. 1, where U_s is the voltage of the source which electrically powers the thermistor R_{th}, U_{th} is the value of the voltage on the thermistor and R is a resistor whose value is equal to R_{th} measured at T_{ref}.

From the relation $\frac{U_{th}}{R_{th}} = \frac{U_S}{R+R_{th}}$ we have: $R_{th} = \frac{U_{th}}{U_S - U_{th}} \cdot R$.

For the values $U_s = 5V$, $R = 33k\Omega$, the relation can be be written as: $R_{th} = \frac{33000}{5-U_{th}} \cdot U_{th}$

This expression will be used in the formula node of the LabView application in order to calculate R_{th}.

The experimental setup that we used can be observed in the following figure (Fig. 2).

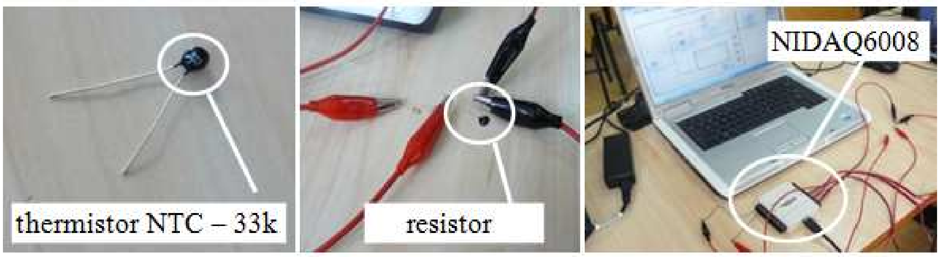

Figure 2. Experimental setup: thermistor NTC – 33k, resistor, NIDAQ6008

The Front Panel of the application contains three thermometric indicators corresponding to the temperature scales Celsius, Fahrenheit, Kelvin and two indicators that show the voltage values on the sensor (U_{th}) and the calculated values of the resistance R_{th}. Moreover, we added two diagrams which track the variation in time of the voltage on the thermistor and of the temperature measured on it (Fig. 4, 5, 6).

The block diagram consists in a WHILE loop (specific for continuous measurements), which contains a DAQ Assistant element necessary to create, edit and run a data acquistion task. The mathematical expression for the calculation of the temperature is employed by a FORMULA element which sends the data to a WAVEFORM GRAPH terminal and a COLLECTOR element. The latter sends the collected data to a WRITE TO FILE element in order to be stored in a text file which can be processed later on in MS Excel.

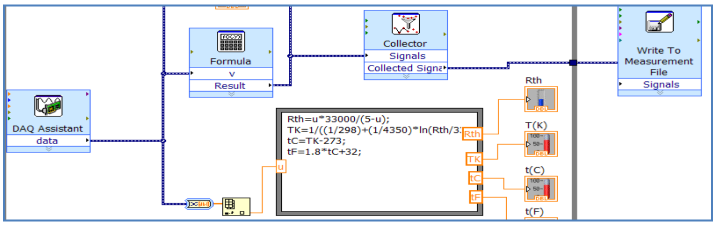

Figure 3. Block Diagram – Thermistor temperature measurement

The experimental results obtained through the temperature monitorings of the surrounding environment (inside the Physics lab), of the water contained in a glass and of the ice present in a plastic container are shown below (Fig. 4).

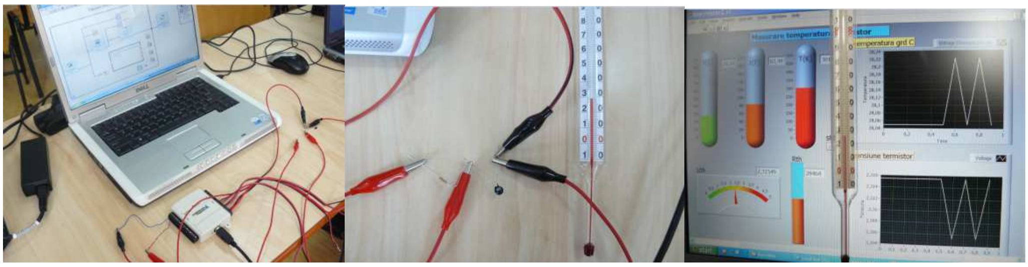

Figure 4. Laboratory temperature monitoring, R_{th}==28,5kohms, t= 28,04°C

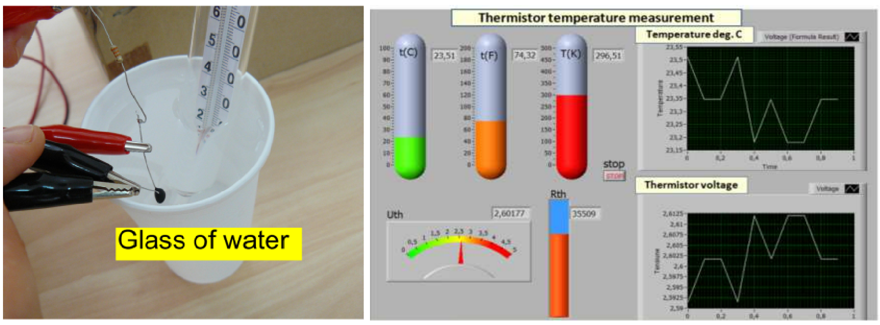

Figure 5. Water temperature monitoring, R_{th}=35kohms, t=23,51°C

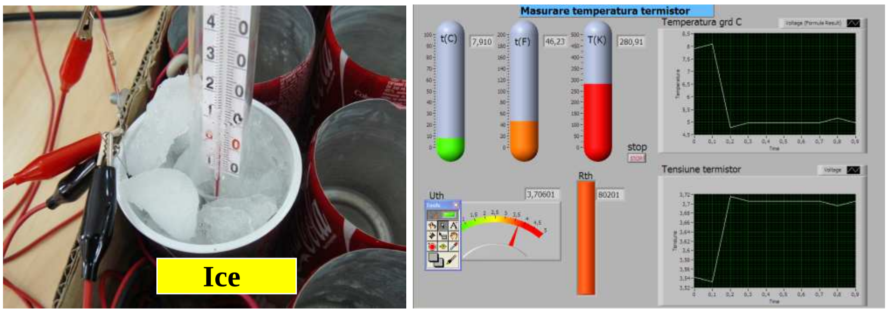

Figure 6. Ice temperature monitoring, R_{th}=80kohms, t=7,9°C

3. Drawing the characteristic of a photoresistor

The objective of this experimental work consisted in the study of the dependence of the electric resistance of a photosensitive device (photoresistor) on the level of illumination from the surrounding environment. The values of this resistance are inversely proportional to the intensity of the incident light stream: maximum resistance to darkness and minimal resistance to powerful lighting.

The experimental setup, whose schema is present in Fig.7, contains a CdS photoresistor (cadmium sulphide) connected through a 100kohms resistor to the pins 31 (+5V) and 32 (GND) of the DAQ device.

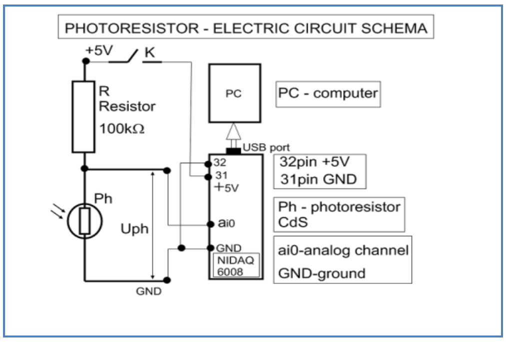

Figure 7. Photoresistor – Electric circuit schema

The experimental setup is illustrated in the following image (Fig.8):

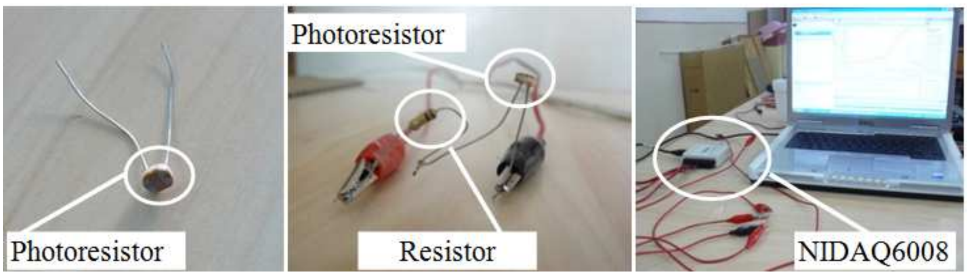

Figure 8. Experimental setup: photoresistor, resistor, NIDAQ

The Front Panel of the LabView application contains two diagrams which graphically show the variation of the voltage U_{th} and resistance R_{ph} of the photoresistor for different levels of illumination (Fig. 11).

The diagram of the application is illustrated below (Fig.9).

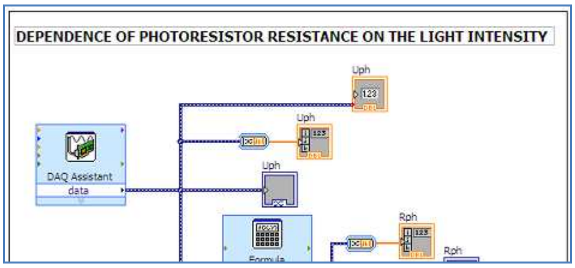

Figure 9. Block Diagram – Dependence of photoresistor on the light intensity

The characteristics of the device were drawn and compared for natural light and for monochromatic light: yellow, red, green, blue (Fig.10).

Figure 10. Photoresistor sensitivity near a monochromatic light sources

The response of the photoresistor to the variations of the natural light is shown in the graphs present in Figure 11.

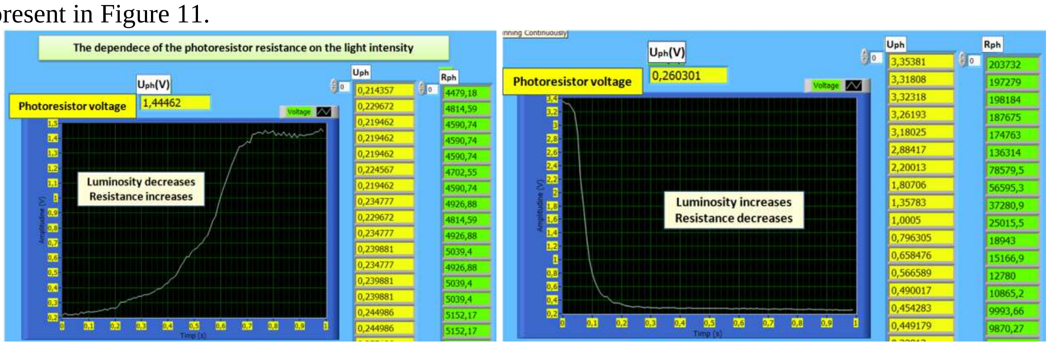

Figure 11. Photoresistor response at the decrease and increase in light

The dark resistance R_d had an approximate value of 416kohms, while the light resistance had an approximate value of 5kohms.

4. Drawing the characteristic of a semiconductor diode

A semiconductor diode is an electronic device whose characteristic current-voltage I_d -U_d is a non-linear one.

The intensity of the current in forward bias is:

[2] $I_d = I_S \cdot \left[\exp\left(\frac{U_d}{m \cdot V_T}\right) - 1\right]$, where I_S is the reverse saturation current and $V_T = \frac{k_B \cdot T}{e}$ is the thermal potential (25mV at room temperature (300K)).

In the V_T formula, k_B is the Boltzmann's constant and e is the charge of the electron.

The factor m has the value 1 for Ge diodes and approximately 2 for Si diodes. As long as $U_d \gg V_T$, the diode is in conducting state $(I_d \gg I_S)$, so that one can approximate:

$$[3] \quad I_d \approx I_S \cdot \exp\left(\frac{U_d}{m \cdot V_T}\right).$$

In this experiment our aim was to draw the characteristic $I_d = f(U_d)$.

The electric circuit schema (Fig.12) and the experimental setup (Fig.13) are shown below.

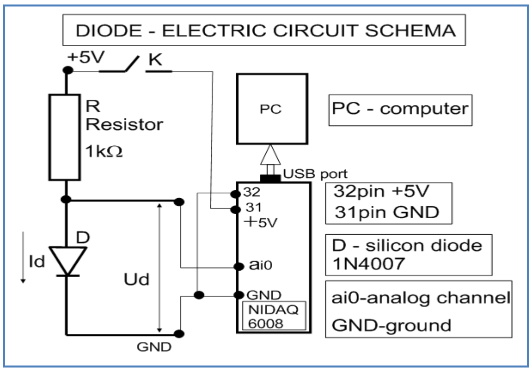

Figure 12. Diode – Electric Circuit Schema

Figure 13. Types of semiconductor diodes, silicon diode 1N4007, NIDAQ6008

The Front Panel of the LabView application contains the electric circuit scheme necessary to draw the characteristic of the diode and a diagram where the graph $I_d = f(U_d)$ is shown. Moreover, we listed the arrays of values of the pairs (I_d, U_d) which build up this graph (Fig.14).

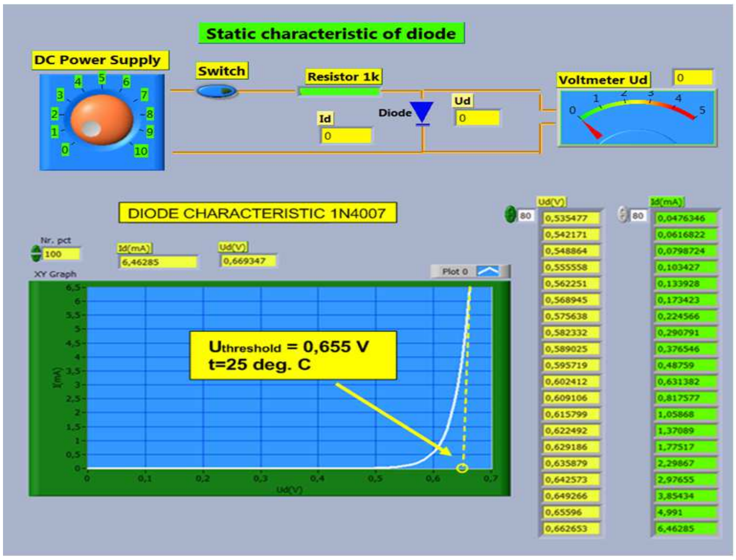

Figure 14. Static characteristic of diode – Front Panel

The following image illustrates the diagram of the application (Fig. 15).

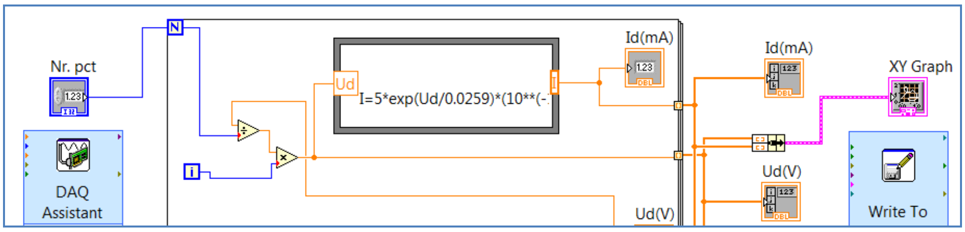

Figure 15. Static characteristic of diode – Block Diagram

In the block diagram we can observe that the array of values obtained from the FOR loop (which contains a formula node) is directed towards a graphic terminal and stored in a text file which is then exported and processed in MS Excel (Fig.16).

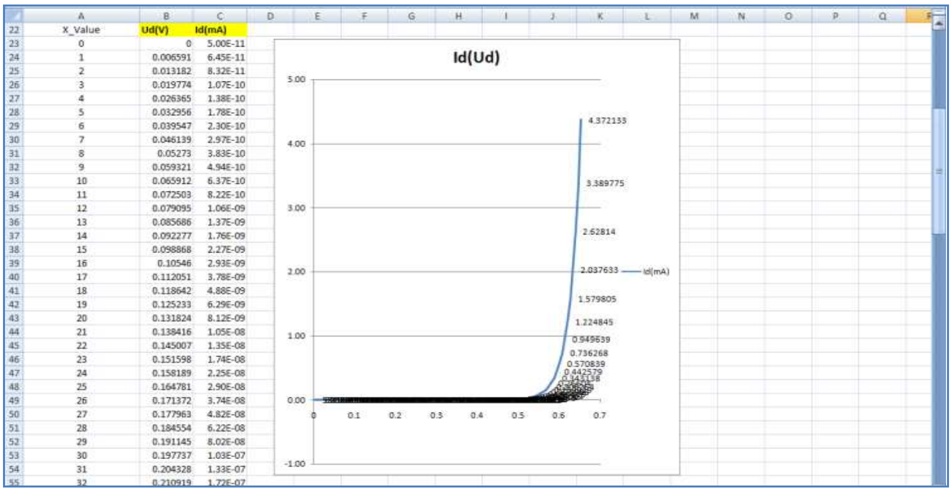

Figure 16. Static characteristic of diode – processed in MS Excel

5. Conclusions

The wide range of physics experiments that can be performed in schools using a data acquisition device determine teachers to view it as a powerful didactic tool, which should be a part of any modern school laboratory. Although there are other types of data acquistion systems which can automatically turn the external signals into numerical values, a data acquistion device is particularly interesting because it can show in detail the logically structured process of the data flow – from the moment when it is picked up by a sensor until it gets processed by a specialised software. In these circumstances, the studied parameters – for example the temperature, the intensity, the voltage – can be understood by the students both in quantitative and qualitative terms.

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Tools in Support of Serious Game Reuse

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Abstract

Serious Games (SG) developers and implementers need direct access to relevant information, knowledge, expertise, resources, best practices, creativity enabling resources, etc. especially in this era of information overload where search engines clearly show their limitations. A large number of potential reusable SG assets is lost due to this information overload, the sustainability and the multiplication effects of SG projects decrease because valuable resources get hidden in abundance. The authors present a Serious Games Reusability Reference Point (SGREF) that has been initiated with the purpose of enabling the collection of references to SG assets, created within the SG community - especially through projects funded at national, European, and international level - that are reusable, standardized, and/or interoperable and are able to potentate creativity. The research is supported through the Game and Learning Alliance Project, funded under FP7, and the "Development Environment and Syllabus for Serious Games Implementation" Project, funded by UEFISCDI.

Keywords: Serious Games, Software Reuse, Knowledge Management

1 Introduction

The rapid growth of the Serious Games (SG) community requires new approaches that address issues such as the fragmentation between SG research and industry, the challenge of reduced budgets and time constraints for product delivery, the rapidly-changing user needs, and the impact of emergent technologies.

In this context, software reuse brings the opportunity to employ existing software or software knowledge to build new software, enabling successful, quality-driven developments and significant savings in costs and time (Yang and Liu, 2012). To achieve this goal, new approaches and resultant tools are required in the SG community to support the development, retrieval, reuse, maintenance and evolution of reusable SG assets.

The authors discuss the need and the opportunities for reuse in the SG community and present a Serious Games Reusability Point of Reference that has been been co-funded by the EU under the FP7, in the Games and Learning Alliance (GALA) Network of Excellence, Grant Agreement nr. 258169 and by UEFISCDI, in the Development Environment and Syllabus for Serious Game Implementation project (DESiG), Contract 19/2014.

2 The Serious Games Reusability Point of Reference

This section presents the Serious Games Reusability Point of Reference (SGREF), a tool developed to support the reuse of SG assets across the SG community and beyond.

2.1 Premises and Scope

Successful development and deployment of SGs relies on solutions that answer to practical problems that characterize software projects such as schedule, cost, performance, and quality (Leach, 2013). Reusability lies at the core of standardization and interoperability and it is widely believed to be a key factor in improving software development productivity and quality.

This research is based on the premises that source code modules are not the only kind of reusable SG assets. SG assets may include things as requirements, project plans, estimates, architectures, designs, user interfaces, game mechanics, game design patterns, test plans, test cases, data, quality plans, documentation, etc.

Managing a set of reusable SG assets requires that developers know what items they have, where to find them and whether they are worth keeping. To achieve systematic reuse it is often essential to have an effective catalogue that connects to repositories.

SG design, development and deployment consist of complex processes that are costly, time-consuming, and require extensive expertize across multidisciplinary teams. Research has revealed that reuse, standardization and interoperability are key factors that can positively impact SG development and implementation. Educational technology standards (Sharable Content Object Reference Model - SCORM, Tin Can API), as well as reusability and interoperability solutions have tried to provide optimization patterns, but failed to reach their full potential, mainly because they have addressed particular issues and not an integrated perspective (Desourdis, 2009), (Robson R., 2010), (Guy, 2011). Moreover, they do not provide references or access to existent resources that could support a sustainable, efficient design, development and implementation of SGs.

Master and Phd students, as well as expert SG developers and implementers need direct access to relevant information, knowledge, expertise, resources, best practices, creativity enabling sources, etc. especially in this era of information overload (Strother et al., 2012), where search engines clearly show their limitations. A large number of potential reusable SG assets is lost due to this information overload, the sustainability and the multiplication effects of SG projects decrease because valuable resources get hidden in abundance (Stănescu et al., 2013).

Under these premises, SGREF has been developed with the purpose of enabling the collection of references to SG assets, created within the SG community – especially through projects funded at national, European, and international level – that are reusable, standardized, and/ or interoperable and are able to potentate creativity.

2.1 General Features of SGREF

Users can submit their SG references and upload their resources by creating an SGREF user account and password or by using an external OpenID-based identity provider (eg. social networks).

The SGREF authentication system manages both user authentication – verifying if a user is who s/he claims to be, and user authorization – determining what an authenticated user is allowed to do. It handles: User accounts; Groups: enables the application of labels and permissions to more than one user; Permissions: designate whether a certain user or group may perform a certain task; A configurable password salt-hashing system (for accounts that use local authentication); Cookie-based user sessions.

The security issues are addressed by: Password strength checking; Throttling of login attempts; Authentication against third-parties.

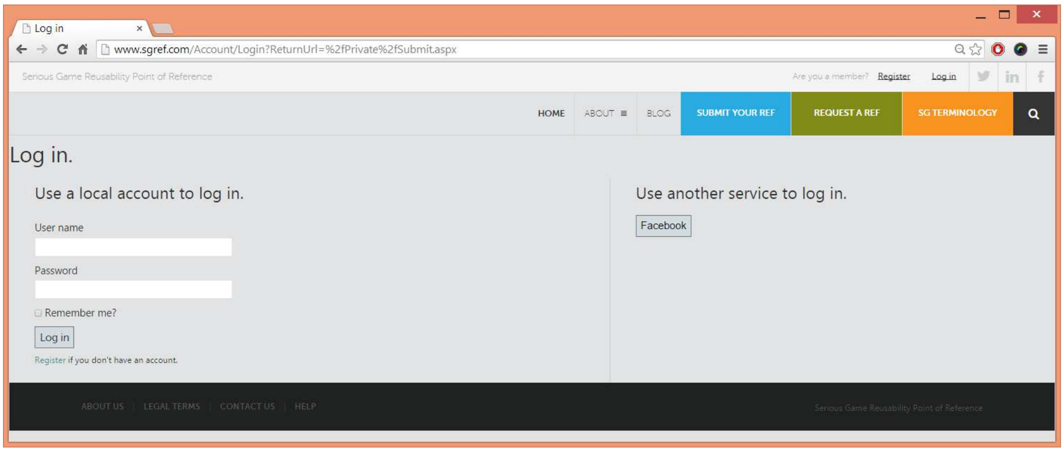

Figure 1. Authentication in SGREF

To avoid long and complicated login forms and increase the sign-up rate, SGREF users can login with their social network accounts. Facebook, Google and Twitter are supported at the moment. The third party authentication system is based on the OpenID standard to allow easy integration with new identity provides in the future, such as LinkedIn, Yahoo, and Windows Live.

SGREF provides a consistent identifier for each social network profile, allowing users to link multiple social network profiles to a single SGREF user account and to recognize returning visitors.

Each SGREF user can create a profile with information they would like to share about themselves, such as: Name, Photo, Title, Organization, Country, Website and Email address as well as a short bio and links to other web pages or social network profiles

Social Sharing

To increase impact and community uptake, SGREF supports an extensive integration with key social networks. Users can share the webpages of their references or of other references available in SGREF, their comments, reviews or other activities directly from SGREF on multiple social networks. Users can share their SGREF activity or content to social networks simultaneously, without leaving application. SGREF stimulate users to share their content and activity.

SGREF tracks registrations, repeat visits, social posts and resulting referral traffic to get insights into what users are interested in and to improve the overall user experience.

SGREF Search

The search function is one of the most important features of the tool and therefore it has been given extra attention in order to enable users to quickly identify the references and content they are looking for. To this end, SGREF provides an internal search function that allows users to search not only by full text, but also by specific reference categories, tags and user profile.

In addition, all the content pages of the site have search engine friendly permanent links that allow easy indexing and direct access from outside pages and search results.

2.2 Reference submission and validation

To submit a reference users need to be logged in. The submission process includes three steps: Details; Review and submit; and Confirmation.

The reference submission form includes the following fields:

- REF name: users need to introduce a title for the reference they are submitting.
- Description: users can provide a short description of the reference they are submitting.

- REF URL: users introduce the link to their reference.
- Category: Users can choose a category for their reference. The main categories are: design; development; deployment; serious games mechanics; personalization and artificial intelligence; architecture; human-computer interaction; interoperability; standards; semantics; assessment; psychology; pedagogy; neuroscience; business & management; engineering & manufacturing; health & fitness; security, safety & crisis management; humanities & heritage; personal, social learning & Ethics. These categories are not mandatory.
- Tags: Users can add their own tags to describe the reference they are submitting.
- Upload: If they want to make the SG asset available, they can upload it in the SGREF.

After users provide the details for the SG reference/ assets they want to upload, they can validate the data in the second step of the submission. If submissions are made successfully, a validation message is displayed in the final phase.

After the initial testing of the system, references have become subject to validation by the administrators of the system or by experts who have been granted rights in order to increase the quality of the resources that are submitted.

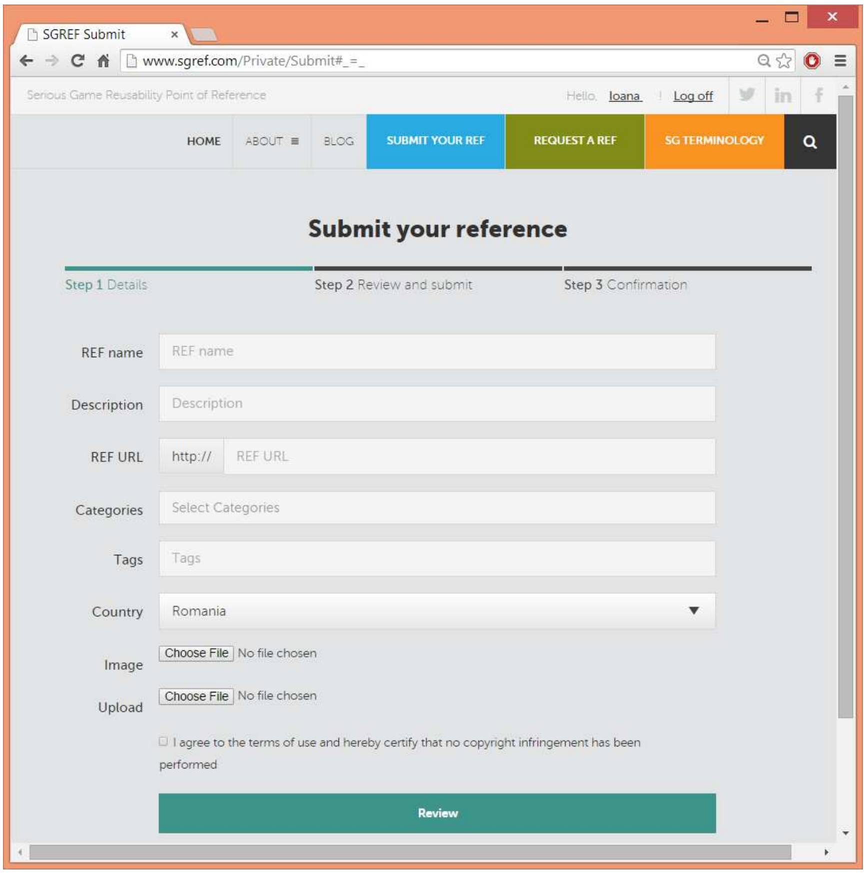

Figure 1. Reference submission in SGREF

3 Conclusions

To enable SG researchers, developers, and implementers adopt reusability as a way of working, it is necessary to create a gateway to reusable SG assets in the SG community, in order to enable the SG community members to start exploring the large and rapidly growing body of literature on SG research, development and implementation, as well as on reuse for more detailed information on cost models, class libraries, organizational structures, repository management, knowledge reuse, and many other important issues.

To fully achieve its goals, software reuse should be translated into understanding how reuse can contribute towards the goals of a business; defining a technical and management strategy to achieve maximum value from reuse; integrating reuse into the total software process and into software process improvement programs; ensuring all staff have the necessary competence and motivation; establishing appropriate organizational, technical and budgetary support; and using appropriate measurements to control reuse performance.

The Serious Games Reusability Point of Reference has been developed with the purpose of supporting the identification of reusable Serious Game (SG) assets and their reuse within SG communities and beyond. To facilitate reuse, SGREF manages collections of references to reusable SG assets and a repository with SG assets uploaded by users. The reference-based approach has been adopted to stimulate availability of resources, even if they are not open source.

Future work includes the further development and testing of the tool with the purpose of supporting SG reuse across the entirety of the design, development and deployment processes.

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A Walkthrough Serious Games Design & Development

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Abstract

The paper details the premises and the challenges associated to designing and developing Serious Games (SG). The authors advance a hybrid, proactive, cost-efficient approach in the SG field that builds upon the power of commercial game engines and that integrates complex, serious games-driven pedagogical analysis. Unlike current developments that are either commercial, implementing the latest technological innovations, or educational, focusing on complex pedagogical constructs, the authors explore an innovative general framework for SG development that will bridge the expertise from the two areas. The researchers adopt a component-based development approach that increases productivity, reduces time to implementation, it is easier to customize and it requires less financial resources. Package software is monolithic, difficult to integrate, and expensive to customize. Custom development is costly and time consuming. Since organisations vary in size, competencies and requirements, component-based development enables companies and educational organisations to reuse what are essentially part of applications that can be customized and tied together to form a unique solution that suits their needs. Cost savings are achieved through a modular approach that enables the reuse of components in customised architectures. The research is carried out within the "Development Environment and Syllabus for Serious Games Implementation" Project, funded by UEFISCDI.

Keywords: serious games, game engines, Experience API, learning analytics

1 Introduction

Serious Games (SG) research and the development of games as educational, business and research tools have not reached maturity. The need to enable sustainable SG design and development (Stănescu, 2012) calls for new levels of resourcefulness that would address specific needs, would decrease fragmentation and would enable advanced opportunities by fostering transparency, dissemination, collaboration, reusability and interoperability. Questions such as: *How accessible is SG design and development? Does the serious game employ attested game patterns and mechanism that stimulate and enhance learning? Can the learner's progress be tracked both quantitatively and qualitatively? Is there an assessment feature included in the game authoring environment?* still need to be answered.

The authors present the premises for the integration of a Serious Games Development Environment (SGDE) for desktop and mobile SGs to provide SG authors with the key components required for progress tracking, change data capture and assessment tools that include statistical analysis to proactively identify problem areas. Interoperability is achieved through the use of the SCORM standard object packaging, as well as of the open standard Web Services that enables the exchange information with a Learning Management System (LMS) and also feeds data into the any other backend system.

The parallel articulation of two development environments, one dedicated to the creation of desktop games, and the second for mobile games, supports efficiency in development and cost reduction based on reusability, standardization and interoperability. Given the non-technical audience targeted by the project, the Development Environment will make available two developed games for which the entire project source is included, so that they can be fully adapted, changed and used as a starting point for further developments by tutors.

2 Serious Game Development Environment

In this section, the authors present the rationale behind the creation of the SGDE and detail the core components of the environment.

2.1 Challenges and Opportunities for Serious Games Design and Development

Innovations in information technology together with evolutions in pedagogical approaches encourage the rapid integration of technology-supported interventions in mainstream teaching and training practices (Earp et al., 2011; de Freitas et al., 2013). SG is one area attracting particularly attention in this respect in informal learning and training experiences in supported and standalone contexts, as well as business experiences. Many studies have pointed to the positive qualities of SGs, such as their persuasiveness and motivational appeal, which can support immersive, situated and learner centred learning experiences (Harteveld, 2012; Hussaan, 2012). Beside contexts that concern workplace training or client training, the potential of SGs has extended to other specific business activities, such as marketing. While researchers and practitioners agree on the multiple benefits and potential of these emerging media in the learning and business environment, their development remains a challenge. Game applications are usually complex, interactive, real-time systems, which are non-trivial to implement. Designing human-centred educational games that have rich storylines is not an easy undertaking.

It is important that educators are able to easily customize and augment SGs with instructional activities that preserve the context (situated cognition) of the game, e.g. by extending the goals and character roles of the game into the classroom. This means that teachers need to know the game well, propose specific learning paths, verify their effectiveness, and most importantly set the gaming experience in a sound overall educational framework. This work is crucial when we consider that such games may not always meet the individual requirements of lecturers whose courses are tied to specific learning outcomes.

In order to exploit this potential fully, educators are called on to possess a range of competencies and assume a variety of roles; they need to be knowledgeable in the SG's content and mechanics, to be instructional designers, subject matter experts and pedagogically open to new ways of designing curriculum and tailoring classes assisted by technology. The best teacher will blend enthusiasm for using games with knowledge to be constructed so as to render a meaningful learning experience for each student. Indeed, not only should teachers know the game well, propose specific trajectories to the students and verify effectiveness, they also need to be mediators and foster post-game discussions. Learning goals are most successfully attained when the teacher has a clear sense of the task set, his/ her mediation, and the type of game selected.

In order to provide complete support, games used in education should incorporate or facilitate assessment and evaluation processes. Games are complex software artefacts that receive continuous input from the user and return immediate feedback. This exchange can be observed and logged, gathering vast amounts of information about how the students are interacting with the game. This creates the need for new assessment models, potentially semi-automatic, in which the interaction can be analysed to learn about the entire gaming activity and to infer information about the learning process. The research interests in this area focus on two directions: assessment of serious games (learning outcomes, performance, etc.) and assessment in/with serious games (explicit or implicit evaluation of student/gamer performance in the game, use of games as an evaluation tool, etc) (Torrente et al., 2011).

From the development perspective, SGs have emerged not only as an opportunity, but also as a challenge. Unlike the billion-dollar entertainment video game industry, which has responded to increased product demand by developing increasingly complex and costly games, the SG segment of the industry has followed an approach of cost containment and technology simplification. While commercial game engines vary widely in the details of their architecture and implementation, recognizable patterns are emerging across both public licensed engines and their proprietary in-house counterparts. Virtually all game engines contain a familiar set of core components, including the rendering engine, the collision and physics engine, the animation system, the audio system, the artificial intelligence system, and so on. Within each of these components, a relatively small number of semi-standard design alternatives are also beginning to emerge. However, no reasonably complete picture of the entire gamut of components that make up a modern game engine has been developed. Moreover, little research has been carried out on serious game engines and the differences between commercial and educational engines.

2.2 SGDE Conceptual Framework

This research builds upon a multidisciplinary approach that considers the various facets of the development of a full-fledged serious game, out of which the most and foremost important is the pedagogical value of the game.

The SGDE integrates multiple components and modules illustrated in Figure 1, including game object repositories. The SGDE acts as a middle layer between the tutor and the end-users, enabling a dynamic and interactive learning environment for the end-users, and clear insight and assessment of the learner's progress for the tutor.

The SG Editor is the authoring tool that tutors can use to develop SGs. It is targeted primarily at non-technical users, but it also has a built-in script editor that can be accessed for coding custom game actions.

Data exchange operations between the system and external components is handled at the networking layer by the communications manager. The communications manager provides a lightweight platform agnostic API that is used by the core components to exchange information about the user's progress within the game and goal completion. The data exchange interfaces are implemented using standards-based Web Services for vendor independence and future proof connectivity.

The components are developed using industry frameworks, such as HTML5/JavaScript and Microsoft .NET Framework, and also educational standards and specifications (LOM, SCORM, Experience API). This approach reduces the cost of further developments since every component becomes more flexible and easily customizable. The use of frameworks-based software components also helps speed up the development cycle. These components can be extended and customized for additional functionality. They can also be bundled together to form more complex components and full applications.

Databases of desktop and mobile 2D objects will be created and aggregate in the SGs created. The library will contain graphic elements as well as animated characters. The graphics elements can be objects or characters, delivered as PNG or SWF, as required. The SGs developed using the SGDE are able to communicate with a variety of external applications using standard Web Services. This innovative feature allows greater control over the learning process as well as user assessment.

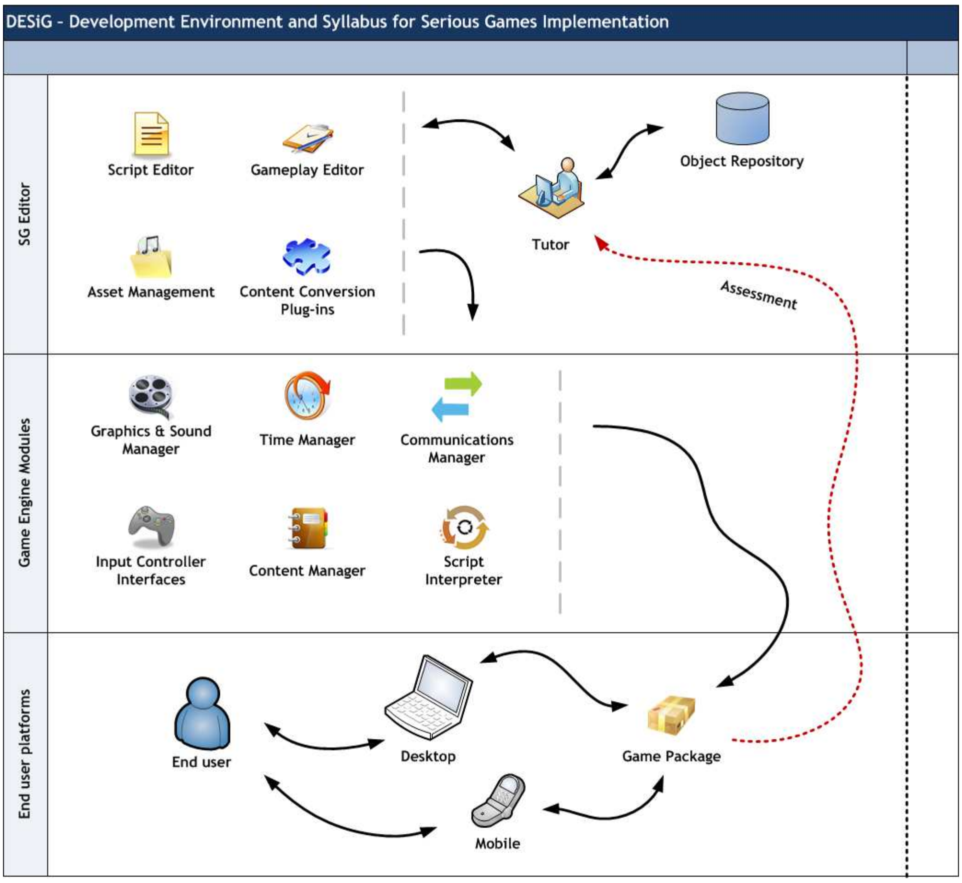

Figure 1. DESiG Conceptual Framework

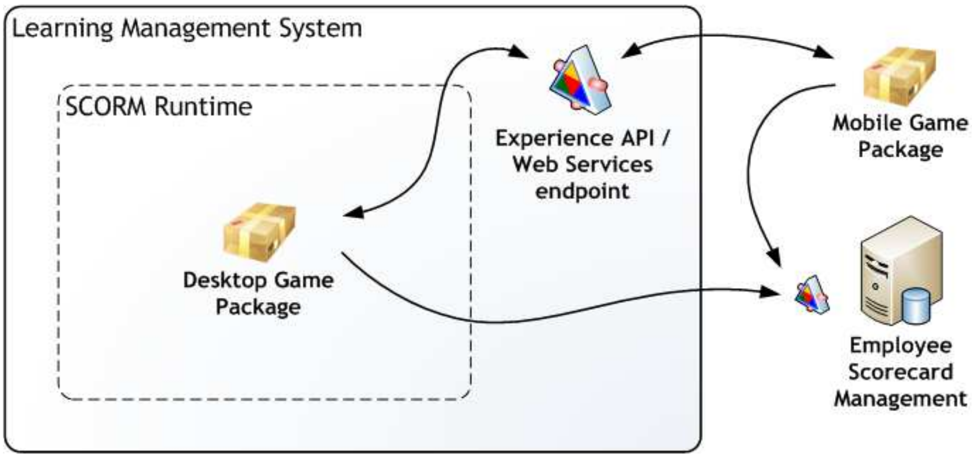

Figure 2. Data exchange interactions

The component-based development drives down the cost of software development in two ways. The first is by introducing re-usable components to the development life cycle, which reduces the amount of software that must be built in later projects. The second is by driving down the cost of development is by lowering the cost of the components themselves. The end result is lower cost, higher quality software components, which leads to lower cost, higher quality software applications.

3 Discussion and Conclusions

The SGDE implements a component-based development approach that increases productivity, reduces time to implementation, it is easier to customize and it requires less financial resources. Package software is monolithic, difficult to integrate, and expensive to customize. Custom development is costly and time consuming. Since organisations vary in size, competencies and requirements, component-based development enables companies and educational organisations to reuse what are essentially part of applications that can be customized and tied together to form a unique solution that suits their needs. Cost savings are achieved through a modular approach that enables the reuse of components in customised architectures.

The SGDE for desktop and mobile settings represents an innovation both at national and international level. Most efforts up to this moment have focused on the creation of SGs, and not on the construction of an environment that fosters SG development. Since the creation of SGs is a complex endeavour that necessitates extensive financial resources, the adoption of SGs in practice has not been accessible for many public and private organisations in Romania. Moreover, the existing SGs have been implemented mostly in desktop environments. The proposed approach initiates an original, complementary path of development that targets both desktop and mobile SGs created using the new development environment.

Future work will investigates relevant concepts such as game mechanics, game patterns, or pedagogical constructs in order to determine a spectrum of activities, practices within which SG mechanics can be identified. This research will fundament the design and development of the functional model of the SGDE.

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Section

SOFTWARE SOLUTIONS

Software Solutions (SOFT):

- **New software environments for education & training**
- **Software and management for education**
- **Virtual Reality Applications in Web-based Education**
- **Computer Graphics, Web, VR/AR and mixed-based applications for education & training, business, medicine, industry and other sciences**
- **Multi-agent Technology Applications in WBE and WBT**
- **Streaming Multimedia Applications in Learning**
- **Scientific Web-based Laboratories and Virtual Labs**
- **Software Computing in Virtual Reality and Artificial Intelligence**
- **Avatars and Intelligent Agents**

Overview of the Multi-Objective Refactoring Selection Problem

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Abstract

Software systems continually change as they evolve to reflect new requirements, but their internal structure tends to decay. Refactoring is a commonly accepted technique to improve the structure of object-oriented software. Several refactoring selection problem have been formalized in the past years. This paper intends to overview the work achieved in this area, starting from the general refactoring selection problem to the single, set, sequence, plan, or strategy based refactoring selection problems. Further research directions on the multi-criteria based selection are detailed.

Keywords: Refactoring, Object-oriented programming, Multi-objective optimization, Genetic algorithms

Introduction

Software systems are subject of the evolution determined by new requirements addition, new working environments adaptation or errors removal. In order to improve the internal structure of object-oriented software, refactoring has proved to be a feasible technique. Its aim is to reverse the decaying process of software quality by applying a series of small and behaviour-preserving transformations, each of them improving a certain aspect of the system. While some useful refactorings can be easily identified, it is difficult to determine those refactorings that really improve the internal structure of the program. Many useful refactorings, whilst improving one aspect of the software, make undesirable another one.

The rest of the paper is organized as follows: Section 2 reminds some close related work on refactoring selection in Search-Based Software Engineering (SBSE). The most general problem on multi-objective refactoring selection is stated in Section 3. Section 4 states the formal requirements for the particular problems on refactoring selection. Future work on refactoring selection is presented in Section 5. Finally, Section 6 concludes.

Related Work

A closely related work is the *Next Release Problem* (**NRP**) studied by several authors (Zhang, Harman, and Mansouri,2007; Bagnall, Rayward-Smith, and Whittley, 2001; Greer and Ruhe, 2004), where the goal is to find the most appropriate set of requirements that equilibrate resource constraints to the customer requests, being the problem defined as a constrained optimization problem.

The appropriate refactoring selection problem is an example of a Feature Subset Selection (FSS) search problem. Other FSS problems in previous work on SBSE include the problem of determining good quality predictors in software project cost estimation, studied by Kirsopp et al (Kirsopp, Shepperd, and Hart, 2002), choosing components to include in different releases of a system, studied by Harman et al. (Harman, Swift, and Mahdavi, 2005) and Vescan and Pop (Vescan and Pop, 2008).

Previous work on search-based refactoring problems (Harman and Tratt, 2007; O'Keefe and O'Cinneide, 2006; Zhang, Harman, and Mansouri,2007; Bowman, Briand, and Labiche, 2007) in SBSE has been concerned with single objective formulations of the problem only. Much of the other existing work on SBSE has tended to consider software engineering problems as single objective optimization problems too. But recent trends show that multi-objective approach has been tackled lately, being the natural extension of the initial work on SBSE.

Other existing SBSE work that does consider optimization formulations of software engineering problems, uses the weighted approach. Therefore, objective functions are combined into a single objective function using weighting coefficients to denote the relative importance of each individual objective. In search-based refactoring field, Seng et al. (Seng, Stammel, and Burkhart, 2006) and O'Keeffe and O'Cinneide (O'Keefe and O'Cinneide, 2006) apply a weighted multi-objective search, by using several metrics to assess the quality of refactorings within a single objective function.

General Multi-Objective Refactoring Selection Problem

A refactoring management process for a complex software system has proved to be not an easy task to do (Fowler, 1999). Multiple refactoring aspects of different parts of an heavy working system need increased attention when planning the order to refactor. Moreover, within a complex system there is a large number of software developers, each of them perceiving the refactoring process in his own different manner.

A refactoring strategy allows to fit each transformation performed on the software system within a general refactoring plan, following a criteria set that unifies particular transformation requests into a homogenous single and desired development trend.

In order to state the General Multi-Objective Refactoring Selection Problem (GMORSP) some notion and characteristics have to be defined. Let $SE = \{e_1, \ldots, e_m\}$ be a set of software entities, e.g., a class, an attribute from a class, a method from a class, a formal parameter from a method or a local variable declared in the implementation of a method. They are considered to be low level components bounded through dependency relations.

A software system SS consists of a software entity set SE together with different types of dependencies between the contained items. A dependency mapping ed is defined as SED ={**u**ses**A**ttribute, **c**alls**M**ethod, **s**uper**C**lass, **a**ssociatedwith**C**lass, **n**o**D**ependency}, $ed : SE \rightarrow SED$

$$ed(e_i, e_j) = \begin{cases} uA, \textit{if method } e_i \textit{ uses attribute } e_j \\ cM, \textit{if method } e_i \textit{ calls method } e_j \\ sC, \textit{if class } e_i \textit{ is a direct superclass for class } e_j \\ aC, \textit{if class } e_i \textit{ is associated with class } e_j \\ nD, \textit{otherwise} \end{cases}$$

where $1 \le i, j \le m$.

If a class $e_i, 1 \le i \le m$ is an indirect superclass, for the class $e_j, 1 \le j \le m$, then $ed(e_i.e_j) = sC^*$ and there is a class $e_k, 1 \le k \le m$, such that $ed(e_i.e_k) = sC$, where $1 \le i \le m, 1 \le j \le m, 1 \le k \le m, k \ne j$. The association relationship between two classes may be expressed as: aggregation, composition or dependency. If a class $e_i, 1 \le i \le m$, has an aggregation relationship with a class $e_j, 1 \le j \le m$, the association multiplicity is nested within the simple class association notation, i.e., $ed(e_i.e_j) = aC*_1^n$.

A set of possible relevant chosen refactorings (Fowler, 1999) that may be applied to different types of software entities of SE is gathered up through $SR = \{r_1, \ldots, r_t\}$. Specific refactorings may be applied to particular types of software entities, i.e., the *RenameMethod* refactoring may be applied to a method entity only, while the *ExtractClass* refactoring has applicability just for classes. Therefore, a mapping that sets the applicability for the chosen set of refactorings SR on the set of software entities SE is defined as: $ra : SR \times SE \to \{True, False\}$

$$ra(r_l, e_i) = \begin{cases} T, \text{ if } r_l \text{ may be applied to } e_u \\ F, \text{ otherwise} \end{cases}$$

where $1 \le l \le t, 1 \le i \le m$.

There are various dependencies between refactorings when they are applied to the same software entity, a mapping emphasizing them being defined by:

SRD={**B**efore, **A**fter, **A**lways**B**efore, **A**lways**A**fter, **N**ever, **W**henever},

$rd : SR \times SR \times SE \to SRD$

$$rd(r_h, r_l, e_i) = \begin{cases} B, \text{ if } r_h \text{ may be applied to } e_i \text{ only before } r_l,\ r_h < r_l \\ A, \text{ if } r_h \text{ may be applied to } e_i \text{ only after } r_l,\ r_h > r_l \\ AB, \text{ if } r_h \text{ and } r_l \text{ are both applied to } e_i \text{ and } r_h < r_l \\ AA, \text{ if } r_h \text{ and } r_l \text{ are both applied to } e_i \text{ and } r_h > r_l \\ N, \text{ if } r_h \text{ and } r_l \text{ cannot be both applied to } e_i \end{cases}$$

where $ra(r_h, e_i) = T, ra(r_l, e_i) = T,\ 1 \le h, l \le t, 1 \le i \le m$.

The effort involved by each transformation is converted to cost, described by the function $rc : SR \times SE \to N$. Changes made to each software entity $e_i, i = \overline{1,m}$ by applying the refactoring $r_l, 1 \le l \le t$ are stated and a mapping is defined: $effect: SR \times SE \to Z$. The overall effect of applying a refactoring $r_l, 1 \le l \le t$ to each software entity $e_i, i = \overline{1,m}$ is defined by the mapping $res : SR \to Z$.

Let $DS = (SR^t, SE^m)$ be the decision domain for the GMORSP and $\vec{x} = (r_1, r_2, \ldots, r_t, e_1, e_2, \ldots, e_m)$, $\vec{x} \in DS$ a decision variable. The GMORSP is defined by the followings:

- $f_1, f_2, \ldots, f_M$, M objective functions where $f_i : DS \to \Re, i = \overline{1,M}$ and $F(\vec{x}) = \{f_1(\vec{x}), f_2(\vec{x}), \ldots, f_M(\vec{x})\}, \vec{x} \in DS$;

- $g_1, g_2, \ldots, g_J$, J inequality constraints $g_j(\vec{x}) \ge 0, j = \overline{1,J}$;

- $h_1, h_2, \ldots, h_K$, K equality constraints $h_k(\vec{x}) = 0, j = \overline{1,K}$;

The GMORSP is the problem of finding a decision vector $\vec{x} = (x_1, \ldots, x_{m+t})$ such that:

[1] $maximize\{ F(\vec{x})\} = maximize\{ f_1(\vec{x}), f_2(\vec{x}), \ldots, f_M(\vec{x})\}, \vec{x} \in DS$

where $f_i : DS \rightarrow \Re, i = \overline{1,M}$, $g_j(\vec{x}) \geq 0, j = \overline{1,J}$, $h_k(\vec{x}) = 0, j = \overline{1,K}$.

Multi-objective optimization often means optimizing conflicting goals. For the GMORSP formulation there may be the possibility to blend different types of objectives, i.e., some of them to be maximized and some of them to be minimized.

Particular ulti-Objective Refactoring Selection Problems

Previous work on searched based refactoring problems (Chisăliță-Crețu and Vescan, 2009; Chisăliță-Crețu, 2009a; 2009b) in SBSE has been concerned with single objective formulations of the problem. The formalism generalizes the Optimal Refactoring Selection Problem (ORSP) to the Multi-Objective RSSP (MORSSP) in (Chisăliță-Crețu, 2009a) and the Multi-Objective RSqSP (MORSqSP) in (Chisăliță-Crețu, 2009b).

1.1 MORSSP

The MORSSP defined in (chisalita vescan 2009a) has two objectives to compromise. The first objective function minimizes the total cost. In order to have a maximized objective, it was subtracted from MAX, the biggest possible total cost, as:

[2] $$maximize\left\{ f_1(\vec{r})\right\} = maximize\left\{ MAX - \sum_{i=1}^{m}\sum_{l=1}^{t} rc(r_l, e_i)\right\}, \vec{r} = (r_1, ..., r_m)$$

The second objective function maximizes the total effect of applying refactorings upon software entities, considering the weight of the software entities in the overall system, like:

[3] $$maximize\left\{ f_2(\vec{r})\right\} = maximize\left\{ \sum_{i=1}^{m}\sum_{l=1}^{t} w_i \cdot effect(r_l, e_i)\right\}, \vec{r} = (r_1, ..., r_m)$$

The goal is to identify those solutions that compromise the refactorings costs and the overall impact on transformed entities. The final fitness function for MOSgRSP is defined by aggregating the two objectives and may be written as:

[4] $$F(\vec{r}) = \alpha \cdot f_1(\vec{r}) + (1-\alpha) \cdot f_2(\vec{r}), 0 \leq \alpha \leq 1.$$

The goal is to select a subset of entities for each proposed refactoring that results in the minimum total cost and the maximum effect upon affected software entities. In order to convert the first objective function to a maximization problem in the MOERSSP, the total cost is subtracted from MAX,

The purpose is to find a subset of entities $ESet_l$ for each refactoring $r_l \in SR, l = \overline{1,t}$ such that the fitness function is maximized. The solution space may contain items where a specific refactoring applying $r_l, l = \overline{1,t}$ is not relevant, since objective functions have to be optimized. This means there are subsets $ESet_l = \Phi, \bigcup_{l=1}^{t} ESet_l = SE$.

1.2 MORSqSP

The MORSqSP is a two folded problem, as:

- it finds a refactoring sequence $rs = (\overline{r_1\ e_1}, \overline{r_2\ e_2}, \ldots, \overline{r_s\ e_s}), s \in \mathrm{N}$ applied to the software system SS, where $e_u, u \in SE, r_u \in SR, 1 \le u \le s, s \in \mathrm{N}$;

ii. it finds a refactoring sequence $rs_e = (r_1, r_2, \ldots, r_s), s \in \mathrm{N}$ applied to a given software entity $e, e \in SE, r_u \in SR, 1 \le u \le s, s \in N$.

The MORSqSP multi-objectiveness aspects are:
• the objectives to be optimized are:
– the overall refactoring cost is minimized;
– the overall refactoring impact on software entities is maximized;
• the software entity dependencies constraints are satisfied;
• the refactoring dependencies constraints are satisfied.

New specific terms of the MORPBP are defined, as: refactoring-entity pair, refactoring sequence, refactoring-entity pair junction point, refactoring plan.

1.3 MORPBP

Refactorings may be organized and prioritized based on goals established by the project management leadership. The MORPBP definition is based on MORSSP (Chisăliță-Crețu, 2009a) and MORSqSP (Chisăliță-Crețu, 2009b).

The MORPBP is the multi-objective MORPBP of finding a refactoring plan $rp = (\overline{r_1\ e_1}, \overline{r_2\ e_2}, \ldots, \overline{r_{s_{rp}}\ e_{s_{rp}}}), s_{rp} \in \mathrm{N}$ from a refactoring sequence set SSR_{rp}, such that:

• the following objectives are to be met:
- the overlall refactoring cost is to be minimized (rc);
- the overlall refactoring impact on software entities is to be maximized (res);
• refactoring dependencies constraints defined by the rd mapping are satisfied.

For the MORPBP the multi-objective function has two objectives to be optimized, as: cost minimization and refactoring impact maximization upon the software entities, being described by:

[5] $$maximize\{F(\vec{rp})\} = maximize\{f_1(\vec{rp}), f_2(\vec{rp})\},$$

where $rp = (\overline{r_1\ e_1}, \overline{r_2\ e_2}, \ldots, \overline{r_{s_{rp}}\ e_{s_{rp}}}), s_{rp} \in \mathrm{N}$ has to be maximized, which is similarly described as in (Chisăliță-Crețu and Vescan, 2009).

The problem decision space is $DS = SSR$ while the decision vector is $rp = (\overline{r_1\ e_1}, \overline{r_2\ e_2}, \ldots, \overline{r_{s_{rp}}\ e_{s_{rp}}}), s_{rp} \in \mathrm{N}$ contains the refactoring sequence obtained by cross-navigating the set of proposed refactoring sequences $SSR_{rp}, SSR_{rp} \subseteq SSR$. The solution may reveal in special cases an empty refactoring plan ($rp = (), s_{rp} = 0$), as the search in the decision space may not satisfy the requested constraints.

1.4 MOSRSSP

Let $REPSet = (\overline{r_1\ e_1}, \overline{r_2\ e_2}, \ldots, \overline{r_p\ e_p}), p \in N$ be the set of all refactoring-entity pairs build over SR and SE, where $ra(r_s, e_s) = T, 1 \le s \le p$. Let $DS = REPSet$ be the decision domain for the MOSRSSP and $\vec{x} = (\overline{r_1\ e_1}, \overline{r_2\ e_2}, \ldots, \overline{r_s\ e_s})$, where $e_u \in SE$, $r_u \in SR$, $1 \le u \le s$, $s \in N$, $\vec{x} \subseteq DS$ a decision variable.

The MOSRSSP (Chisăliță-Crețu, 2014) is the problem of finding a decision vector $\vec{x} = (\overline{r_1\ e_1}, \overline{r_2\ e_2}, \ldots, \overline{r_s\ e_s})$, such that:

• the following objectives are optimized:
– the overall refactoring cost is minimized (rc);
– the overall refactoring impact on software entities is maximized (res).
• the following constraints are satisfied:
– software entity dependencies (ed);
– refactoring dependencies (rd).
• the addressed strategy-based criteria are met:
– $RMandatory = \{r_1, ..., r_{rm}\}$ is the set of mandatory refactorings, where $r_1, ..., r_{rm} \in SR$, $0 \le rm \le t$;
– $ROptional = \{r_1, ..., r_{ro}\}$ is the set of optional refactorings, where $r_1, ..., r_{ro} \in SR$, $0 \le ro \le t$;
– $RSelect = \{r_1, ..., r_{rs}\}$ is the set of single selected refactorings, where $r_1, ..., r_{rs} \in SR$, $0 \le rs \le t$;
– $1 \le rm + ro + rs \le t$, $RMandatory \cap ROptional \cap RSelect = \phi$;
– conditions on the number of applied refactorings on attribute, method, and class levels are met.

Further Work

For the various refactoring selection problems formalized within this book, there is a number of directions where the research may follow. Few of them refer the formal aspects of the addressed problems, while other turn up in the practical area only. An important aspect of the refactoring plan building problem is to follow the approach with the parallel refactoring sequence composition. In order to achieve this, new notations such as multi-junction points that provide multi-connection points between different refactoring sequences, resulting in parallel refactoring selection have to be defined. A thoroughly study on the junction points may be advanced further, as they may represent refactoring sequences intersection points.

Other aspects related to the refactoring sequences cover the various relations that exist among refactoring sequences and the possibility to navigate them in the reverse building order. The latter feature may be considered for refactoring sequences that have a two way junction points embedded. Moreover, refactoring sequences composition may involve the integration of a refactoring sequence within an already existing refactoring plan or just configuring a new refactoring plan starting from a well-defined refactoring sequence set.

Based on the different criteria used in refactoring plan building process by the management leadership, different refactoring strategies may be shaped. Therefore, refactoring plan building principles may be enounced and described. Research on the strategic refactoring plans configuration may address the possibility to setup a model that may highlight different scenarios, relations, and building methods for different refactoring stories.

Further work on multi-objective problem formulation may be achieved with several goals, as: defining the cost as a constraint, instead of an objective, or problem formulations with more than two objectives to optimize. Context adapted objectives identification for real-world problems represent another aspect that needs to be studied in the future.

Conclusions

In order to improve the internal structure of object-oriented software, refactoring may be used in complex software management development processes to achieve several enforced targets. Multiple refactoring aspects of different parts of a heavy working system need increased attention when planning the refactoring order. Refactorings may be organized and prioritized based on goals established by the project management leadership.

Current paper is an overview of the refactoring selection problem. Refactoring may be integrated within different types of problems having the same goal, i.e., improving the internal structure of software systems, from simple problems requesting a single refactoring to complex problems, which work with various refactoring sequences. Therefore, refactoring may be used in complex software management development processes to achieve several enforced targets.

The *General Refactoring Selection Problem* with the corresponding multi-objective formal definition for several specialized multi-objective refactoring selection problem, with two specific conflicting objectives are fully overviewed.

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Multi-Criteria Strategy-based Refactoring Selection

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Abstract

Refactoring has proved to be a feasible technique that improves the internal structure of object-oriented software without changing the initial behavior. Scheduling a refactoring process for a complex software system is a difficult task to do. Refactorings may be organized and prioritized based on goals established by the project management leadership, that shapes a refactoring strategy.

The paper presents the results of a multi-objective approach to the Strategy-based Refactoring Set Selection Problem (SRSSP) where the refactoring cost and impact are treated as objectives of a weighted-sum fitness function. The results of the proposed weighted objective genetic algorithm on an experimental didactic case study are presented and discussed.

Keywords: Refactoring, Multi-objective optimization, Genetic algorithms, Software engineering

Introduction

Software systems continually change as they evolve to reflect new requirements, but their internal structure tends to decay. Refactoring is a commonly accepted technique to improve the structure of object-oriented software. Its aim is to reverse the decaying process of software quality by applying a series of small and behaviour-preserving transformations, each improving a certain aspect of the system (Fowler, 1999).

Refactorings may be organized and prioritized based on goals established by the project management leadership. The SRSSP definition is based on the Refactoring Set Selection Problem (RSSP) (Chisăliță-Crețu, 2009a; Chisăliță-Crețu, 2010). Therefore, the SRSSP is the refactoring set selection problem that combines multiple strategy criteria in order to to find the most appropriate set of refactorings.

The paper is organized as follows. Section 2 presents some close related work on refactoring selection for the SRSSP. Useful formal notations inherited from RSSP (Chisăliță-Crețu, 2009a) and the formal definition for the SRSSP are presented in Section 3. The multi-objective optimization formulation for the SRSSP is stated in Section 4. The Local Area Network (LAN) Simulation source code used to study our approach is provided in Section 5. The proposed approach and several details related to the genetic algorithm are described in Section 6. The obtained results for the studied source code are presented and discussed in Section 7. The paper ends with conclusions and future work.

Related Work

A closely related work is the *Next Release Problem* (**NRP**) studied by several authors (Zhang, Harman, and Mansouri,2007; Bagnall, Rayward-Smith, and Whittley, 2001; Greer and Ruhe, 2004), where the goal is to find the most appropriate set of requirements that equilibrate resource constraints to the customer requests, being the problem defined as a constrained optimization problem.

The appropriate refactoring selection problem is an example of a Feature Subset Selection (FSS) search problem. Other FSS problems in previous work on SBSE include the problem of determining good quality predictors in software project cost estimation, studied by Kirsopp et al (Kirsopp, Shepperd, and Hart, 2002), choosing components to include in different releases of a system, studied by Harman et al. (Harman, Swift, and Mahdavi, 2005).

Previous work on search-based refactoring problems (Harman and Tratt, 2007; O'Keefe and O'Cinneide, 2006; Zhang, Harman, and Mansouri,2007; Bowman, Briand, and Labiche, 2007) in SBSE has been concerned with single objective formulations of the problem only. Much of the other existing work on SBSE has tended to consider software engineering problems as single objective optimization problems too. But recent trends show that multi-objective approach has been tackled lately, being the natural extension of the initial work on SBSE.

Other existing SBSE work that does consider optimization formulations of software engineering problems, uses the weighted approach. Therefore, objective functions are combined into a single objective function using weighting coefficients to denote the relative importance of each individual objective. In search-based refactoring field, Seng et al. (Seng, Stammel, and Burkhart, 2006) and O'Keeffe and O'Cinneide (O'Keefe and O'Cinneide, 2006) apply a weighted multi-objective search, by using several metrics to assess the quality of refactorings within a single objective function.

More recent work on search based refactoring problems (Chisăliță-Crețu, 2009; Chisăliță-Crețu, 2009a; (Chisăliță-Crețu, 2009b) in SBSE have defined the General Refactoring Selection Problem (GRSP), used to refine the Multi-Objective Refactoring Set Selection Problem (MORSSP) (Chisăliță-Crețu, 2009a) and the Multi-Objective Refactoring Sequence Selection Problem (MORSqSP) (Chisăliță-Crețu, 2009b).

Strategy-Based Refactoring Selection Problem

The Strategy-based Refactoring Set Selection Problem (SRSSP) is mainly based on the Refactoring Set Selection Problem (RSSP) fully formalized in (Chisăliță-Crețu, 2009). SRSSP is a special case of RSSP where the refactoring selection is enhanced by certain criteria, e.g., refactoring application priority, refactoring application type: optional or mandatory.

The SRSSP formal definition requires several input data notations from the RSSP. Subsequently, additional terms and notations are introduced to completely state the SRSSP.

1.5 Input Data

Let $SE = \{e_1, ..., e_m\}$ be a set of software entities as it was defined in (Chisăliță-Crețu, 2009). The software entity set SE together with different types of dependencies among its items form a software system named SS. The set of software entity dependency types SED and the dependency mapping ed are similar to the ones described in (Chisăliță-Crețu, 2009).

A set of relevant chosen refactorings that may be applied to the software entities of SE is gathered up through $SR = \{r_1, ..., r_t\}$. The ra mapping sets the applicability for each refactoring from the chosen set of refactorings SR on the set of software entities SE as it was defined in (Chisăliță-Crețu, 2009).

The set of refactoring dependencies *SRD = {**B**efore, **A**fter, **A**lways**B**efore, **A**lways**A**fter, **N**ever, **W**henever}*, together with the mapping rd that highlights the dependencies among refactorings when applied to the same software entity are stated in (Chisăliță-Crețu, 2009).

The effort involved by each transformation is converted to cost, described by rc mapping (Chisăliță-Crețu, 2009). Changes made to each software entity $e_i, i=\overline{1,m}$, by applying the refactorring $r_l, 1 \le l \le t$, are stated by the $effect$ mapping defined in (Chisăliță-Crețu, 2009). The overall impact of applying a refactoring $r_l, 1 \le l \le t$, to each software entity $e_i, i=\overline{1,m}$, is defined as: $res : \mathrm{SR} \to \mathrm{Z}$,

$$res(r_l) = \sum_{i=1}^{m} w_i * effect(r_l, e_i) \ ,$$

where $1 \le l \le t$ and w_i is the weight of the corresponding software entity e_i from SE.

SR_e represents the *subset of refactorings that may be applied to a software entity* $e, e \in SE$ (Chisăliță-Crețu, 2010). Therefore, $SR = \bigcup_{e_i \in SE} SR_{e_i}, i=\overline{1,m}.$ SE_r represents the *subset of software entities to whom a refactoring* r *may be applied* $r \in SR$ (Chisăliță-Crețu, 2010). Therefore, $SE = \bigcup_{r_l \in SR} SE_{r_l}, l=\overline{1,t}.$

In (Chisăliță-Crețu, 2010) the refactoring-entity pair notion was introduced, as it was required for the refactoring sequence selection problem definition. Therefore, a refactoring-entity pair was defined as a tuple $\overline{r_l\ e_i} = (r_l\ e_i)$ consisting of a refactoring $r_l, 1 \le l \le t$, applied to a software entity $e_i, 1 \le i \le m$, where $ra(r_l, e_i) = T$.

Let $REPSet = (\overline{r_1\ e_1}, \overline{r_2\ e_2}, \ldots, \overline{r_p\ e_p}), p \in N$ be the set of all refactoring-entity pairs build over SR and SE, where $ra(r_s, e_s) = T, 1 \le s \le p$.

1.6 Refactoring Strategy

The refactoring strategy may be formally described by one or more functions $sf_i, i=\overline{1,NC}$, where NC is the total number of criteria integrated with the strategy. In the following, a sample strategy consisting of two criteria, i.e., mappings, is introduced.

The development team may consider relevant that in a specific context some refactoring applications to be mandatory, optional or selected from a subset. Let $RType = \{\mathbf{M}andatory, \mathbf{O}ptional, \mathbf{S}elected\}$ be the set of possible refactoring types. The mapping $rtype$ associates a type to each refactoring from SR as follows: $rtype : SR \to RType$,

$$rtype(r) = \begin{cases} \mathbf{M}, \ \textbf{if } r \textbf{ is applied } \textit{mandatory} \\ \mathbf{O}, \ \textbf{if } r \textbf{ is applied } \textit{optional} \\ \mathbf{S}, \ \textbf{if } r \in \{r_1, \ldots, r_q\}, \ 0 \le q \le t \end{cases}.$$

A second criterion considered by the development team may refer the level of the affected entity when refactoring. Let $RLevel = \{\mathbf{A}ttribute, \mathbf{M}ethod, \mathbf{C}lass\}$ be the set of refactoring levels involved in the transformation process. Therefore, the function $rlevel$ maps each refactoring to the entity level that it mainly changes, as: $rlevel : SR \to RLevel$,

$$rlevel(r) = \begin{cases} \mathbf{a}, \ \textbf{if } r \textbf{ is applied to } \textit{attributes} \\ \mathbf{m}, \ \textbf{if } r \textbf{ is applied to } \textit{methods} \\ \mathbf{c}, \ \textbf{if } r \textbf{ is applied to } \textit{classes} \end{cases}.$$

1.7 Output Data

The strategy-based refactoring set selection means to choose the appropriate refactoring subset such that the stated criteria on refactorings are met, e.g., refactoring application level and type.

Other specific conditions to be satisfied refer to the refactoring cost and the refactoring final impact on entities. Therefore, a multi-objective strategy-based refactoring set selection problem (MOSRSSP) may be defined.

Multi-objective optimization often means optimizing conflicting goals. For the MOSRSSP formulation it is possible to blend different types of objectives, i.e., some of them to be maximized and some of them to be minimized.

MOSRSSP Formulation

Multi-objective optimization often means compromising conflicting goals. For our MOSRSSP formulation there are two objectives taken into consideration in order minimize required cost for the applied refactorings and to maximize refactorings impact upon software entities. Current research treats cost as an objective instead of a constraint. Therefore, the first objective function minimizes the total cost for the applied refactorings, as:

$$minimize\left\{ f_1(\vec{r}) \right\} = minimize\left\{ \sum_{l=1}^{t}\sum_{i=1}^{m} rc(r_l, e_i) \right\},$$

where $\vec{r} = (r_1,..., r_t)$.

The second objective function maximizes the total $effect$ of applying refactorings upon software entities, considering the weight of the software entities in the overall system, like:

$$maximize\ \left\{ f_2(\vec{r}) \right\} = maximize\ \left\{ \sum_{l=1}^{t} res(r_l) \right\},$$

where $\vec{r} = (r_1,..., r_t)$.

The goal is to identify those solutions that compromise the refactorings costs and the overall impact on transformed entities. In order to convert the first objective function to a maximization problem for the MOSRSSP, the total cost is subtracted from MAX , the biggest possible total cost, as it is shown below:

$$maximize\left\{ f_1(\vec{r}) \right\} = maximize\left\{ MAX - \sum_{l=1}^{t}\sum_{i=1}^{m} rc(r_l, e_i) \right\},$$

where $\vec{r} = (r_1,..., r_t)$. The final fitness function for MOSRSSP is defined by aggregating the two objectives and may be written as:

[1] $F(\vec{r}) = \alpha \cdot f_1(\vec{r}) + (1-\alpha) \cdot f_2(\vec{r}),$

where $0 \le \alpha \le 1$.

Let $DS = REPSet$ be the decision domain for the MOSRSSP and $\vec{x} = (\overline{r_1\ e_1}, \overline{r_2\ e_2}, \ldots, \overline{r_s\ e_s}),$ where $e_u \in SE$, $r_u \in SR$, $1 \le u \le s$, $s \in N$, $\vec{x} \subseteq DS$ a decision variable.

The MOSRSSP is the problem of finding a decision vector $\vec{x} = (\overline{r_1\ e_1}, \overline{r_2\ e_2}, \ldots, \overline{r_s\ e_s}),$ such that:

- the following objectives are optimized:
  – the overall refactoring cost is minimized (rc);
  – the overall refactoring impact on software entities is maximized (res).
- the following constraints are satisfied:

– software entity dependencies (ed);
– refactoring dependencies (rd).

- the addressed strategy-based criteria are met:

– $RMandatory=\{r_1,...,r_{rm}\}$ is the set of mandatory refactorings, where $r_1,...,r_{rm} \in SR$, $0 \le rm \le t$;

– $ROptional=\{r_1,...,r_{ro}\}$is the set of optional refactorings, where $r_1,...,r_{ro} \in SR$, $0 \le ro \le t$;

– $RSelect=\{r_1,...,r_{rs}\}$ is the set of single selected refactorings, where $r_1,...,r_{rs} \in SR$, $0 \le rs \le t$;

– $1 \le rm+ro+rs \le t$,

$RMandatory \cap ROptional \cap RSelect = \phi$;

– conditions on the number of applied refactorings on attribute, method, and class levels are met.

Case Study: LAN Simulation

The algorithm proposed was applied on a simplified version of the Local Area Network (LAN) Simulation source code that was presented in (Demeyer et al., 2005). Figure 1 shows the class diagram of the studied source code. It contains 5 classes with 5 attributes and 13 methods, constructors included.

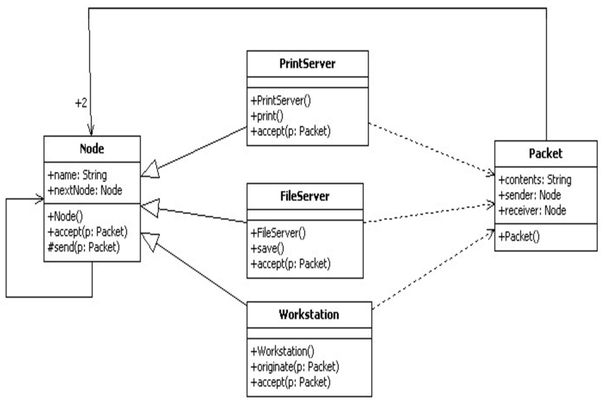

Figure 1. Class diagram for LAN Simulation

The current version of the source code lacks of hiding information for attributes since they are directly accessed by clients. The abstraction level and clarity may be increased by creating a new superclass for PrintServer and FileServer classes, and populate it by moving up methods in the class hierarchy.

Thus, for the studied problem the software entity set is defined as: $SE=\{c_1,...,c_5,a_1,...,a_5,m_1,...,m_{13}\}$. The chosen refactorings that may be applied are: *renameMethod*, *extractSuperClass*, *pullUpMethod*, *moveMethod*, *encapsulateField*, *addParameter*, denoted by the set $SR=\{r_1,...,r_6\}$in the following. The dependency relationship between refactorings is defined as: {(r_1, r_3) = B, (r_1, r_6) = AA, (r_2, r_3) = B, (r_3, r_1) = A, (r_6, r_1) = AB, (r_3, r_2) = A, (r_1, r_1) = N, (r_2, r_2) = N, (r_3, r_3) = N, (r_4, r_4) = N, (r_5, r_5) = N, (r_6, r_6) = N}.

Due to the space limitation, intermediate data for the used mappings was not included. The refactoring strategy consists of the following refactoring criteria:

• $RMandatory = \{r_2, r_5\}$, $ROptional = \{r_1, r_6\}$, $RSelect = \{r_3, r_4\}$, where if r_3 is applied to the entity $m_i, i = \overline{1,13}$, r_4 will not be selected to be applied to the same entity;

• $1 \leq | RMandatory | + | ROptional | + | RSelect | \leq 6$, $RMandatory \cap ROptional \cap RSelect = \phi$;

• refactorings of all levels have to be selected (attribute, method, and class).

An acceptable solution denotes lower costs and higher impact on transformed entities, both objectives being satisfied. The entities dependencies and refactoring dependencies need to be met as well, while the strategy selection criteria constraints have to be fulfilled.

Proposed Approach Description

The MOSRSSP is approached here by exploring a possible application strategy for the addressed refactorings. As its multi-objective formulation states it (see Section 4), two conflicting objectives are studied, i.e., minimizing the refactoring cost and maximizing the refactoring impact, together with the constraints to be kept and the selection strategy criteria to be followed.

An adapted genetic algorithm to the context of the investigated problem, with weighted sum fitness function, similar to the one in (Chisăliță-Crețu, 2009b; Chisăliță-Crețu, 2010a), is proposed here.

In a steady-state evolutionary algorithm a single individual from the population is changed at a time. The best chromosome (or a few best chromosomes) is copied to the population in the next generation. Elitism can very rapidly increase performance of genetic algorithm, because it prevents to lose the best found solution to date.

The genetic algorithm approach uses a *refactoring-based* solution representation for the strategy-based refactoring set selection problem, being denoted by *SRSSGARef*.

The decision vector $\vec{S} = (S_1, ..., S_t)$, where $S_l \in P(SE)$, $1 \leq l \leq t$, determines the entities that may be transformed using the proposed refactoring set SR. The item S_l on the l-th position of the solution vector represents a set of entities that may be refactored by applying the l-th refactoring from SR, where any $e_{l_u} \in SE_{r_l}$, $e_{l_u} \in S_l \in P(SE)$, $1 \leq u \leq q$, $1 \leq q \leq m$, $1 \leq l \leq t$. This means it is possible to apply more than once the same refactoring to different software entities, i.e., distinct gene values from the chromosome may contain the same software entity.

Practical Experiments for the SRSSGARef Algorithm

The algorithm was run 100 times and the best, worse, and average fitness values were recorded. The parameters used by the evolutionary approach were as follows: mutation probability 0.7 and crossover probability 0.7. Different numbers of generations and of individuals were used: number of generations 10, 50, 500, and 1000 and number of individuals 20, 50, 100, and 200.

A first experiment run for the LAN Simulation Problem source code proposes equal weights (i.e., $\alpha = 0.5$) the refactoring cost application and the transformation impact within the aggregated fitness function.

For the recorded experiments, the best individual obtained for the *SRSSGARef* Algorithm after 1000 generations of evolution with a 100 chromosomes population, has the fitness value of 0.457. This means in small populations (with fewer individuals) the reduced diversity among chromosomes may induce a harsher struggle compared to large populations (with many chromosomes) where the diversity breeds near quality individuals.

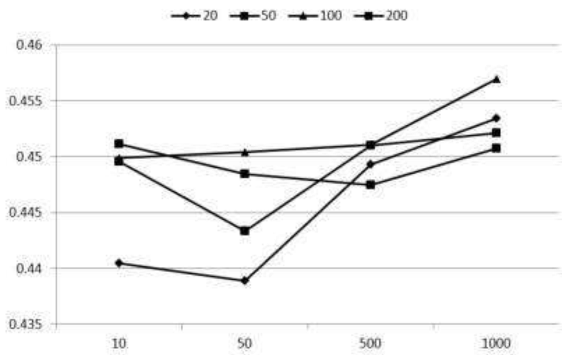

Figure 3. The fitness value for the best chromosomes within populations with 20, 50, 100, and 200 chromosomes and 10, 50, 500, and 1000 generations evolution, for the *SRSSGARef* Algorithm, with α = 0.5

As the Figure 3 shows it, after several generations, greater populations produce better individuals (as number and quality) than smaller ones, due to the large population diversity itself.

SRSSGARef Algorithm: Impact on the LAN Simulation source code. The best individual obtained when the refactoring cost and impact on software entities have the same relevance allows improving the structure of the class hierarchy. The analysis of the best chromosome partially satisfies the initial strategy (see Section 5).

The current version of the *SRSSGARef* Algorithm lessens criteria constraints of the addressed strategy. Therefore, it admits as a valid solution chromosomes where the number of applications for the mandatory refactoring *encapsulateField* is at least 1. For the single selected refactorings from the set *RSelect*, the current version of the algorithm accepts the solutions that have at least an additional application of the addressed refactoring, i.e., *pullUpMethod* and *moveMethod*.

Conclusions and Future Work

This paper addresses the strategy-based refactoring set selection problem. It advances the evolutionary-based solution approach for the MOSRSSP. An adapted genetic algorithm has been proposed in order to cope with a weighted-sum objective function for the required solution.

Two conflicting objectives have been addressed, as to minimize the refactoring cost and to maximize the refactoring impact on the affected software entities, following a refactoring application strategy. The run experiments used a balanced weighted fitness function between the cost and the impact on the entities. Further work may be done by investigating the results where refactoring impact or the refactoring cost has a greater weight on the fitness function.

A refactoring-based solution representation was used by the algorithm implementation. The first recorded experiments have lessened the constraints criteria of the refactoring strategy.

Strengthening the refactoring strategy criteria is another task that will be approached in the future. The results achieved here will be compared to the experiments results obtained from the entity-based solution representation for the same algorithm.

The study of the weighted-sum fitness function will be further investigated, by including the strategy-based criteria in the fitness function.

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The Validation and Efficiency Testing of an Intelligent Tutoring System that Uses Natural Language Processing Technologies

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Abstract

Currently, against a backdrop of the activities in all areas being interconnected with the learning activity, whereby lectures can no longer be delivered the traditional way, computer use in learning passed to a new stage, namely from the Computer-Assisted Instruction to Intelligent Tutoring Systems.

This paper presents the development of an Intelligent Tutoring System (ITS) capable to assist users who want to learn and understand the concepts and aspects related to Computer Programming and Programming Language C. The system generates tests with questions to which the users provide answers in text format, the answers being analyzed using Natural Language Processing (NLP) technologies as well as the system calculates and provides the scores to users.

The proposed system has been tested by the author in one of the Informatics labs belonging to the Department of Informatics, Information Technology, Mathematics and Physics of the Petroleum-Gas University of Ploieşti. The results obtained by the students, using the proposed system have been compared with the ones obtained by the student during the official examination. These results were interpreted with the purpose to achieve some conclusions presented in this paper, as clear as possible, conclusions referring to the application functionality and efficiency.

Keywords: Intelligent Tutoring System, Natural Language Processing, METEOR Metric, BLEU Metric

1 Introduction

The establishments activating in the field of higher education took full advantage of each and any opportunity offered by the progress of Information and Communication Technologies (ICT) and have developed and implemented a wide variety of computer-assisted learning programs and/or other means of mass-media. Of course, the Internet technologies have their role, vitally important you can tell, ever-evolving learning programs assisted by the instruments provided by the ICT development (Dobre, 2014a).

The impact these changes have had on the learning process are clear and, at least at the present time, these are more than welcome in view of the forecast published by Geoff Maslen in February 2012 on the website of *University World News, Issue No. 209*, forecast showing that by the year 2025 it is expected a doubling in the number of students at global level, to finally achieve an impressive figure of about 262 million students (http://www.universityworldnews.com/article.php?story=20120216105739999).

The continued growth in the number of students in conjunction with the development of the ICT requires new approaches to the learning process within higher education. Such an approach is the ITSs, systems which, according to researchers in the field, are nothing more than „computer systems that aim to provide immediate and customized instruction or feedback to learners, usually without intervention from a human teacher" (Psotka and Mutter, 1988 quoted in http://en.wikipedia.org/wiki/Intelligent_tutoring_system#cite_note-1). The field covered by the paper hereunder, the ITSs, is mainly aimed to obtain information and knowledge rich and diversified as possible, by providing specialized educational support, customized for each user.

This paper presents the development of an Intelligent Tutoring System capable to assist users who want to learn and understand the concepts and aspects related to Computer Programming and Programming Language C.

The proposed system has been tested by the author in one of the Informatics labs belonging to the Department of Informatics, Information Technology, Mathematics and Physics of the Petroleum-Gas University of Ploieşti. The results obtained by the students, using the proposed system have been compared with the ones obtained by the student during the official examination. These results were interpreted with the purpose to achieve some conclusions presented in this paper, as clear as possible, conclusions referring to the application functionality and efficiency.

2 An ITS that Uses NLP Technologies – General Presentation

The system developed by the author generates tests with questions to which the users provide answers in text format, the answers being analyzed using NLP technologies as well as the system calculates and provides the scores to users. For clarification purpose, by questions generation has to be understood that the system is selecting the questions which are part of the tests, randomly, from a questions data base, this data base being classify by chapters. The questions data base is created and managed by the teacher. The author of the proposed system has considered that the intervention of the human expert (the professor) in the definition of the questions and reference answers is capital because the human expert is the one who knows and understands fully the level and quality of knowledge that has to be achieved as well as the students' assessment criteria.

In addition, the system follows permanently the students' actions and progress, granting virtual awards based on the scores obtained, facilitates the communication between instructor and users and provides the option to visualize the users' evolution since the first login in of each user together with a personalized feedback (Dobre, 2014a).

The architecture of the proposed system was developed based on the typical structure for ITSs as it was proposed by Nkambou (Nkambou et al., 2010), structure consisting from four interdependent macro-environments. The first component, *the Domain Model*, contains the domain knowledge base. The second module, *the Student Model*, identifies and stores the information about student: the student's personal data, the student's evolution during the teaching-learning process, tests taken, the scores and virtual awards granted. *The Tutoring Model* generates the tests with questions for which the user has to provide answers in text format, analyzes the responses provided by students, calculates the scores for each test using BLEU and METEOR algorithms, calculates the percentages obtained for each chapter of the course, presents the student's evolution since the day of student registration in the system through a graphic presentation for each chapter separately and for overall progress, calculates the average scores for all chapters of the course and generates a personalized feedback. The last component of the system is *the Communication Model* which is the program interface itself.

3 Proposed system validation and efficiency testing

The proposed system has been tested by the author in one of the Informatics labs belonging to the Informatics, Information Technology, Mathematics and Physics Department of the Petroleum-Gas University of Ploieşti. Like this, has been tried to obtain results and collect sufficient information, on one hand to demonstrate the functionality and the efficiency of the system developed and on the other hand, to identify the opportunities for system further improvement. To validate the system and to test its efficiency, in the very first phase of this process have been performed an empirical evaluation, consisting from an experiment in which were involved some students from first year of study, specialization Informatics, Faculty of Letters and Sciences, Petroleum-Gas University of Ploieşti. A number of 27 students volunteered to test the proposed system so they get access to the instructional materials containing the concepts and aspects taught for the course named “Procedural programming”, course that was taught during the first semester of the universitary year 2013/2014 (Dobre, 2014a).

The students answered to the tests generated by the system, deemed to assess the knowledge they achieved during learning cycle, and they had the possibility to visualize the results obtained, the graph showing their progress (evolution) by chapter and overall progress as well as the average results by chapter and overall. In addition, depending on the results obtained for each chapter, the students have been “awarded” by conferring virtual medals. Also, through the application, the students have sent and received – displayed messages to administrator and from administrator testing the communication features of the system.

3.1 The comparative analysis of the results obtained using the proposed system versus the ones obtained through the traditional instruction

The results obtained by the students, using the proposed system, have been compared with the ones obtained by the student during the official examination. These results were interpreted with the purpose to achieve some conclusions, as clear as possible, conclusions referring to the application functionality and efficiency.

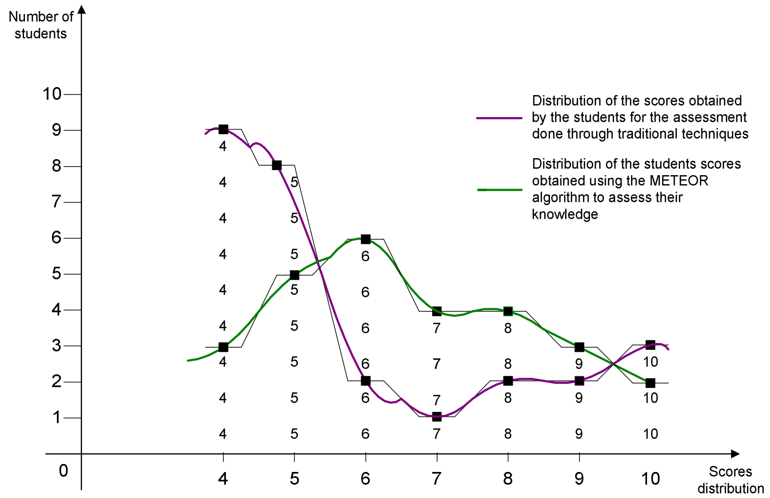

Figure 1. The comparison of the scores distribution curves for the results obtained based on the students evaluation using the application with METEOR algorithm versus the traditional evaluation

Thus, due to the advantages brought through the definition of the METEOR metrics versus the BLEU algorithm, as well as due to the results obtained and based on the conclusions coming from the comparative analysis presented in Dobre (Dobre, 2014b), has been decided to use METEOR algorithm for the application testing and validation. In the figure 1 could be observed that the line corresponding to the allocation of the results obtained through the traditional evaluation is an eccentric curve having two peaks (around scores of 4 and 10), a bimodal curve, this distribution being considered abnormal. On the other hand, in the other case, the line of the results distribution for the results obtained using the proposed application does not have the perfect shape of a bell but is closed to such shape. Considering that if the number of students volunteered for this experiment was higher, most probably, the line was more round and the distribution could be considered a “normal” one. Taking into consideration these aspects, was possible to state that in this phase of the results interpretation the application which uses the METEOR algorithm could assure a high level of objectivity and efficiency (Dobre, 2014a).

As in the case of interpretation of the results obtained using the METEOR algorithm (figure 2), also in the case of traditional evaluation has been proceeded to do the interpretation of the scores distribution using same procedure and, as could be observed in figure 3, same at left hand and right hand of the median, the scores distribution presents anomalies due to the presence in each of the mentioned zones of a peak of the curve. One of the peaks is just on top the score 4, this score being considered as failure and not a satisfactory one.

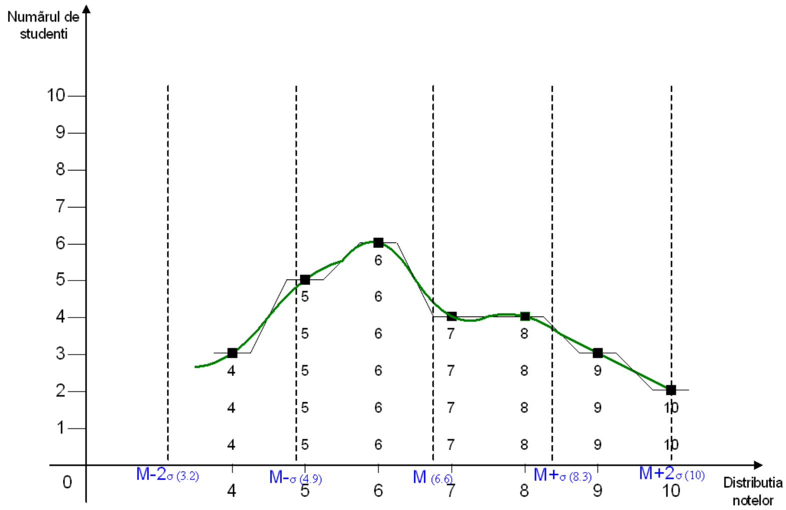

Figure 2. Scores distribution obtained based on the students assessment done with the proposed application and METEOR algorithm corroborated with standard deviation

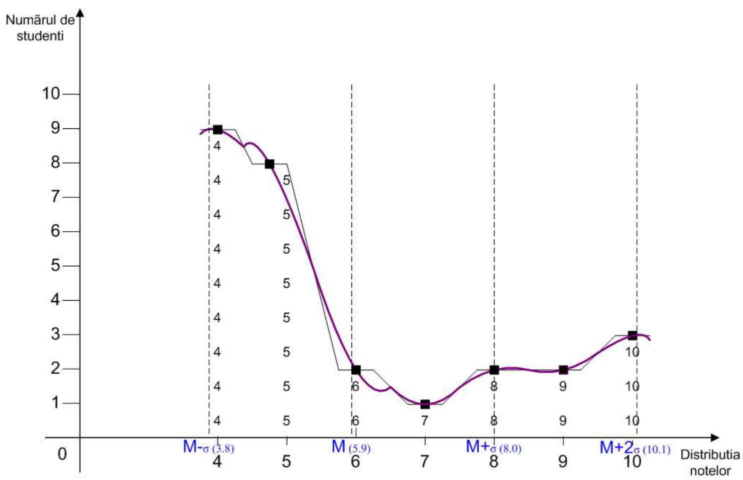

Figure 3. The distribution of the scores obtained during the traditional evaluation of the students corroborated with the calculated standard deviation

The figure 4 presents the comparison of the two histograms previously mentioned, where could be observed that the histogram built based on the results through the classic assessment presents three peaks instead one, while the histogram built for the results obtained when was used the METEOR algorithm has only one peak, centered. In the METEOR algorithm case, around the peak are allocated the scores of 7 and 8, these scores being on the left and right hand of the median. Taking into consideration that the specialized researches demonstrated that a normal distribution of the scores obtained is considered normal only when there is a single peak, centered, once again the conclusion is that the distribution of the scores obtained through the classic assessment is an abnormal one while the distribution for the scores obtained through the application using the METEOR algorithm can be considered as a normal one (Dobre, 2014a).

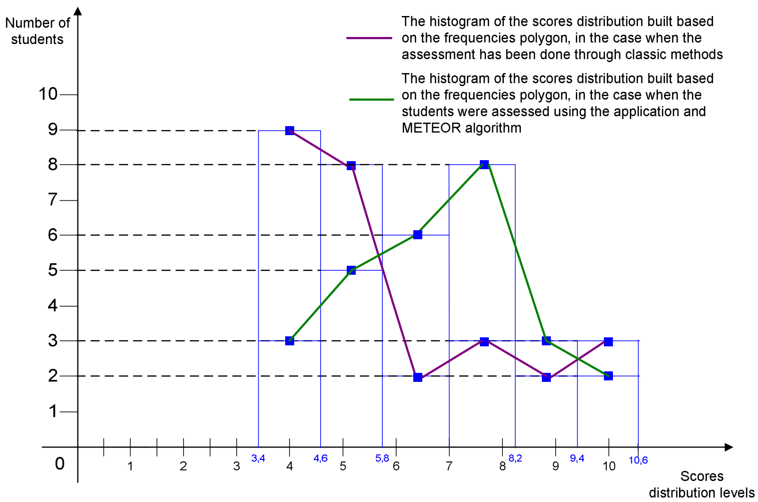

Figure 4. The comparison of the histogram distribution based on the frequencies polygon, in the cases of students' assessment through classic techniques, respectively, through the application using the METEOR algorithm

4 Conclusions

Taking into consideration the above could be concluded that the application using the METEOR algorithm has the capability to offer a high level of objectivity for the students' assessment. Therefore, the experiment results prove the positive effect of the use of Natural Language Processing technologies within the Intelligent Tutoring System developed by the author of this paper.

In order to improve the Intelligent Tutoring System developed could be taken into consideration several major directions, as follows (Dobre, 2014a):

- test the application on a more diversified testing group of users, of different ages, different levels of knowledge and from different domains of activity;
- verify the functionality and efficiency of the proposed system through the testing on more groups of students, having available for them the option to access the application from home computers, for longer periods of time, for various disciplines, and maybe even for disciplines belonging to distance learning;
- prepare a short guide which will present the application features, options and instructions necessary to use it, in order to offer the possibility to use the system proposed for distance learning as well.

In conclusion, the author of this paper considers that the development of an application offering a simple management of the instructional process from various domains of activity, efficient (capable to maximize the students learning speed) and effectual (capable to increase the students performances), having menu in Romanian language, involving low financial resources and also able to facilitate a good communication and an objective assessment is more than welcomed.

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Self Assessment in the Learning Process of the Object Oriented Programming

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Abstract

In the procedural programming can directly evaluate the immediate results so that the developer can assess the progress. In the case of object oriented programming, even the application can operate correctly, in case of extending or modification it can be seen a number of problems due to the objectually organizing application. It is difficult to make a test for mechanisms which will be used in a further step. An approach to this problem may begin from the simulation of possible problems that may occur in a future development of the application due to the objectual nature. Even though, OOP mechanisms work properly, it may not be an optimal choice from data organization point of view. An example may be that an another level of refinement of the initial data may lead to a completely different performance. The paper aims to systematize some of those problems in a manner that the self-assessment learning in this area can be improved.

Keywords: self assessment, object orientated programming

1 Introduction

Developing an Object Orientated Programming (OOP) application involves the following steps: Planning, Analysis, Design, Extract reusable classes, Prototype, Test, Customer evaluation.

Class testing is different from conventional testing in that conventional testing focuses on input-process-output, whereas class testing focuses on each method. Object Oriented programming is centered around concepts like Object, Class, Message, Interfaces, Inheritance, Polymorphism, etc.

Self assessement are made, usually, in the learning stage and it doesn't cover concrete problems which a developer will confront in the extension stages of the application. The self-evaluations are made by using tools based on OOP concepts and less on how to transpose real problems in OOP. In OOP solving a particular case of a problem can help to solve the general case.

After developing the application, self assessment assumes the testing modules performed and comparing the results obtained with the requirements of the design.

2 Classical testing for OOP applications

Software design means to create a software system which can accomplish its goals being easy to be maintained and expanded. An efficient design will perform an operation correctly without consuming more resources than needed.

The test results are reported to the requirements of the analysis stage, which were imposed at the design stage.

Object-oriented analysis (OOA) is the first technical activity that is performed as part of Object Oriented software engineering. The intent of OOA is to define all classes that are relevant to the problem to be solved, the operations and attributes associated with them, the relationships between them, and application behavior. To accomplish this, a number of tasks must occur:

1. Basic user requirements must be communicated between the customer and the software engineer.
2. Classes must be identified (e.g. attributes and methods are defined).
3. A class hierarchy must be specified.

4. Object-to-object relationships (object connections) should be represented.
5. Object behavior must be modeled.
6. Tasks 1 through 5 are reapplied iteratively until the model is complete.

Object-oriented design (OOD) transforms the analysis model created using OOA into a design model that serves as a blueprint for software construction.

Traditional testing techniques can be adopted for Object Oriented application by using the following techniques:

- *Method Testing*: Each individual method of the Object Oriented software has to be tested by the programmer.
- *Class Testing*: Class testing is performed on the smallest testable unit in the encapsulated class. New methods, inherited methods and redefined methods within the class have to be tested.
- *Integration Testing*: Integration refers to the combining together of units to form a module of a larger unit .
  - *Thread-based testing*, which integrates classes required to respond to one event.
  - *Use-based testing*, which integrates classes required by one use case.
  - *Cluster testing*, A cluster of classes/methods are identified which work together to achieve the functionality.
  - *State Machine Testing* : A class instance can have state machine. The state of the class change when an event occur.
- *System Testing*:
  - *Recovery testing*: how well and quickly does the system recover from faults;
  - *Security testing*: verify protection from unauthorized access;
  - *Stress testing*: place abnormal load on the system;
  - *Performance testing*: investigate the run-time performance at unit level.
- *Regression Testing*: Regression testing check whether previous functionality still works after new functionality is added.

3 Extending the application

Due to the self assessment of the developed software application, before the start of a new extension stage of the software application we'll should answer to some questions as:

- How much the new extension would use the existing modules?
- How actual modules will be able to endure further changes?

Achieving *self assessment* can begin from the analysis stage. In this respect, Table 1 illustrates several criteria that can be pursued at this stage.

Table 1. Self assessment at OOA stage

OOA Component	**Detail of OOA Component**	**Self Assessment Issue**
Static view of semantic classes	These classes persist throughout the life of the application and are derived based on the semantics of the customer requirements	Customer demand can be refined so that it appears another level classes?
Static view of attributes	The attributes associated with the class provide a description of the class, as well as a first indication of the operations that are relevant to the class	The methods are quite specialized, so that a larger part can be reused?
Static view of relationships	Objects are "connected" to one another in a variety of ways. The operations that affect these connections can be identified.	Were reduced as far as possible the functions of type friend?

OOA Component	Detail of OOA Component	Self Assessment Issue
Static view of behaviors	Define a set of behaviors that accommodate the usage scenario (use-cases) of the system.	Behaviors derived from customer requirements are fully described by the methods of the classes?
Dynamic view of communication	Objects must communicate with one another and do so based on a series of events that cause transition from one state of a system to another	Must be analyzed the order for a state transition system to another and identified critical routes (initial and final states are identical but routes to reach them are arbitrary)
Dynamic view of control and time	The nature and timing of events that cause transitions among states must be described.	Check list of events. Check synchronization events .

Extending the application depends largely on the design of data abstraction.

We can have the following types of data abstraction: abstraction of appearance, abstraction of structure, abstraction of functionality, abstraction of privilege, abstraction of purpose.

4 Case Study

As an example consider a data acquisition module of a process. From the customer's specifications were synthesized the following:

- Data acquisition includes several locations (Location code).
- In a location have more points of measurement (MP code);
- For a measuring point, we take several parameters (Parameter code);
- Entries parameters are both analogue (AI) and digital(DI);
- Read data are transferred to a DBMS.

It requires the achievement of a software module for data acquisition (DAQ). Data flow diagram is shown in Figure 1.

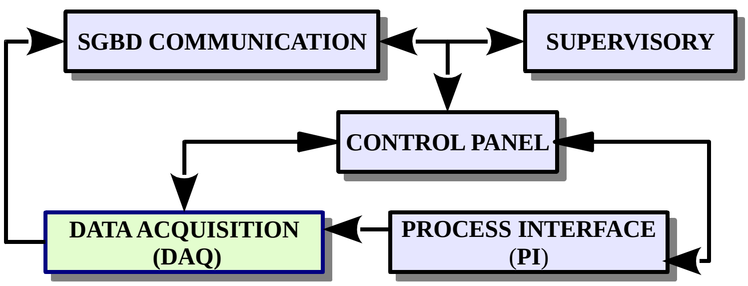

Figure 1. Data flow diagram

In the abstraction stage, we can have several approaches:

a) *Approach based on the area of measurement*. In this case we have a class hierarchy like: Location -> Point Measurement -> Parameter.

b) *Approach based on acquisition process*. It is possible hierarchy of classes: Acquisition Network -> Module acquisition -> Acquisition Flow

c) *Approach based on data stream*. In this case there will be the hierarchy: (Data sources; Process flow) -> Parameter flow. This option is only possible for languages that allow multiple inheritance (e.g. C ++, Python, Objective-C, Tcl, Eiffel etc.).

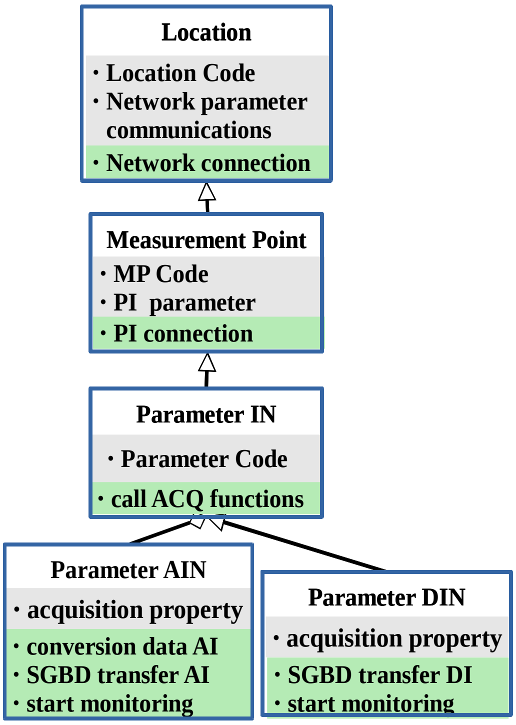

Figure 2. Approach based on the area

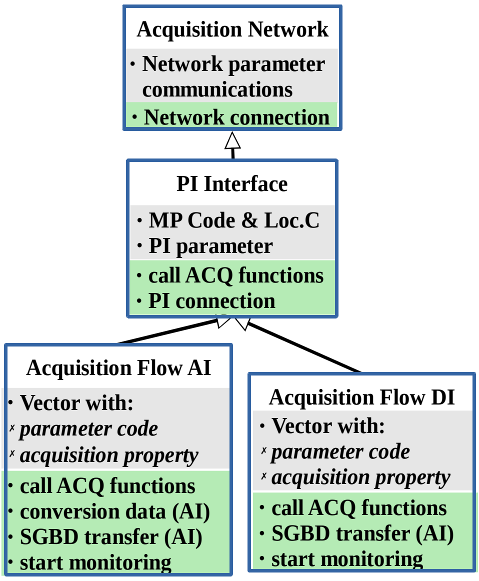

Figure 3. Based on acquisition process

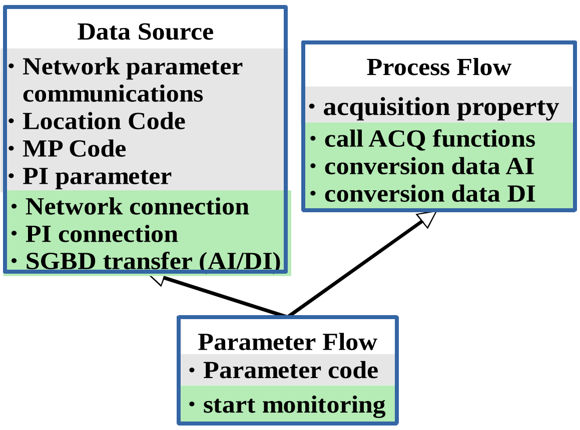

Figure 4. Approach based on data stream

At the time of extension, every type of data abstraction will affect the way are created the new classes. This is illustrated in Table 2.

Table 2. Example of problems arising from expansion

Requirement for expansion	Solving mode		
	case a)	**case b)**	**case c)**
Extending the measurement points with points as part of a hierarchy of more detailed location	Recreate class “Measurement Point” and adding a new class	only derivation existing classes	Only derivation existing classes
Adding acquisition procedures	Only derivation existing classes	Recreate class “PI Interface” and adding a new class	Only derivation existing classes
Saving on multiple servers	Only derivation	Only derivation	Renew class „Data Sources”

5 Conclusion

Self assessment must begin by testing, relative to the stages of analysis and design. Data abstraction can radically influence the development application; the relationship between objects is influenced by this step. Practically to start a self assessment is necessary to apply at least some tests similar to those described in the paper.

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The Training of Software Developers on Maintenance Activities for Database Applications

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Abstract

During the exploitation of database software applications may occur problems with origins in the development stage and problems due to the evolution of resources that are interacting with the application (software, hardware and human resources). The initial construction of the application is made with a predetermined resources system, but during the exploitation some of the resources are changing (the OS, the DBMS, the communication with other software resources etc). The intervention on a running database application makes some problems which do not appear in the development stage. The occurred risks in the intervention moment on a running database application are higher than the ones from the first use of the application and it needs more attention in this stage of the maintenance training of software developers. There are also cases where the database system architecture has undergone multiple changes or its architecture is no longer known. In this case it is necessary to identify the existing architecture in order to transform the architecture according to the new requirements appeared in the maintenance stage. This paper aims to summarize some of these problems that are occurring in the maintenance stage of the relational database applications and it proposes some guidelines to resolve them during the training process for software developers..

Keywords: database application, maintenance, training.

1 Introduction

The maintenance of the data base applications sometimes may be more complex then the development of the application itself and it's less described in the specialized literature. Therefore it's insufficient presented during the data base's domain learning.

This activity ensures the good exploitation of the software. In this period may occur:

2 Errors on client's side;
3 Errors on server's side;
4 Errors regarding database resources access;
5 Requests regarding the ergonomy of the application;
6 Requests regarding modifications on client's side;
7 Requests regarding modifications on server's side;
8 Requests to improve the working speed.

The maintenance stage is the last stage of the software's application (requirement analysis, design, implementation, testing, maintenance/evolutions). Activity maintenance database applications, with bases are different from the data in dependence on the data stored up to now. Modification of the application also involves designing the conversion of data between the two versions of applications. If the application design documentation is no longer available is necessary to apply *reverse engineering*.

2 Treating of the access errors during the maintenance

Usually it may occur in following situations:

- When new client hosts and users appear during the extending process of the software application;
- When the networks accessed by the application are redesigned;
- After the application is modified or extended.

In figure 1 is presented in a simplified way how these errors may be treated.

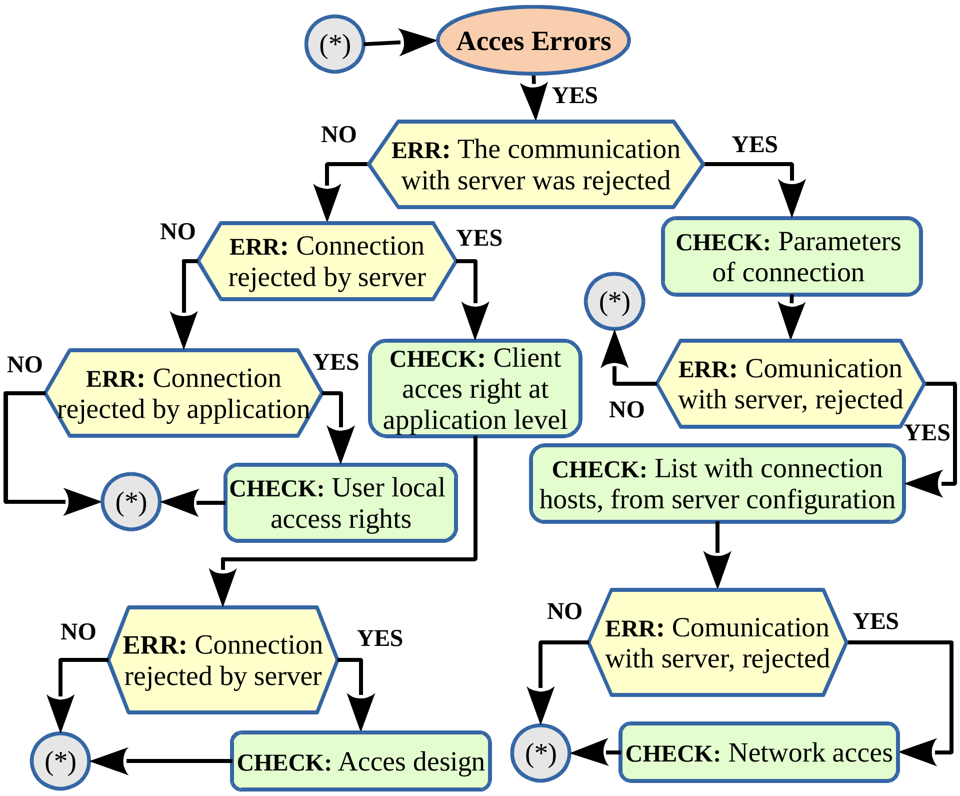

Figure 1. Access error treatment

A large part of the software applications manage the users passwords at application level. The application has access based on its own password and based on access rights makes users with access rights (rights given in the users table) and passwords generated by the application, then it transfers the execution to those users.

When the user claims the impossibility to access data it must be verified, first of all, if there is communication with the data server. In case there is no communication then must be checked the connecting parameters (IP, port, database name, user, password etc). If still is no connection with the server will be checked if the client is registered in the access list on the database server. This is usually mentioned by a specific message of the server. The most usually reason is the change of the client's IP. If the problem still persists will be checked the access restrictions in the network for the client because a usual cause is given by the security restrictions as firewall.

If the connection is established and the servers still reports a user-name and/or password access error then it will be checked the access of the user-name that launches the application. This message may be interpreted by the application too. Next error message regarding access may occur at application access table level. Here the access rights are given by software's administrator. The access limitation messages may appear also based on modifications or extensions of the database's objects made without giving access rights over them too.

3 Tracking the errors

In a database application the errors may be as well on server level as on client level (user interface). In figure 2 is proposed an evaluation sequence of these errors.

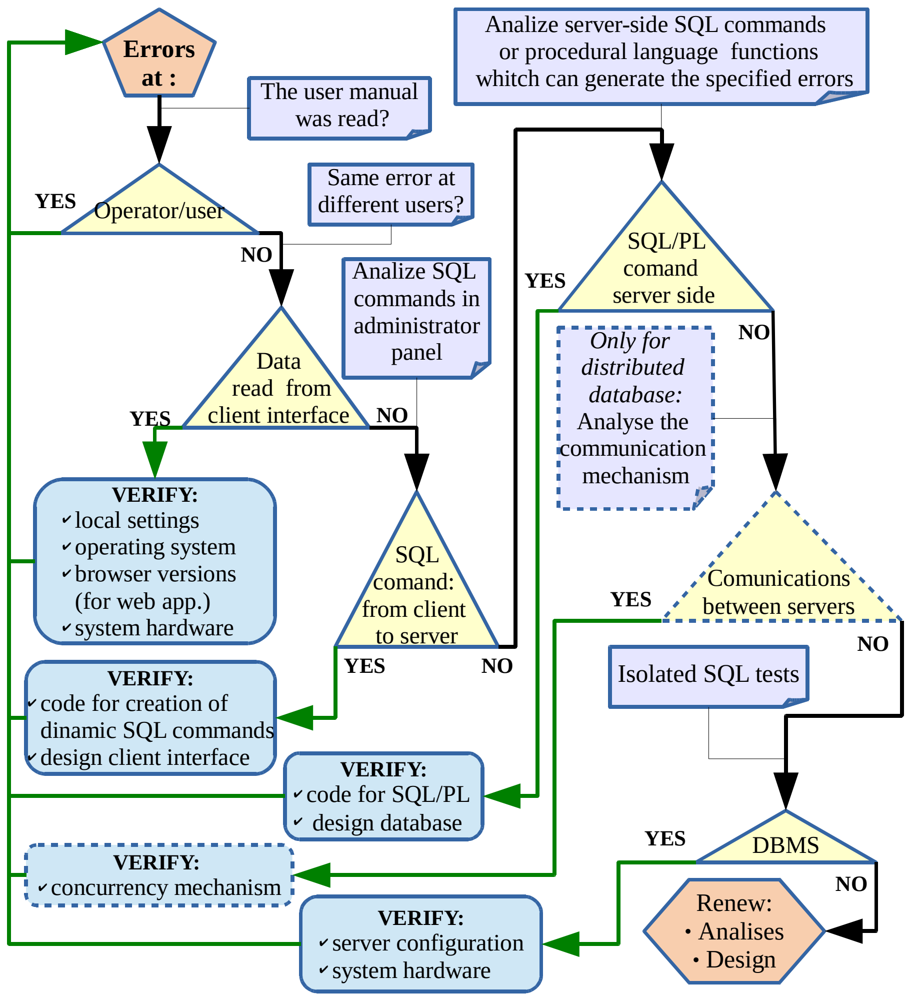

Figure 2. General error treatment

When is reported such an error first question would be if the application's operations where made according with the user-guide (the user interface must be tolerant at stress test – where the application is forced by the user with improper operations). If the error appears only on a specific client it means that the error occurs because of the local settings, browser's version (in WEB interface case), operating system or some hardware limitations at client's level. In case the error occurred to all users will be checked the way the SQL commands are formed at client's level. Usually the SQL commends are created dynamically based on controls conditions from the user interface window panel. This can be checked by monitoring the activity of the database server. An error at this levels requests a new design at client's level. If the error does not appear at client level will be searched again at database server level.

At server's side is analyzed the execution of the SQL block commands and of the procedural language function type. For distributed databases is analyzed also the communication mechanism as well as the synchronization between them.

If the error isn't identified some incorrect settings in the Data Base Management System or hardware errors at the server level may occur. Also, if on the other server the error is maintained, then, the design stage of the application must be repeated.

For an easier tracking of possible errors I recommend that the notifications sent by the server to the client to be taken over the application's system messages. A detailed error message can reduce the response time in order to correct it.

There are errors that can alter the data in the database and then the system will should be stopped, but there are also errors that can be corrected later.

4 Analysis of the causes which lead to reduced application response speed

Reducing the application speed performance can be analyzed starting with the client side. If the speed drops to all clients a problem may not be at the client level. It can be checked the SQL commands execution speed within DBMS administration panel. The administration panel will separately launch on both client and server hosts. If there are significant differences between speed of SQL commands execution, it means that there are problems related to server-client data transfer (usually the amount of data from the client to the server is much lower than from server to client).

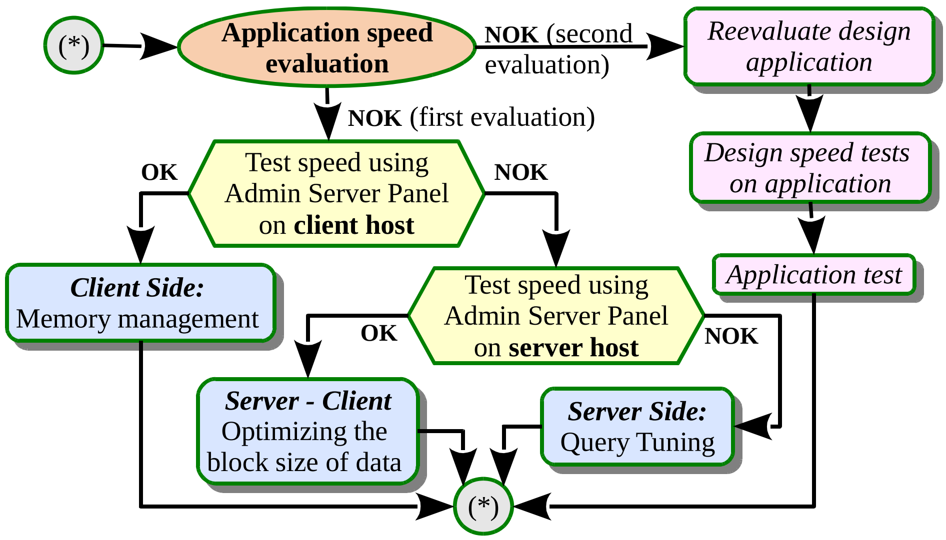

Figure 3. Speed error checking trace

5 Accomplish Ergonomic Requirement

Graphics User Interface ergonomics requirements may evolve during use of application.

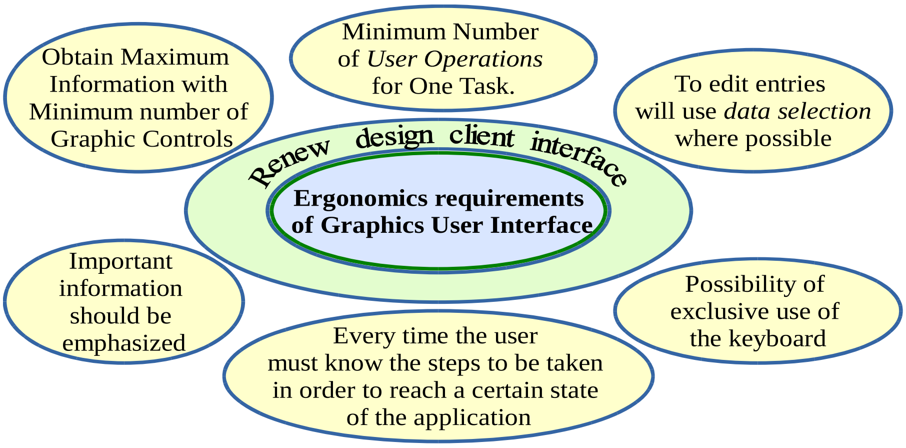

Figure 4. Accomplish ergonomic requirements

User's requirements converge in certain aspects:

- Windows application must have a minimal number of graphical controls that are providing as much information as possible;
- To perform a task the operator must perform a minimal number of operations as possible;
- Where it's possible the data will be taken from graphical controls that displayed as lists;
- The editing operations can be performed using only the keyboard (for example, positioning in the edit box is more efficient to use the *Tab* key versus mouse positioning);
- To reach a certain application status, the user should know exactly the steps to be followed to reach that state;
- The important information displayed in the window should be distinguished.

6 Reverse engineering

Sometimes it is necessary to ensure the maintenance of the database applications for which there are no data on their design. In this case it is necessary to apply some techniques to obtain the design data corresponding to the existing application.

The first step is to identify, on the server, the database structure. Thereby are identified the tables, fields, sequences, primary keys, foreign keys, views etc. It is possible that the meaning of the fields can't be deducted entirely from the start. The next step is given by identifying the SQL blocks and procedural language type functions on the server side.

On the client side, the identification of the database structure and knowledge of the significance of graphical controls can lead to set control and *data source* connections, there where *data source* is an intermediate level of data used by the control.

An other important step is to identifying events that are associated with each graphic control and events used to create and transfer SQL blocks.

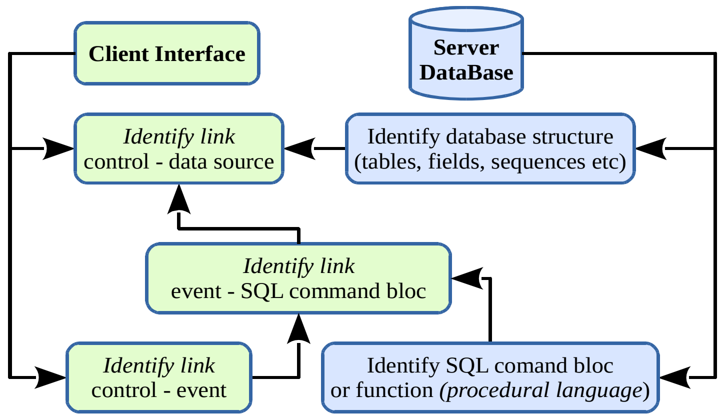

Figure 5. Reverse engineering

Thus can be determined: external schema (user views, subsets of conceptual schema, etc.) and internal schema (logical and physical schema). The conceptual schema will be approximate.

7 Application modification

Any activity evolves over time. Once the evolution of activity is also necessary to adapt the software. The stages of the change are detailed in figure 6. The modifications can be:

- Changes in the Graphical User Interface (client side);
- Changes in the structure of the database or data stream on the server.

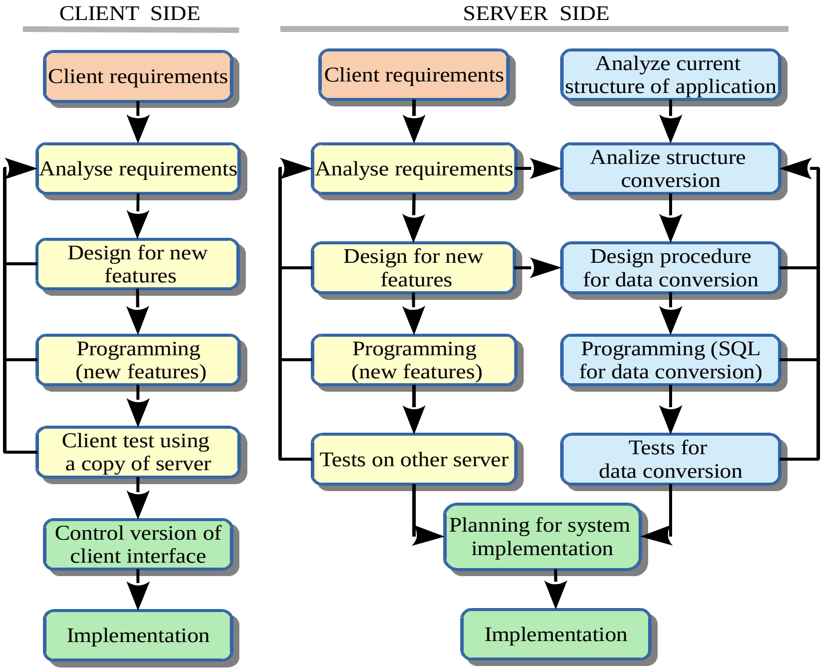

Figure 5. Modification stages

8 Conclusions

These diagrams can be useful in the training process on maintenance activity. Depending on the field of application database, these diagrams can assist in the formation of decision trees. In the maintenance stage, as well as the design stage, have different treatment for side client and side server. On the client side we have graphical user interface and construction dynamic SQL commands and on the server side we have SQL execution block.

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Optimizing a GIS Map For an Archeological Management Web Application

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Abstract

This paper presents designing a geographic informational system (GIS) used to process, adapt and manage data and components within a spatial geographic map needed for the distribution of records data from historical plans overlapped on the terrain map. The Internet app, developed under the name RM360 (Roşia Montană 360) was designed in order to create an electronic inventory of the areas of cultural, archeological, architectural and historical heritage near Roşia Montană and to offer a complex management platform for this kind of site. In order to create the project there were used JavaScript, HTML5, CSS3, jQuery 1.10.2, jQuery 1.10.4, Google Maps API (Application Programming Interface). For the server-side the XAMPP platform was used. The result of the GIS map optimization can be adapted to every type of natural or historical site.

Keywords: Archeological site, Geo-spatial map, Management platform, Web app

1 Introduction

The first part of the project treats the concept of informational geographic system, the web app architecture, and each module. The advantages and disadvantages of the app are shown. The second part details the app, presenting the results and highlighting the personal contribution.

2 The RM360 application

RM360 is a GIS application to inventory and manage cultural monuments from the Roşia Montană area. It developed from the initiative to create a geo-spatial database to monitor the heritage starting from records for construction, for the archaeological, architectural areas, historical mining locations and showing them into a spatial geographic system (see Figure 1). The need for such a system has grown in the last years, with the raised awareness of the patrimony.

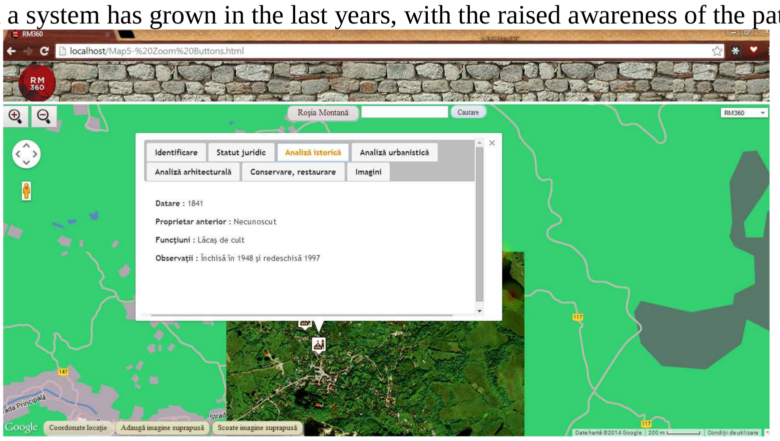

Figure 1. The RM360 application interface

The inventory and the maps in non-computerized format are hard to maintain and manage, and the already existent systems are very expensive and not very well suited. That is why it was opted for an open-source app (free access to the source code), which can be easily used. Starting from these records, the external loading jSON files were created to be displayed in the app. The constructions are seen as markings with specific icons. Each marking has an info window with details.

3 Application presentation

3.1 Creating the HTML page

In order to create the app you need a web page that includes the scripts needed to load the map. This web page contains a HTML file and an external style CSS sheet.

3.2 Loading the Google Maps API

The API is a Javascript file hosted on the Google servers. To be able to load the Google Maps API you need an access key that you could use to monitor the traffic and, in case of exceeding the limit (maximum 25000 daily loads), Google will be able to contact the app developer. To obtain an API key you need to follow these steps:

1. Access https://code.google.com/apis/console with a Google account;
2. Access *Services* category from the left hand side;
3. Activate *Google Maps JavaScript API v3* service;
4. Access *API Access* category from the left menu (the API key is in the *Simple API Access* panel and loading the API is made through a tag-script).

3.3 Localization

Google Maps API uses the browser language settings. Most of the times, it is preferred to use the default browser language. Once the Google Maps API is loaded, through the URL you can add additional libraries by adding the libraries parameter to the URL. Libraries are code modules that provide additional functionalities to the main API but they are only loaded through a specific request.

3.4 Initializing and loading the map

After creating and loading the Google Maps API, the map needs to be inserted into the page. For this we need an initialization. The Javascript class that represents the map is called Map. The objects from this class define one map within a page. To create multiple maps you need to create multiple instances of this class.

To initialize the map you need to create a Map options type object that contains the map option. This creates a LatLng type object representing a geographical point. The latitude is specified in degrees within the [–90, 90] degrees interval, and the longitude in the interval [–180, 180]. The noWrap optional parameter allows, if set to true, to use values outside these intervals [1]. The initial zoom level specifies the initial map display resolution. Level 0 zoom displays the whole map. Maximum level is 21. For this app, we chose a minimum level of 2, and the maximum 20. The Google Maps images contain overlays. At a lower zoom, level the map area is seen with a small set of layers. When the zoom increases, the layers will also get to higher resolutions.

3.5 Controllers

The maps offered by the Google API contain graphical elements called controllers that allow the user to interact with the map. Some controllers are configurable, allowing some change in the properties. These can be changed by altering the option fields from the MapOptions object [2]. Most controllers have the positioning property that indicates where they can be placed within the map. In the app, we implemented the zoom in and zoom out buttons. Placing the controller in the map at a certain point it is done by adding it to the position vector.

Another controller is the map redirect. This one will center the map in the point with the coordinates 46.3° N, 23.1° E, representing Roşia Montană.

Another one displays the spatial coordinates of a map location. You just need to press in the desired place on the map, and then click *Location Coordinates*.

To add or remove an overlay we have two controllers: *AddRM*() function, which sets the current map for overlay, and *DeleteRM*(), which sets an empty map. In the same manner, we implemented the buttons to add and remove the visualization layer of the map marking distribution.

To search elements from the map we have a search controller, which retrieves the keyboard value from the input box and compares it with values from a string (see Figure 2). Data is inserted into a jSON file. If the two values are equal then when you press the *Search* button, the map will be centered in the point with those coordinates. For element search, we used the auto-complete jQuery function. It displays a map just below the input box with elements from the source vector that correspond to the search, by comparing the inserted string with strings from the source vector.

Figure 2. The search map element

When pressing the *Search* button, the map will center in the searched element coordinates, and the zoom level will change to 10.

Controllers have been added so that:

- The *Zoom in and* Zoom out buttons are in the left top corner;
- The *Redirect* button is located in the top center;
- The *Add* text box and the *Search* button are in the center;
- The *Map type* menu is in the right top corner;
- The *Pan* button in the left top corner;
- The *Street View* button is in the left top corner;
- The *Location Coordinates* button is in the left bottom corner;
- The *Add/Delete overlapped map* button is in the left bottom corner;
- The *Overview* button is in bottom right corner;
- The *Add/Delete markers distribution* button is in the bottom left corner.

3.6 Creating a new type of GIS map

Google Maps API allows to personalize the appearance of standard map by modifying visual aspect of some elements like: parks, roads or areas with buildings. There are two ways to realize this: by modifying the *.styles* property of the *MapOptions* object, thus the base map style will be modified, or by creating a new *StyledMapType* [3].

3.6 The two concepts used to modify the map style are:

- map features: geographic elements found on map;
- stylers: map features properties that can be modified.

Map features and stylers are combined in a vector, which is included in *MapOptions* object or in StyleMapType constructor. A map consists of a set of features, specified through MapTypeStyleFeatureType objects. Feature types form a category tree, having all as root, which selects all elements from map [3]. Some features have sub-categories, which are specified using this notation: administrative category contains this sub-categories: administrative.country, administrative.land_parcel, administrative.locality, administrative.province [3]. If the parent feature is specified (administrative), then all the modifications applied to this category will be applied to all sub-categories of this category [3]. Every feature of the map contains different elements. For example, a road may contain geometric elements such as graphic line, but also it can contain a label, which specifies road's name. Google Maps offers a vary number of such elements [3].

Stylers are applied in the same order they were added in the stylers vector. Because of that, is not recommended to combine multiple operation in a single styler operation. Styled maps uses HSL model (Hue, Saturation, Lightness), to denote the colors in styler operations. Hue indicates the base color, saturation indicates the intensity of the color and lightness indicates the amount of white or black in a color [3].

The new styled map type, to which personalized features were added, does not affect the appearance of base map.

The personalized map was build by:

- creating a vector to modify features of map;
- creating an *StyledMapType* object, which has styled vector as parameters and new map's options;
- creating a vector with map types available in this application, and in Option object is indicated this vector.

3.7 Markers

A marker of a location indicates the place where a point will be added on map. This markers are from Marker object class. Google Maps API offers the possibility to use a standard marker, or to customize it.

Markers are interactive. Usually, they receive 'click' events, and that way you can add methods to display a info window in the same moment that marker is clicked [4]. For adding a new marker is used *Marker* constructor, which contains only one *Marker options* object, specifying the initial options of the marker. In the simplest way, marker's *icon* can be an image that replaces the standard Google's *pin*. To specify such an icon, a MarkerImage object is created, and it will contain image's URL.

For this application were created two types of icons (see Figure 3).

Figure 3.a Marker for house

Figure 3.b Marker for church

3.8 Infowindow for markers

An infowindow displays content, usually text or images, in a pop-up window inside the map, at a specific location (see Figure 4). Usually, an infowindow is attached to a marker, but it also can be attached at a specific location (latitude and longitude). The event that sets the content of the infowindow and opens the window attached to a marker is placed inside a for loop that reads a jSON file. The content is displayed with a *jQuery* function that creates *tabs*. It will be created an event that starts when the infowindow content is attached to the *DOM* element. The *DOM* element is a div with the *ID infocontent* [5].

Figure 4. The infowindow attached to a marker

3.9 Adaptation of the overlay image

The purpose of this application is to visualize and document the architectural and archeological buildings near Roşia Montană. For this matter it is necessary using a satellite map with high resolution. Google Maps API does not offer a great quality map for RM360 application. On this account, it was used a higher resolution map which satisfies the requirements (see Figure 5). Because the image was in a format that Google does not support, it were applied several post processing operations with Adobe Photoshop. This operations consist , first, of changing format type: from TIF format to PNG. Another operation it was to crop from the entire image just the area of interest for the application.


Figure 5. Difference of quality between Google map (left) and satellite image (right)

To add the overlay image on top of initial Google map it needs to be created an LatLngBounds object, which will contain coordinates of the overlay's margins (see Figure 6). GroundOverlay constructor specifies the URL of the image and the LatLngBounds object [6].

Figure 6. The overlay image

3.10 Intensity distribution of markers

Visualization of the intensity distribution of markers is possible by applying an overlay named *HeatmapLayer* (see Figure 7). Once it is active, areas with higher intensity will be colored in red, and areas with lower density will be colored with green [7]. To visualize this layer the *google.maps.visualization* library must be loaded [7].

Data for this layer is updated from an external jSON file. A *HeatmapLayer* object is created with go*ogle.maps.visualization.HeatmapLayer* constructor.

Figure 7. The intensity distribution of markers

4 Loading optimization

For a more efficient loading of data in infowindows were used external jSON files (see Figure 8) [8].

Another way to reduce loading time is to find an optimal dimension for the overlay image. The satellite image was reduce from 1GB to 11,4 MB. In addition, it was used an standard image format, like PNG [9].

Figure 8. The jSON format

5 Conclusions

For the application it was used Google Maps API JavaScript because the flexibility offered. Google Maps API allows the user to visualize different zoom levels. In the same time, it allows the application to grow for other areas because of the possibility to visualize the entire globe.

This application embeds the methods and objects from Google Maps API and integrates them in a web platform designated to monitoring and documenting the archeological area from Roşia Montană. Modifications applied to standard map offered from Google derive from customize map features, like roads, lakes, areas of buildings, point of interest, etc.

Another modification was the controls. It was chanced the position of the standard controls, and new controls were created: zoom in and zoom out buttons, redirect button, display coordinates buttons, add and remove overlay image, search markers button.

An optimization was added by update the data for markers and infowindow through external jSON files. In this way, loading time was decreased.

RM360 application combines the necessity of identifying and inventorying archeological and architectural resources with analyzing and monitoring buildings classified historical monuments, and planning the investigations of them.

In the future, the application can be developed easily on a mobile platform, because the Javascript code is standardize and can be integrated with ease in Android platforms. For this application can be developed services to connect to social media, services that indicates information about the roads, traffic, etc.

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Designing an Application of QR Recognition Techniques on Android Platform

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Abstract

This paper presents the stages of conception, design and implementation of a software product for the Android platform, which recognizes and scans QR Codes, with applications in geo-spatial databases for an archeological management system. The programming language mainly used to develop the application is Java. The application presented in this paper was developed in order to be used in an archaeological site and it can be adapted to any kind of particular case. It can be installed and used on Android powered smart phones. The details displayed on the mobile device screen can be images, map locations and many others. This preview of records from a database it is used in many tourist destinations around the world. The initial purposes of the bidimensional barcodes diversified, one of them being to be able to keep some sort of record in the wished manner of a number of tourist, historical, high importance destinations. The records viewed with our application contain information related to the edifices found in an archaeological site.

Keywords: Archeological site, QR Code, Automatic recognition, Scanner, Web app

1 Introduction

We chose as a middle ground between the real and the virtual world the QR symbol rule because it has numerous benefits when used for this purpose. Its versatility, the possibility of reading the code even if it is partially deteriorated but also the easiness with which it can be read, interpreted and used in real life led to the mainstream usage of the QR Codes in many domains.

Furthermore, QR Codes are being used a lot more in tourism all around the world. There are already fully functional projects, and might we add, prolific ones, in a lot of cities and archeological sites around the globe.

Each edifice has a QR Code placed so that it is very visible; anyone can simply scan the QR Code and the mobile device will then display more info regarding that specific structure. The smart phone market has grown a lot in the last years and the development of mobile apps is at a peak level for a number of current mobile platforms. This fact, combined with the growth in the mobile Internet speed and mobile data plans led to the popularization of bidimensional symbol rules.

2 The QR Code

The QR Code (shortened form of Quick Response Code) is the trademark of a Matrix barcode (bidimensional), initially designed for the Japanese auto industry. A barcode is an optical tag, which can be interpreted automatically, that contains information about the object that it is attached to. A QR Code uses one of four standard coding types (numeric, alphanumeric, binary or kanji) to store the data in an efficient manner. Extensions can also be used [1].

The QR Code system (Figure 1) became popular outside of the auto industry due to its high legibility and high storage capacity when compared to standard UPC barcodes. Applications include product tracking, component ID, document management, marketing, etc. [2]

A QR Code is made out of black modules (rectangular dots) arranged in a rectangular grid on a white background, can be read by a device (like a camera) and processed using the Reed-Solomon codes until the image can be properly interpreted. The necessary data is then extracted from the patterns detected in the horizontal/vertical components of the image [2].

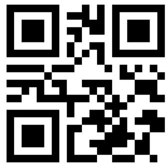

Figure 1. The QR Code

3 Application design

The software development method chosen by us corresponds to the incremental model, illustrated below, in Figure 2.

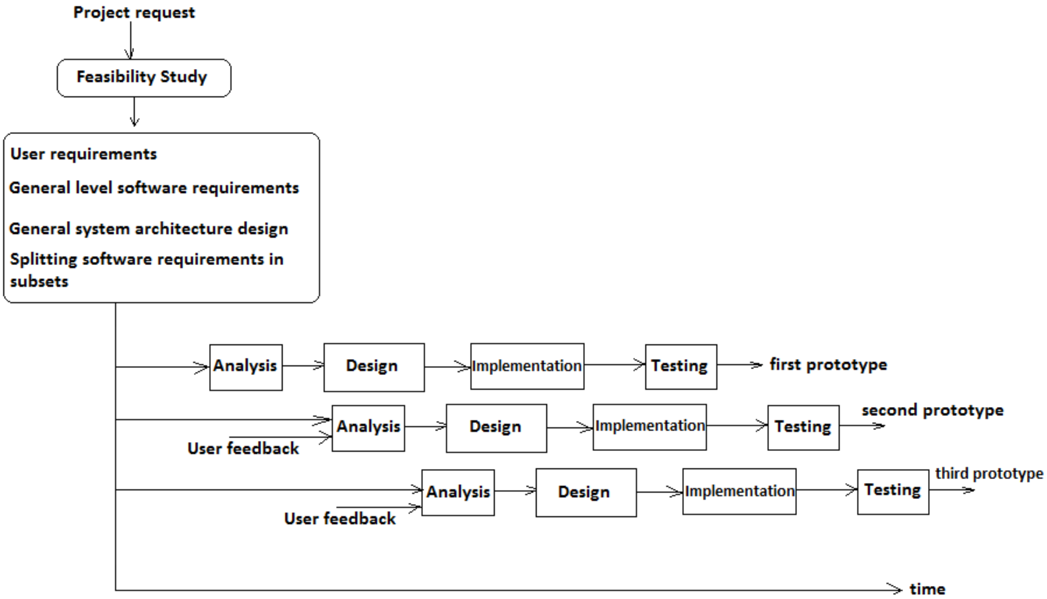

Figure 2. The incremental software development model

It is based on the very simple idea that if a system is too complex to be understood, designed or created in a single phase it is better to split the project into multiple phases, like an evolving system. If we are talking about an application, it can be revised and new features can be added or redone during the development, in phases.

In the initial phases, a started project can be extended with a more detailed one. In the next phases, the increments are typically additive. Each new iteration includes the analysis of the last version and the adding of new features, which involves redesigning, coding and testing. After going through a few iterations, we have obtained a functional application, which fully fulfills its main purpose. The stages that we followed during the application development are described in the following paragraphs:

Stage 1: After visualizing the requirements, we went on to the analysis of the methods, which we could use to create and develop the app in a coherent manner. We decided to use Android SDK (so the official version of the development kit, offered by the developers of the Android operating system). Therefore, the chosen development environment is Eclipse.

Stages 2&3: Design & implementation. In the design stage, we created the application layouts; we took the decisions regarding its functionality, like choosing the library used for reading and interpreting barcodes. Still, the most important decision that we took here was defining and clarifying the working principle of the application. We decided that the application should interpret QR Codes, and then to redirect the user to the URL indicated by the code, for a better previewing of the returned information. Thus, the application can use fewer resources; can run on a larger range of devices, without any major restrictions regarding the mobile device specifications.

QR Codes cannot store very large amounts of data without big disadvantages, one of these being the physical size of the codes. Our application limits the size of the QR Code that needs to be scanned. Furthermore, QR Codes can only store text without any formatting, so images are out discussion from the beginning. The maximum amount of data a QR Code can store is about 4KB, insufficient for our purpose. The codes used in the test application are type v2 (their size is 25×25).

To achieve the purpose of the application in an efficient way we used the following method: the application scans the QR Code (which is actually an URL in our case) and will redirect the user to a specific record into a new layout (without the need to have open a separate browser). This reasoning has many advantages [3]. The barcode library used in our application is Zbar, which is an open-source library also implemented in other operating systems like Linux, Windows. It is mainly used on the iOS platform [4].

4 Description of application functioning

The name of our application is *RMdigitour*. In Figure 3, it is shown the start screen, which shows up for 5 s after the application was launched. The app logo is visible in the top row, right before the application name. The main layout (Figure 4) has a simple design and it is easy to use. This was the main purpose, so that anyone can easily use the app. After the application shows the start screen, it will navigate to this main layout. In the top row, we have the app name and to its left we have the logo. Between the captured image and the two buttons, we have the usage instructions. The largest portion of the screen it is occupied by the images coming from the mobile device camera.

Figure 3. The start screen

Figure 4. The main app layout

After identifying a QR Code, the captured image will freeze on the last frame and the result will be displayed below, as shown in Figure 5.

If the scanning was successful, the user can press the “Open link (after scan)” button to open that URL in a new layout, which will show the desired record (Figure 6). If the identification was incorrect or it was a false positive, the user can press the “Scan again” button to reinitialize the application and to erase the previously scanned QR Code.

Figure 5. The recognized QR Code

Figure 6. The record preview

5 Optimizing the application

To be able to optimize an application, above all you need a predefined platform that the application can run on with very good performance. We tried to balance this with a very large compatibility of the application.

The app can run on any mobile device with Android Gingerbread (2.3) or newer. So theoretically, any Android mobile phone released after 2011 should be compatible with our application. In addition, the hardware requirements are very low, the application using only about 32MB of RAM whilst running, and with peaks of about 60MB. The CPU usage is not that high either reaching peaks lower than 25% load.

All the application strings were written in the dedicated file called strings.xml. This fact helps in a number of ways:

- It allows all the occurrences of those strings to change when someone changes the strings.xml file. So there is no further need to edit each string individually;
- It is very useful if the app supports multiple languages because each language can have a separate strings.xml.

Using dark colors also reduces the battery usage in case of mobile devices equipped with AMOLED screens. We optimized the PNG format images with software called OptiPNG, which reduces the file size in this format with minimal quality loss. This was also made in order to reduce the application package size.

Another optimization method is to use the ART virtual machine. Nowadays, most (over 85%) Android mobile phones run all the applications using the Dalvik virtual machine. The majority of applications are written in Java programming language and then compiled in byte code for the Java virtual machine. After that a translation into Dalvik byte code takes place and the data is stored in .dex (Dalvik EXecutable) and .odex (Optimized Dalvik EXecutable) files. Then the Dalvik virtual machine runs these proprietary format files, optimized for a lower memory usage. Dalvik it is written in such a way that a mobile device can run multiple instances at once.

The alternative is ART (Android RunTime), which was introduced along with version 4.4 of the operating system. Dalvik has a just-in-time compiler, whereas ART uses ahead-of-time processes in which the code is precompiled in machine language when the application is installed.

The disadvantages are that the software takes a bit longer to install and the occupied space is about 10 to 20% higher because of the precompiled code. Along with the newest version of Android, Android L, ART replaces Dalvik completely.

6 Conclusions

The current interface of the application is fully functional, easy to understand and to use and it serves the application purpose entirely. In the next version of the OS developed by the giants from Mountain View, Android L, Google introduces for the first time the concept of Material Design.

They inspired from the tactile reality, from the study of paper and ink, and introduced layers and shadows that take the realism of the new apps to the next level. After the newest version of Android (codenamed L for now) will be launched, the interface of our application can be redone in concordance with the new design language to improve the user experience.

The interface that we created is very intuitive and easy to comprehend. The main purpose was that this application should run on as much devices as possible (from both the software and hardware points of view). While the application is opened, it uses about 32MB of RAM, so we can say with certainty that the app can run on any mobile device, which runs the Android operating system.

Another aspect that is worth mentioning is that focusing is not mandatory while reading QR Codes, so even mobile devices with a weaker camera module can read them without any issues. This does not mean that a phone that supports auto-focus cannot use this app, it is actually recommended. However, for phones that do not have this feature scanning is still possible.

For this reason the error correction level used for the codes that redirect to that specific edifice record is M, so at most 15% of the code surface can be damaged and it can still be recognized with success.

The app compatibility with older versions of Android is another feature that does not restrict in any way the diversity of mobile devices that can scan QR Codes. The application can be installed on any mobile device with Android Gingerbread (2.3) or newer. Still, the application was designed to run optimally on Android KitKat (4.4) and a great amount of the testing process was done on phones equipped with this version of Android.

The fact that our application uses QR Codes is a positive fact, this symbol rule being in a continuous ascension in popularity right now. There are many uses for these QR Codes. This popularity of the QR Code is also due to its low price and to the fact that it can be read very easy without very high hardware or software requirements.

Still, another problem that users can encounter is the website that the QR Code redirects to. Most of those who use QR Codes to promote a product or business do not think about this and they create codes that redirect users to desktop websites, which are not mobile optimized.

In our case, the app redirects users to a mobile-friendly interface, which is very pleasing to the eye. Zoom function is enabled but its use is not mandatory. We have left this feature enabled because the app can be used to read any QR Code, some of these leading users to non-mobile websites.

Furthermore, mobile-friendly websites have another advantage: you can measure and monitor how many users are scanning a certain QR Code through the website statistics.

Similar applications, with variations of course, have been already introduced in Europe (in Amsterdam), in North America (Central Park, Manhattan), in South America (Rio de Janeiro) and in Asia (India).

The sky is the limit when it comes to the purposes of using these codes for tourism purposes. The main point is that, after scanning a QR Code, the user does not have to see a record; he can see a video presentation of the location or even an audio file. Still, in order to show as much information and to minimize the system requirements, showing a record of that edifice is one of the best solutions. It can contain information that is not that well-known or little location secret, even pictures.

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System of monitoring animals from a zoo

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Abstract

The problem of animal monitoring from a zoo is complex, given the fact that animals are not present in their natural environment and they do not dispose of their usual food. There are greater chances of contracting diseases or of inadaptability to the new conditions. In order to alert the zoo personnel in case of these types of situations we present a system of monitoring by weight sensors (low consume of food and water leads to weight loss) as well as movement sensors. The system processes data received from sensors and the personnel is alerted if received values are different from normal ones.

Keywords: Measured, Microcontroller, Sensor, Algorithm, Java

1. Introduction

Taking care of animals in a zoo is an extremely challenging task because sometimes the animals can be endangered or very rare or they can request special conditions for grows. In this matter, a special system was designed to alert the staff if any problem occurs. It uses the weight of the animal and verifies if the animal has reached the feeding zone. We will present next the main sections of the paper.

In section II we will present general information about zoological gardens and the usual animals living in it. Next, the section III will give information about the system and its components. The last section will contain several conclusion regarding the subject and future work for this system.

2. General information about ZOOS

The number of zoological gardens in Romania today reaches 41 and they are administered by local authorities [1]. In Romania, the law that establishes rights for animals in zoos and these types of institutions is the Law no. 19/16.04.2002, called formally “The Law for zoological gardens and public aquariums” [7]. Zoos are places where animals from around the world are brought (a type of park) and they can be seen by people in the city. The diversity of the animals requires a great deal of attention and responsibility from the staff. In some cases, where zoos are larger, there can be found very rare animals that are kept there for the protection against dangers from outside. The oldest zoological garden in the world is Tiergarten Schönbrunn from Vienna [8].

3. System description and components

Every system has input values, output messages or data and the algorithm. In our case, input values are represented by the weight of the animal and its presence in the feeding area or not. The output is represented by a message which contains the weight loss for an animal (when there is the case), the weight of the animal and the presence or not in the feeding area. The algorithm uses previous measurements in case of the weight and compares them with the actual ones, also compares the actual measurements with the normal weight for every animal and detects the presence of an animal in the feeding area.

The system functions very simple and the steps are presented in the next rows:

Step 1. Animal weight and other parameters will be measured with the corresponding hardware.

Step 2. Values will be sent to the microcontroller and then to the workstation (in files).

Step 3. The values will be taken from the files and processed.

Step 4. The resulting values will be displayed (a warning message or a value).

There are several components that the system will contain in order to function: the “hardware” part, which contains the modality of weighing and the devices that ease the access to the computer and send data to it, and the “software” part, which will make the reading of the information easier. A similar system is presented in paper [2].

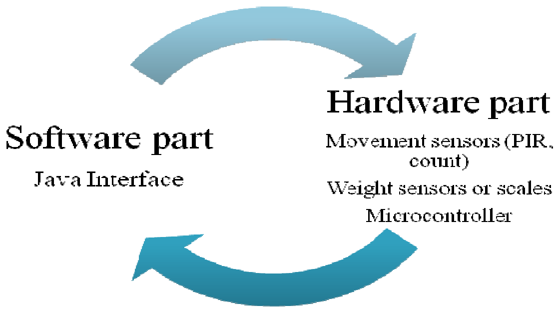

Figure 1. Structure of system

The hardware consists in a device that can weigh the animals. The best modality of doing this is to find a place where the animal usually spend its time, in order to be sure that it can be weighed. It is also important to mask somehow the device so the animal should not be stressed and something unwanted happens (the animal has a weird behavior or loses weight). The device varies according to the type of the animal and it has to adapt to animal’s needs. So, it should consist in a weight sensor or a scale, depending on various factors, such as weight or location. Other parameter is the presence or not of the animal in the feeding area, provided by a PIR sensor [3], which detects occupancy of a place. These types of sensors are used in nursery (elder caring) or other domains, as presented in papers [4], [5] and [6]. An extension of this application would be when there are more animals in a delimited area (more specimens from the same species). In this case, more types of sensors will be needed. To be more precise, the animals can be detected by counting sensors, to determine if all animals are presented in the feeding area. Also, we should consider that wireless sensors are easier to use than other types of sensors for obvious reasons. The hardware part is completed with an interface that consists in a microcontroller that makes the connection to a computer.

Figure 2. A scheme for the hardware part

The software part is made from an application which takes data from sensors and displays it in a more understandable way. This part is made in Java programming language and is an interface to the responsible persons that take care of animals. A print screen of the application can be seen in the next figure.

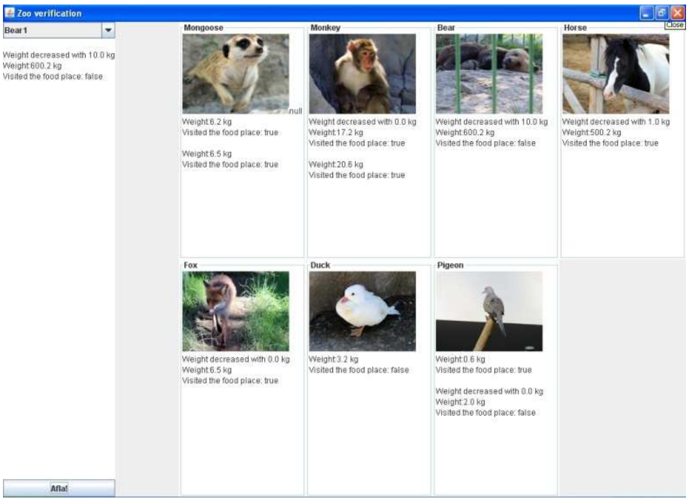

Figure 2. The Java interface

Describing the system in a more formal language, we obtain the mathematical model that characterizes it.

We denote by numbers 1, 2, …, n the cages where animals are kept. In every cage one single or more animals can be kept, so we denote every animal in a cage with 1, 2, …, m (in our case, we consider m=1). The weight of every animal is denoted by $W_{i,j}$, where *i* is the cage and *j* is the animal in the cage. The presence of every animal is denoted by $P_{i,j}$, its values being 0/false and 1/true. The system shows the actual weight and compares it with the previous weight at a moment *t*. Thus, we can define two functions and some constants:

- $W_t : \{1,2,\dots,n\} \times \{1,2,\dots,m\} \rightarrow Q$, $W_{i,j}$ = the weight of an animal, $i = 1,n$ and $j = 1,m$;
- P_t: $\{1,2,\dots,n\} \times \{1,2,\dots,m\} \rightarrow \{0,1\}$, $P_{i,j}$ = the presence of an animal in the feeding area, $i = 1,n$ and $j = 1,m$;
- $[WEIGHT_{min}, WEIGHT_{max}]$ is the interval where the animal has a normal weight.

In the system, these relations are verified:

- ✓ if $W_{i,j\ now} - W_{i,j\ previous} \geq 0$, then the animal j from the cage i has not a problem, where $W_{i,j\ now}$ is the last measurement made, $W_{i,j\ previous}$ is the previous measurement;
- ✓ if $W_{i,j\ now} \in [WEIGHT_{min}, WEIGHT_{max}]$, then the animal j from the cage i has not a problem;
- ✓ $P_{i,j} = 0$, if the animal j is not in the feeding area from zone i or 1, if the animal j is in the feeding area from zone i, $i = 1,n$ and $j = 1,m$;

4. Conclusions and future work

Monitoring animals from a zoological garden can be a difficult task. This application can ease this by measuring some parameters which are essential in the health status of the animals. The handiest parameter to be measured is the weight, which lowers when the animal has a health issue.

Zoos are places where people come for improving their knowledge or to see animals which normally they cannot afford to see in their natural habitats. As a result, animals must have a morphology and behavior as close as they have in places where can be normally found. But the most important fact is that the animals should benefit from a fair treatment from people – animal welfare.

Future task would consist in improving the mechanism and easing the identification of the number of animals and their location. This is part of the development for the case when more animals are present in a delimited area. The design of the Java application can also be improved.

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System of monitoring the irrigation of an agricultural surface

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Abstract

The problem of the efficiency of the water consume for irrigating agricultural surfaces is very important in the actual context, when the accent is set on lower costs and bigger crops. The monitoring systems proposed in the paper propose the usage of pipes equipped with taps and the adjustment of the flow according to values provided by humidity sensors associated with every tap.

Keywords: Measured, Microcontroller, Sensor, Algorithm, Java

1. Introduction

The problem of minimizing costs in every domain of activity is an actual issue nowadays. The agriculture is one of these domains. This cost minimization implies also an ecological approach, which means that natural resources, such as the soil or the water, must be used rationally and in a polite manner. Another important issue in the agriculture is irrigation, which helps crops to get water from other sources than rainfall. Farmers water the cultures to maximize their crops and to help plant to develop properly. Watering depends on various factors, such as a source of water, investments in technology and the existence of irrigation infrastructure. In this paper we propose a system that monitors the soil water content and based on this, controls the flow of the water and the quantity of it.

In section II, we will show general data about irrigations in Romania and in other parts and general information regarding water in the soil. In the next section we will present a description of the system and in section IV will include the mathematical model. Finally, in section V we will conclude the paper and give some directions regarding the development of the system.

2. IRRIGATIONS – when, where, why

Climate changes led to a more proper approach to natural resources. Desertification, water drain and rapid-changing weather are some of the results of using the resources too hard. So the agriculture comes with some principles nowadays and people are changing their vision about the relation between agriculture and nature. Irrigation is the water given to plants in order for the processes inside the plant to develop or it is a way of helping the plant and to minimize the costs for treatments for different diseases. Without necessary water, the plants dry and the crops are lower.

The control of irrigation is studied also in papers [6], [7] and [8].

There are several types of irrigation used today:

- spraying irrigation: the plants are "sprayed" with water; the leaves are also wetted, but this type of irrigation is not very economic;

- irrigation by flooding; this type is used especially for several types of cultures (i.e. rice) and it is mandatory for a good development of plants;
- furrow irrigation; used for vegetables culture. The furrows are little channels made between plant rows, as described in paper [4];
- drip irrigation; the plants get water at their roots drop by drop through little holes made in the pipes.

In Romania, the total surface that has irrigations is 2.991.943 ha. The main source of water is Danube (85%) and the rest is represented by inner rivers. The installed power for pumping stations is 4.134 MW. This is a figure that represents the irrigable surface in Romania:

Figure 1. The irrigated surface in Romania

The data can be found at the Land Reclamation National Agency (ANIF in Romanian) website [1].

The soil water helps plants to adjust their processes such as the photosynthesis or respiration and variables such temperature [2]. It also has important effects on compounds and minerals transport and their solubilization. There are several forces that act on the soil water: gravity, capillary forces, sorption force or osmotic force. There are also indexes that express the soil humidity, such as wettability index, wilting index, capacity for water or the humidity equivalent, which are expressed in different units or percents. A very important characteristic for water soil is suction, which means the attraction force for water and can be measured with a sphygmomanometer and expressed in pF (the common logarithm of the height of water column). At pF=0 the soil is saturated and at pF=7 the soil is dry.

Usually, the soil gets water from rainfalls and irrigation. But soil water is lost by several direct or indirect processes, such as evaporation (unproductive consumption), plant sweating, evapotranspiration (expressed by ETP index) or drain (which can be external or internal). A balance can be done between gains and losses of soil water using the next formula, extracted from paper [3]:

$$SWC_T = SWC_Y + EP + I - ETP - ID,$$

where SWC_T = current soil water content from today

SWC_Y = soil water content from yesterday

EP = effective precipitation since yesterday

I = irrigation since yesterday
ETP = evapotranspiration
DP = internal drain.

All the terms are expressed in [mm]. This formula could be a verification of the direct measurement of soil water content and we will detail it later in the paper.

In the next figure a clear definition of the processes and variables presented above are shown.

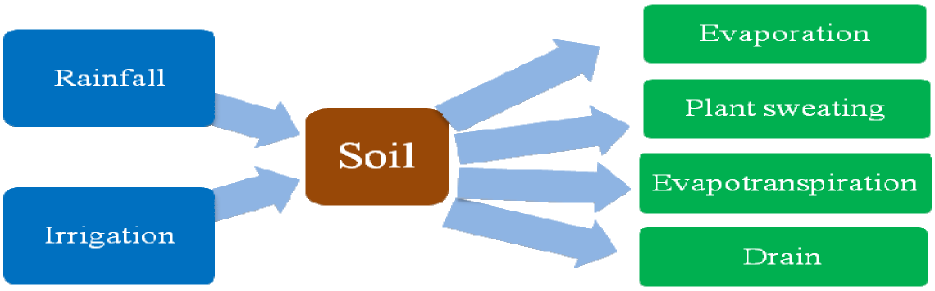

Figure 2. Water balance in the soil

Besides the dangers that drought brings, we should consider also that a larger quantity of water than the soil can bear (the capacity of water) is harmful for plants, because the processes cannot develop as they should (i.e. aerobic respiration cannot develop properly, roots rot etc.).

3. System description

The system has as input data the content of water in the soil and output an alarm message in case of loss of water soil and the actual level of soil water. The algorithm calculates the water level, converts mm in liters and output the necessary quantity for the soil to be irrigated.

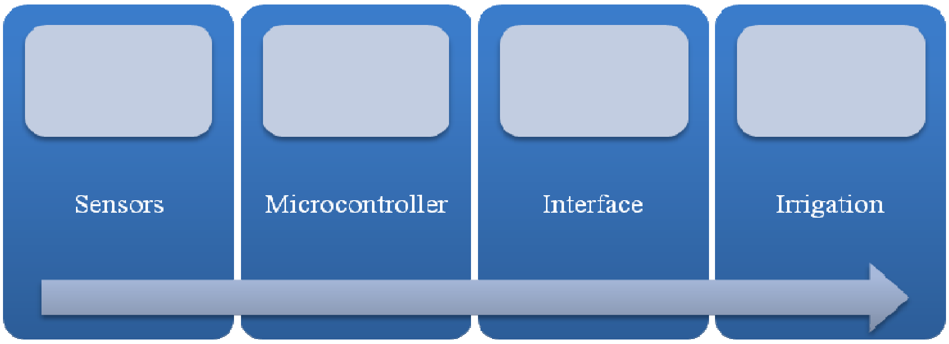

Figure 3. Scheme of the system with its principal components

Steps followed through the entire process can be seen next.

Step 1. Data will be collected from the sensors.
Step 2. The values will be output using the Java interface.
Step 3. The water quantity necessary for irrigation will be calculated and an alarm message will be shown if water level in the soil drop under the usual level.

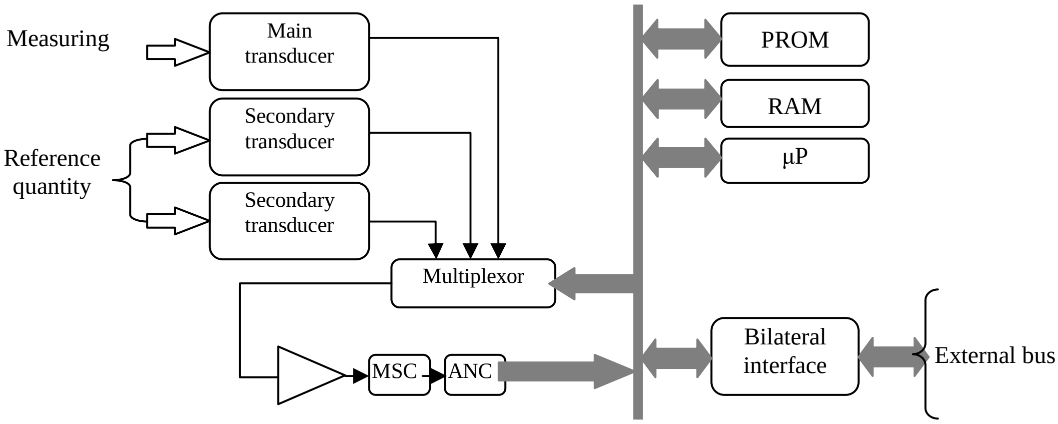

Figure 4. Scheme of a transistor with a microprocessor which may be used in the system [9]. A - amplifier, MSC - Memory and Sampling Circuit, ANC - Analogical – Numerical Converter, PROM - memory, µP - microprocessor and RAM - another type of memory.

The interface is made in Java programming language and the measurements will be made with humidity sensors whose values are transmitted to computers by a microcontroller. A print screen of Java interface can be seen in the next figure.

A parallel verification of determining necessary water for irrigation is using the formula from paper [3]. The determination of equation terms can be made in this way:

- ✓ SWC (soil water content) can be measured with a sphygmomanometer;
- ✓ EP (effective precipitation) is obtained by considering 75% of rainfall (rainfall quantity can be found from weather forecast);
- ✓ I (irrigation) is the water used to irrigate and depends from irrigation equipment;

ETP (evapotranspiration) depends on the plant and can be consulted on specialized sites.

4. Mathematical Model

Transposing the system in a mathematical model, we consider the next notations:

- SWC : $\{1,2,\ldots,n\} \rightarrow R$, SWC_i = the soil water content from area i;
- MIN: $\{1,2,\ldots,n\} \rightarrow R$, MIN_i = the minimum limit of soil water in area I, or the maximum allowable deficit;
- MAX : $\{1,2,\ldots,n\} \rightarrow R$, MAX_i = the maximum limit of soil water in area I, which varies depending on the soil type from 83 mm for sandy soils to 200 mm for clay [5];
- DEP : $\{1,2,\ldots,n\} \rightarrow R$, DEP_i = the depth of the roots;

Measurements can be made daily or on a larger period of time.

For a given SWC_i, MIN_i and MAX_i , $i = 1,2,..n$, the algorithm verifies the next relation described in section III:

- $MIN_i \times DEP_i \leq SWC_i \leq MAX_i \times DEP_i$, which means that soil water content is lower or equal than the minimum limit of soil water, $i = 1,2,\ldots,n$;
- the algorithm outputs the difference between $MAX_i \times DEP_i$ and SWC_i (MAX_i - SWC_i) and alerts the start of irrigation when $SWC_i \leq MIN_i \times DEP_i$.

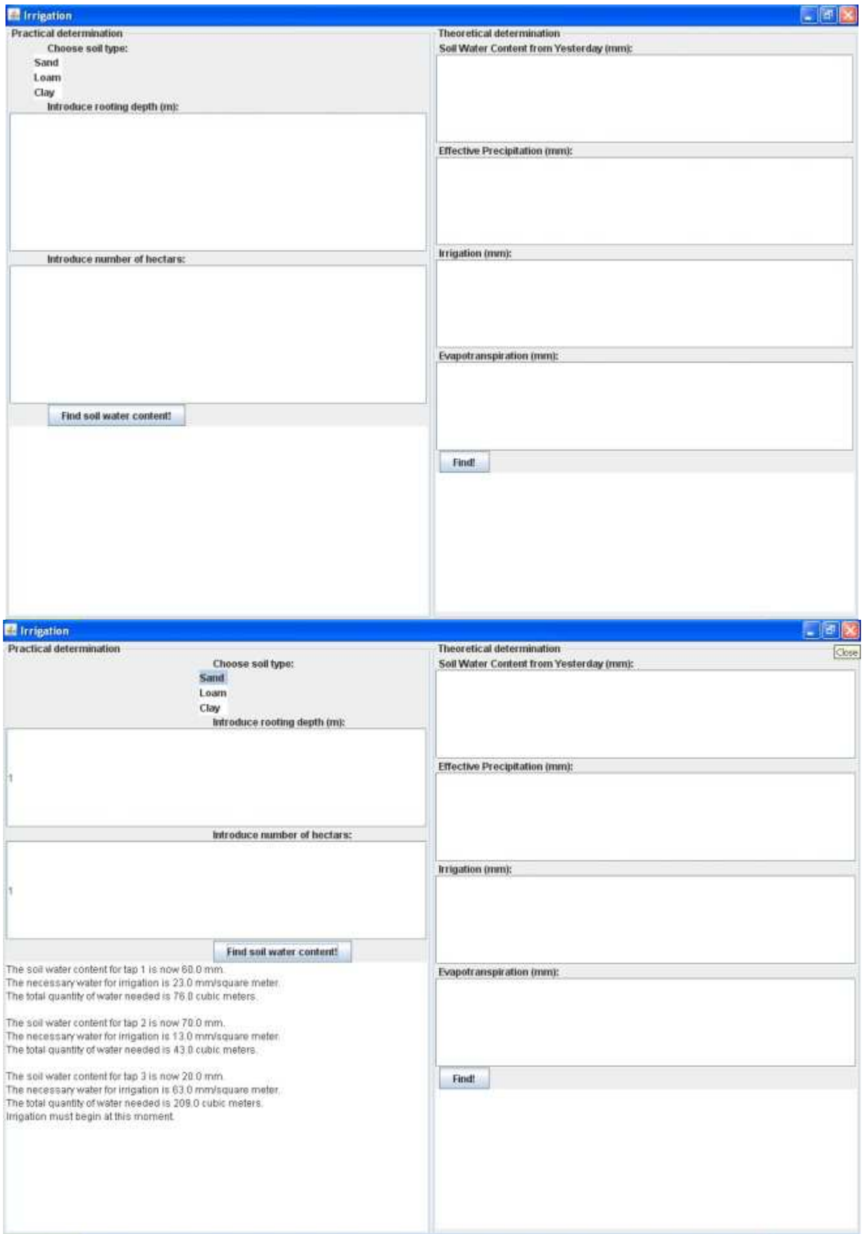

Figure 5. The Java interface

5. Conclusions and future work

Irrigations are very important in a crop balance and water is essential for plants. This is why the accent is laid on minimizing costs while maximizing profit. The system measures the soil water content and calculates the necessary irrigations for the plant, achieving the requests listed above. Famine is an issue, maybe virtual for some parts of the world, but real for some people and this issue is directly related to agriculture. For solving problems like this, we should produce more, but at least at a minimum quality for people. Also related to famine are water problems, so it should be used rational.

Regarding the system, a future work would be a better development of the hardware part.

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Software application for health state monitoring and data modeling for health risk factor evaluation, based on wearable sensors and observer patterns for sensors data tracking

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Abstract

In this paper is presented a software application for monitoring elderly patients. Healthcare applications are based on wearable and implanted microelectronic device. Wearable sensors are used in direct contact with human body surface of a human. The implantable medical devices use invasive method for object inserting in inside human body. This software application can be used for monitoring the ski humidity of elderly patients in hospitals and at homes. Generally, wearable sensors (humidity, temperature, glycemia) embedded on clothing can collect information about patient health state. Based on correlation between parameters tracked from sensors, the medical staff can act and obtain a predictive modeling of patient health state. Also in this paper is presented a solution for evaluation outside parameters in order to establish risk factors for ill patients. The software application is notified automatically of any temperature, humidity, noise or light state changes, by calling one of their methods. It is know that for patient health is important to track his health parameters related to physical body and also an important aspect is related to ambient parameters. The motivation of using observer patterns is that can implement distributed event handling systems. By using observers can collect data from distributed sensors networks, analyze and evaluate parameters modification. These data can be used by doctors for evaluate patient health state in correlation with ambient parameters state and create personalized healthcare services.

Keywords: Sensors, Software, Elderly, Monitoring, Network, Risk factors, Pattern Observer

1 Introduction

According to the European Commission’s 2009 Ageing Report people older than 79 expected to triple in numbers by 2060 and the long-term care segment will be one of the drivers of this expansion over the next fifty years.

The continuous monitoring of critical vital it is a process specific for hospitals. Currently this process is performed by using different cabled sensors, being attached to the patient and connected to bedside monitors. The patient mobility by using this type of monitoring it is severely restricted, the patient it is tight to devices at the bedside.

By using small wireless sensors, attached to the patient body, measure vital sign data, and transmit them via the established sensor network to an external observation unit. Today the sensor networks, are used for environmental monitoring and are either statically pre-configured for a certain task, or build spontaneous networks. For patients suffering from others diseases, ambient risk factors like high or low temperature and humidity have an important influence in disease worsening or triggering of new. Thermal stress is an important risk factor not just for industrial situations, athletic events or military scenarios, but also for patients suffering a cardiovascular disease. For medical usage, this system behavior has to be transformed to a reliable and defined system set-up, working automatically but nevertheless being under explicit control of a clinician. Technology improvements in the field of microelectronics with respect to size and power consumption created a new category of devices: autonomous micro devices. Adding sensor capabilities and radio interfaces leads to wireless sensor networks. Two kinds of wireless sensor configurations can be seen today: point-to-point and autonomous auto-configuration. In both cases the membership of sensor nodes to a certain network is either statically predefined or subject to a manual association procedure.

For the elderly the chronic disease management was the largest contributor to the monitoring services market. The market for post acute care services accounted for 19.5 percent of the overall monitoring services revenue in 2012. The mobile tech vendors' new products and services are meeting to increase the demand for mobile monitoring solutions as healthcare providers are seeking ways to costs while improving patient care.

2 Monitoring vital signs for elderly patients

The software application VitalMon v 1.1 was developed for monitoring the vital signs for elderly patients with wearable sensors devices (humidity, temperature). For portability and easy use, sensors must be submitted on clothing article. The software present to access levels (figure 1) – guest can access statistics about patients and data monitoring, and also a restricted access- usable just for medical staff. Medical staff can login and have access to data about patients' data (name and vital parameters monitories) and diagnostics. Also medical staff can create user account for application login.

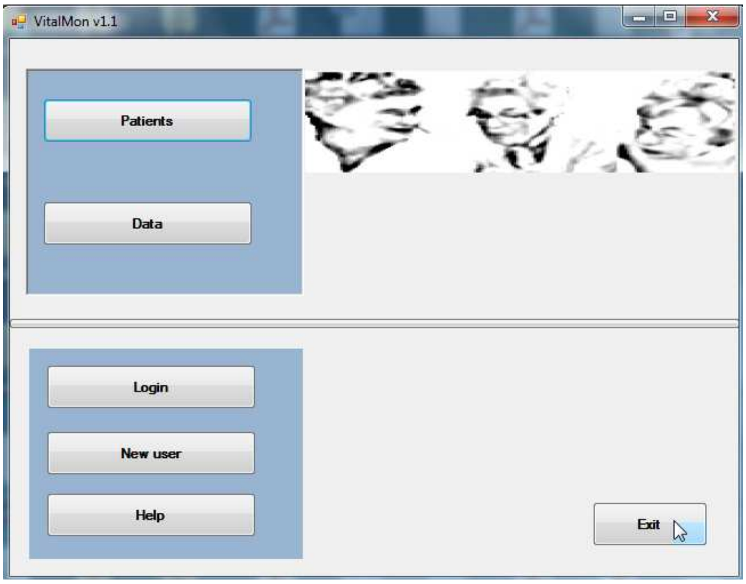

Figure 1. VitalMon software

Doctors can login in account and search patients that already exist in database or to insert new patients. The patient searching is possible by using all fields name, address or diagnostic or to fill data just in one field for searching.

By searching patient data, doctors can have access to the patient vital parameters: humidity, temperature. By accessing the button temperature or humidity it will displayed a graphical chart regarding patients' parameters values for current month.

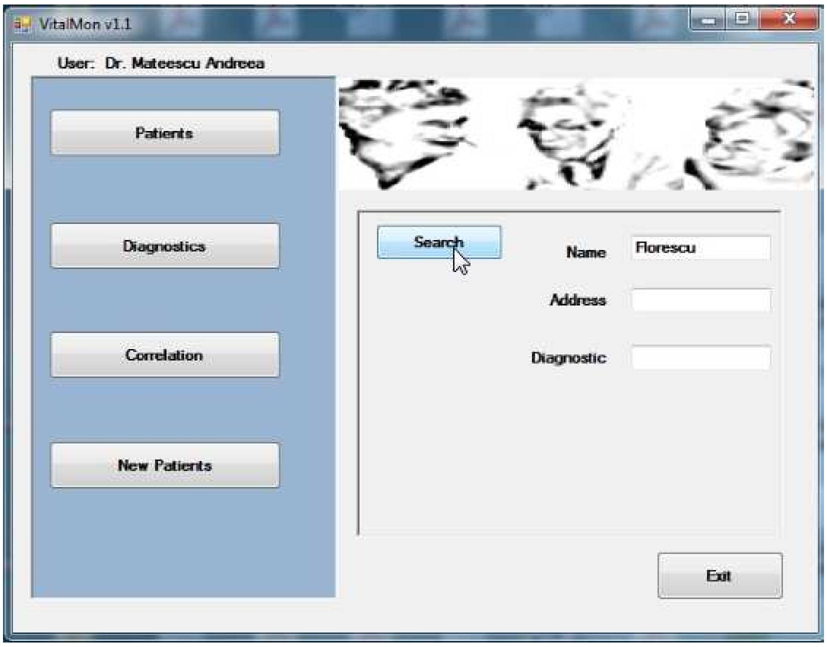

Figure 2. Software VitalMon –patients search

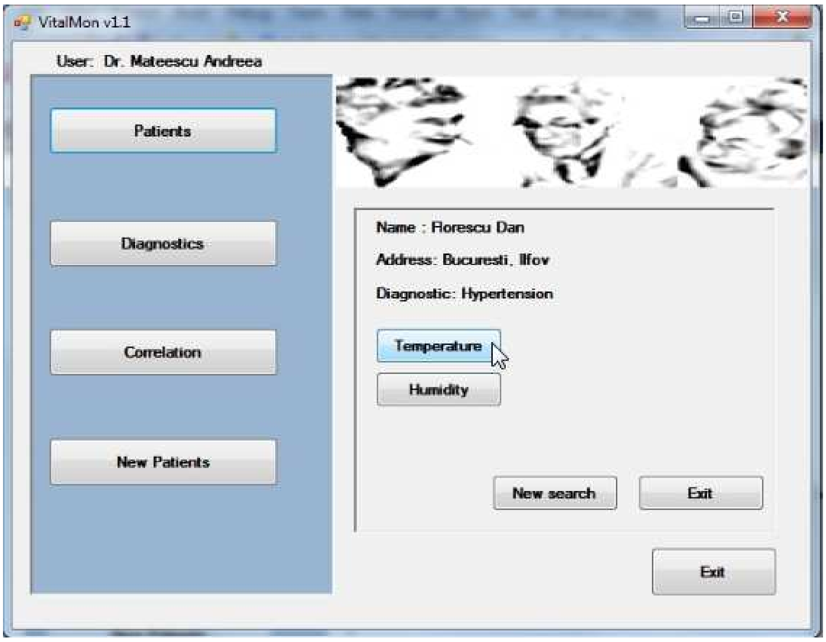

Figure 3. Software VitalMon – patient data

The application VitalMon can be extended for displaying vital parameters statistics monthly or annual. The application allows doctors to add new patients in database.

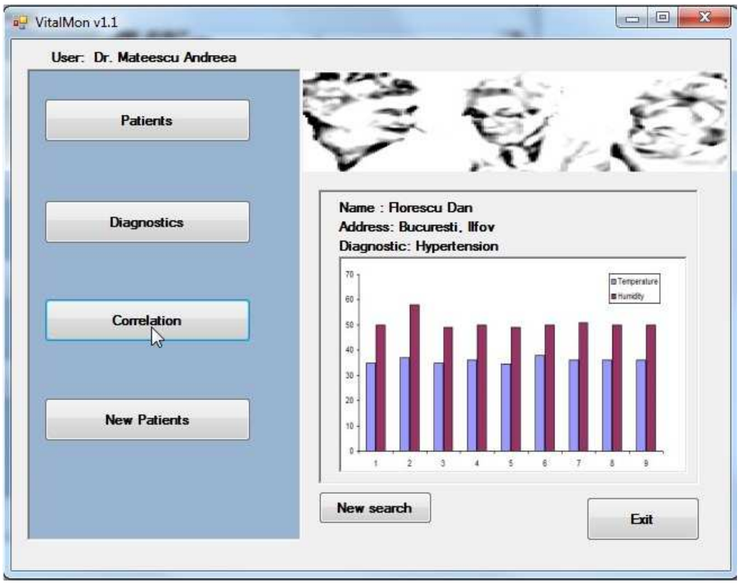

Figure 4. VitalMon – temperature humidity correlation

The correlation option permits to display a chart with both values for humidity and temperature (figure 4).

3 Data modeling for health risk factor evaluation based observer pattern

The observer pattern (figure 5) is a type of design pattern in which an object, called the subject, maintains a list of its dependents, called observers, and notifies them automatically of any state changes by calling one of their methods. This type of pattern can be used for implement distributed event handling systems, distributed sensors network. The relation is one to many. The observer pattern was first implemented in Smalltalk's MVC based user interface framework.

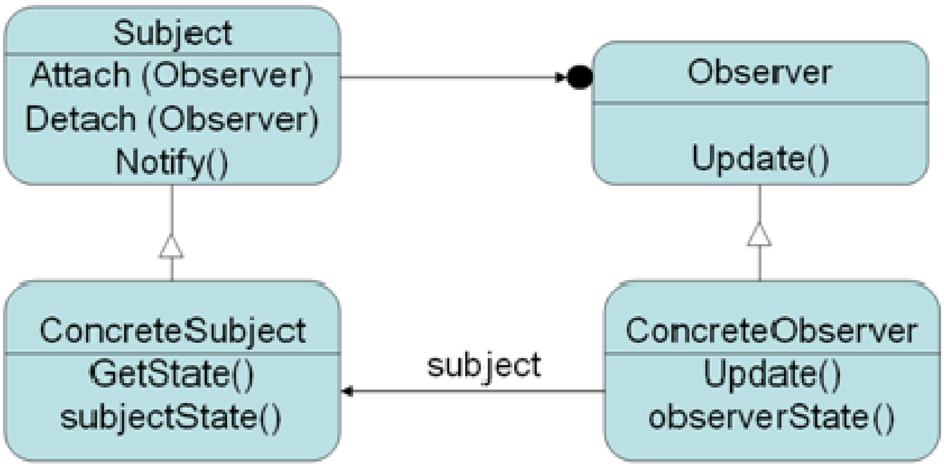

Figure 5. Pattern observer

Starting from classical observer pattern chart we can derivate the chart for sensors observer pattern (figure 6).

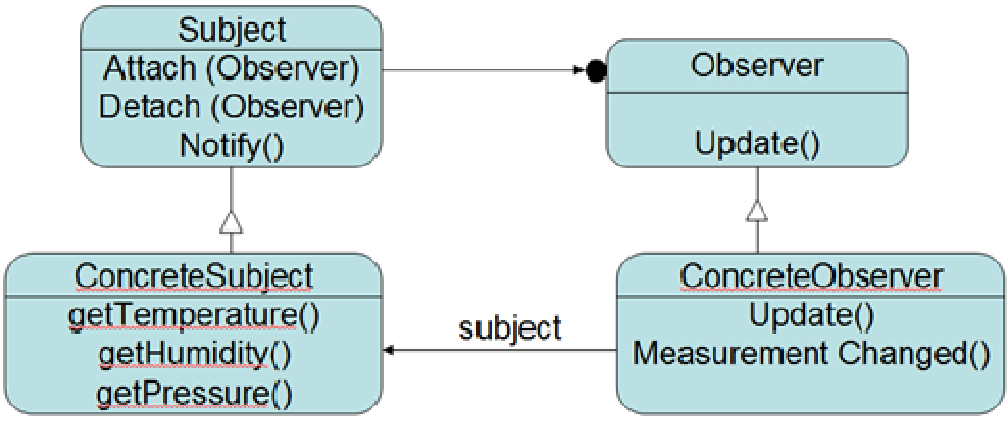

Figure 6. Sensors observer pattern

By using java programming we implemented the classes: subject, observer, temperature and pressure.

```
// subject class java implementation
import java.util.ArrayList;
import java.util.List;
public class Subject {
  private List<Observer> observers
    = new ArrayList<Observer>();
  private int state;
  public int getState() {
    return state;
}
  public void setState(int state) {
    this.state = state;
    notifyAllObservers();
}
  public void attach(Observer observer){
    observers.add(observer);          }
  public void notifyAllObservers(){
    for (Observer observer : observers) {
      observer.update();
}  } }
// Pressure class java implementation
public class Pressure extends Observer{
  public Pressure(Subject subject){
    this.subject = subject;
    this.subject.attach(this);
}
```

```
// object class java implementation
public abstract class Observer {
 protected Subject subject;
  public abstract void update();
}
// temperature class java implementation
public class Temperature extends Observer{
  public Temperature(Subject subject){
    this.subject = subject;
    this.subject.attach(this);
}
  public void update() {
    System.out.println( "Temperature: "
    + Integer ( subject.getState() ) );
}
}
// Humidity class java implementation
public class Humidity extends Observer{
  public Humidity(Subject subject){
    this.subject = subject;
    this.subject.attach(this);
}
  public void update() {
    System.out.println( "Humidity: "
    + Integer ( subject.getState() ) );
}
```

public void update() {
  System.out.println("Pressure: "
  + Integer (subject.getState()));
}}
	}

3 Conclusions

The vital parameters data tracking from small wireless sensors can permit monitoring of elderly patients with comorbidity risk and can conduct to reducing the costs with medical staff or caregivers. The advantages are:

- active monitoring for preventing actions
- possibility to make correlations between vital parameters and develop predictive models
- increasing the safety for elderly that are home alone
- reducing costs with hospitalization
- reducing costs with medical staff and caregivers

For risk factors evaluation the usage of pattern observer for sensors data tracking have the advantage that observer is notified by subject in a single event call as Broadcast communication.

The disadvantage is in case of debugging process that becomes very difficult because flow of control is implicitly between observers and observable.

Another inconvenient is about memory management all the reference of all the observers will be hold by subject and if we do not unregister the observer objects it can create the memory issue. The sensors data tracking about ambient parameters is a very important point because human body perceives heat depending on the temperature and humidity, in function of thermal comfort index. If atmospheric humidity is higher the perceived temperature of the human body is high level one. These aspects can lead to worsening health of patients, especially for elderly who have more disease. The patients' health state must be evaluated by considering also the risk factor of thermal stress, because variations of humidity, pressure and temperature care allow health conditions modifications.

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Software application for non-Newtonian fluid flow numerical analyze

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Abstract

This paper presents a software application for non-Newtonian fluid flow simulation through arteries. The numerical analyze refer to the non-Newtonian fluid flow parameters. This numerical analyze is usefully for artificial arteries production, made from textile yarns. Rheology generally refers to the behavior of non-Newtonian fluids, by characterizing the minimum number of functions that are needed to relate stresses with rate of change of strains or strain rates. Considering that arteries have the ideal tubular structure, it is very important, for arteries development, the fluid and flow parameters analyze. This application can compute, by using Grid network system, very easy the numerical value for fluid flow parameters.

Keywords: Grid, Network, Arteries, Artificial, non-Newtonian, Fluid, Simulation

1 Introduction

Most programs are written by using the algorithms, they containing the list of instructions in their proper order execution by the computer. The program is based on an algorithm, by the organization, and can use also some external data in main program. It can consider that the program is a package of data and algorithm.

Based on complex mathematical models, previously performed, which highlights the flow parameters in terms of the movement bio-fluid - solid coupling for Y textile structures, subroutines were developed to calculate the flow velocity for bio-fluid, by using the programming language FORTRAN and power of the GRID Network (figure 1).

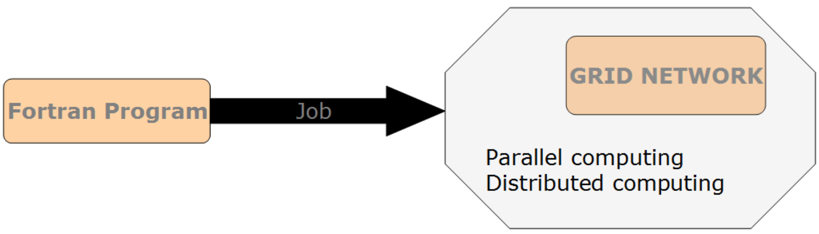

Figure 1. Grid Network

As in the areas of bio-fluid flow artery bifurcation becomes difficult to determine the numerical simulation is required that flow rates using appropriate calculation routines.

2 Software application development

The goal was to create the console application software, writhed in FORTRAN, velocity.f.

The experimental part in this work it is represented by dividing the problem – biofluid velocity calculation:

- Using modularization by decomposing the complex problem - bio-fluid flow velocity – in the subroutines and function by using the programming language Fortran (figure 2)
- Formulation of the logic programming concept - which consists in the execution of logic flow chart that is presented in figure 3.

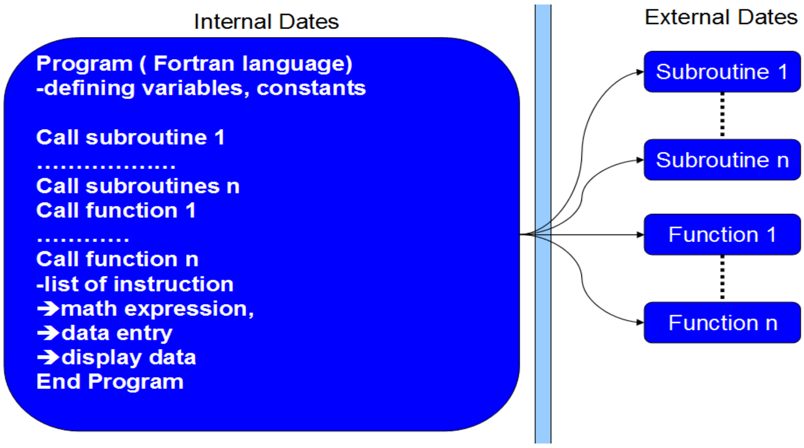

Figure 2. Modularity – Fortran programming

- Mathematical modeling of the bio-fluid flow velocity (2):

The start point in this application was the math formula for velocity (1):

$$v_z(r,z,t)=\frac{1}{\pi i R^2}\sum_j \frac{J_0(rs_j)}{[J_1(Rs_j)]^2}\int_{\gamma-i\infty}^{\gamma+i\infty}\left[C_1(s_j,p)e^{-\alpha z}+C_2(s_j,p)e^{-s_j z}+T(s_j,z,p)\right]e^{pt}dp \quad (1)$$

$$v_z(r,z,t)=\frac{1}{\pi i R^2}\sum_j \frac{J_0(rs_j)}{[J_1(Rs_j)]^2}\int_{\gamma-i\infty}^{\gamma+i\infty}C_2(s_j,p)e^{-s_j z}dp \quad (2)$$

For calculation the velocity Vz by using the formula (2) it was done the software application velocity.f. In the program the formula (2) was calculated by using the variable SumaC2. The expression $\sum_j \frac{J_0(rs_j)}{[J_1(Rs_j)]^2}$ is calculated in program by using the variable SumaJ. The value of the mathematical expression $\frac{1}{\pi i R^2}$ is held by the variable Calc.

The calculation of the velocity value is based on Bessel function roots.

Velocity Vz value was calculated by using the next algorithm described by using pseudo code:

Algorithm velocity_Vz

Integer n, NT, aa, bb; //n- Bessel function order, NT- Bessel function roots number

Real p, v, d, e, g, l, u, b, Rs, R, z, interval; // p-pressure, v-viscosity, d-density, e g-elasticity coefficients, R-radius value.

begin

read n , NT, aa, bb, p, v, d, e, g, l, u, b, Rs, R, z, interval;

```
// subroutine for integral value
 if M ≤ NT then begin        //intermediary calculus for obtaining integral value
        RY2←sqrt(RJ0**2+p/v);
        RY3←RJ0/(RJ1**2);
        RY4←4*v*RY2*RJ0**3-((2*v*RJ0**2+p)*(2*v*RJ0**2+p))/v;
        RY5←(-1)*RJ1*(e+g)/(e+2*g);
        RY6←(-1)*((((2*i*u*sqrt(g/d)*RY5*RY2*(-1)*RJ1)/(i*u*sqrt(g/d)+p))-
        (2*v*RJ1**2+p))*(((sqrt(g/d)*RY5*RJ1)/(i*u*sqrt(g/d))-((u*b**2)/
        (v*RJ1*p*(P**2)))/RY4))*Rs*RJ1);
        RY7←RY6*RJ0;
        RY8←EXP((-1)*RJ1*z);
        RY9←(-1)*((((2*i*u*sqrt(g/d)*RY5*RY2*(-1)*RJ1)/(i*u*sqrt(g/d+aa))-
        (2*v*RJ1**2+aa))*(((sqrt(g/d)*RY5*RJ1)/(i*u*sqrt(g/d))
        -((u*b**2)/(v*RJ1*aa*(aa**2+b**2)))/RY4))*Rs*RJ1)*RJ0*
        EXP((-1)*RJ1*z);
        RI1←(-1)*(((2*i*u*sqrt(g/d)*RY5*RY2*(-1)*RJ1)/(i*u*sqrt(g/d)+bb))-
        (2*v*RJ1**2+bb))*(((sqrt(g/d)*RY5*RJ1)/(i*u*sqrt(g/d))
        -((u*b**2)/(v*RJ1*bb*(bb**2+b**2)))/RY4))*Rs*RJ1)*RJ0*
        EXP((-1)*RJ1*z);
        RI2←RY9+RI1;
        Dy←(bb-aa)/Interval;
        RI6←RI2;
        if k ≥ 1 then begin
            if k ≤ (interval-1) then begin
                    Y←aa+k*Dy;
                    RI6←RI6+2.0FF(y);
                    SumaJ←0;
               SumaC2←0.0;
               Exp←exp((-1)*z*b);
               Dy←(bb-aa)/NT;
               Integral←0.0;
               if j ≥ 1 then begin
                   if j ≤ NT then begin
                      SumaJ←SumaJ+RY3(j);
                      SumaC2←SumaC2+RY6(j);
                      Integral←Integral+RI6(j);    //integral value
                            end
                        end
                  end
               end
            end
Write ('m  Jn(m) J'n(m) Yn(m) Y'n(m), Omega, J, Delta, B, C2, C3, Exp, C4, C5,C6,C8,C9');
Write (n, NT,v,d,e,g,i,u,b,Rs,R,z,aa,bb,interval,Valoare);
Write (SumaJ, SumaC2, exp, Dy, Integral);
Value←SumaJ*Integral/(3.14*i*R**2);                //velocity value
Write (Value, 'Velocity Vz');
end.
```

For programming in FORTRAN the software application velocity.f were made the following subroutines and functions:

- Subroutine MembriIntegrala (N,NT,RJ0,RJ1,RY0,RY1,RY2,RY3,RY4,RY5,RY6,RY7,RY8,RY9,RI1,RI2,RI6,RI7);
- Subroutine functii (N,X,BJN,DJN,FJN,BYN,DYN,FYN,GYN,OYN,PYN,RYN,QYN,VYN,YYN,IYN,ZYN,ZY1 ,ZYP, ZY5,ZY6);
- Function : REAL Function FF(y), for calculating the integral value by using the trapezoidal method – it is calling an external function FF;

For input area, by using write and read instruction, it were used the next real or integer type parameters:

```
WRITE (*,*)'Enter Bessel function order n :'
READ(*,*)n
WRITE (*,*)'Enter Bessel function roots NT :'
READ(*,*)NT
WRITE (*,*)'Enter the blood pressure - mm Hg p :'
READ(*,*)p
WRITE (*,*)'Enter viscosity value - cm2/s v :'
READ(*,*)v
WRITE (*,*)'Enter density value - g/cm3 d :'
READ(*,*)d
...................................................................
WRITE (*,*)'Enter lower limit of integration aa :'
READ(*,*)aa
WRITE (*,*)'Enter upper limit of integration bb :'
READ(*,*)bb
WRITE (*,*)'Enter the interval number value :'
```

For output area it were displayed the calculated values for the integral and for velocity Vz:

```
SumaJ=0.0, SumaC2=0.0, Integral=0.0
DO 60 j=1,NT
SumaJ=SumaJ+RY3(j)
SumaC2=SumaC2+RY6(j)
Integral=Integral+RI6(j)
 9      CONTINUE
................................................................
Valoare=SumaJ*Integral*Calc         ! Valoare Vz(r,z,t)
PRINT 70, 'Velocity value in cm/s-Vz(r,z,t)=', Valoare
```

Is important to note that the subroutine MembriIntegrala call is made in the main program and the subroutine Functii and the external function FF call is done in the subroutine MembriIntegrala.

3 Conclusions

The objective of using the Grid Network was to obtain an upper computing power for parallel calculation of the complex mathematical formula for the bio-fluid flow velocity. The subroutines were done by using the algorithmic programming language FORTRAN. In this way it can conclude that is was obtained:

- a computing power for parallel calculation;
- time saving;
- precision calculation;

- logic programming execution based on operations based on modularization.

This software application can be used by researches and can be start-up for developing another complex software application.

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New trends in teaching CAG classes

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Abstract

The aim of this paper is to propose a solution to improve the teaching process for CAG (Computer Aided Graphics) classes. In engineering universities the students must be able not only to extract the skills acquired in CAG classes but also to connect thisinformation to a real situation. The main object of the paper is to present a solution to improve the teaching process for CAG classes. The new solution will help the students to better understand the theoretical concepts and to solve the applications.

Keywords:Computer Aided Graphics, teaching process, CAG environment

1. Introduction

The aim of the paper is to propose a new solution to improve the teaching process for CAG (Computer Aided Graphics) classes. In engineering universities the students must be able not only to extract the skills acquired in CAG classes but also to connect the technical information to the real world (Mohora et al, 2009). A student must find the connection between education process – knowledge and CAG classes. This connection is like a circle between these elements where the starting point could be the information and final point is the improved teaching process (Mohora et al, 2009). The education process aim is to improve the university activity and to add value to the teaching process. The paper tries to propose a modern solution for improving the education activities in engineering universities using a different way to teach. The application of this solution could become an important education element in order to achieve high and performing skills. Using this new learning system can be a great aid in developing a teaching process with high performance indexes.

2. The development of CAG environment

The aim of the paper is to present a solution for improving the education process using a CAG class's environment. The target of the new teaching methods for CAG classes is the student. The aim of the paper is to present a new solution to improve the education process for CAG classes. We shall try to develop a CAG class's environment to improve the education process. The proposed solution will help the students to better understand the theoretical principles and to develop a logical way to think.

Figure 1 presents the logical interconnection between the CAG environment modules.

The proposed CAG classes'environment will integrate in the same platform theoretical principles, programs, labs and homework.The moduleCourse notes will integrate all the theoretical concepts related to Descriptive Geometry and Industrial draw. Each course must have its own story and conclusion. After reading a course a student must be able to describe the problems and to indicate the practical applications. The moduleLabs will integrate different CAD programs. CAG Labs must be examples of active process learning. The students will study different types of software such as open source programs.The labs must present useful and real situations using different types of programs. Each student will choose a type of software to solve a graphical problem.

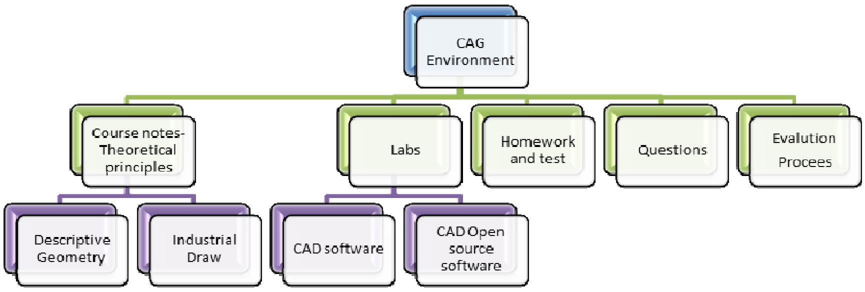

Figure 1. The CAG environment modules

The proposed solution could integrate different CAD open source software.Figure 2 presents an example of an open source program a real time CAD drawing system that allow students to develop the engineering models presented in interactive classes.

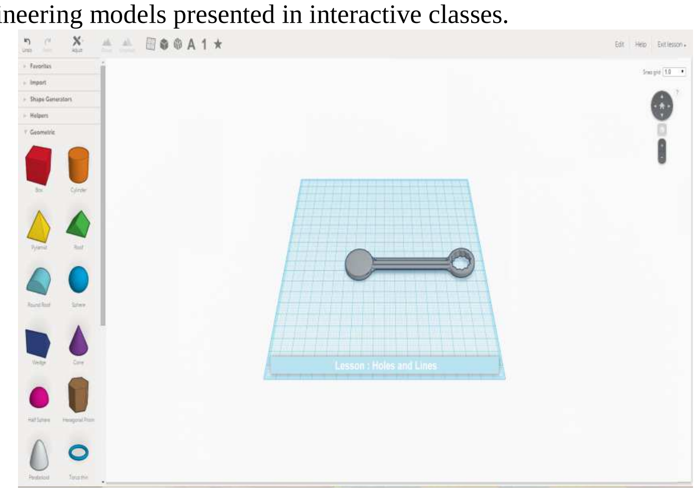

Figure 2. Real time CAD drawing system

Using different types of programs a student could understand that the theoretical conceptions are the same in each situation.

3. TheCAG environment solution

The proposed solution for a CAG environment will help the students to better understand the technical and applicative concepts. That is why the proposed CAG environment tries to develop a flexible way to think and the students must be able not only to extract the theoretical knowledge acquired in classes, but also to connect the technical information to the a real situation (Serban and Calin, 2011). Figure 3 will present an example for course content.

The module Questions will improve the communication between the actors involved in the learning process: student-professor.

Figure 4 presents the main page of CAG classes'environment. The proposed solution is a learning platform designed to provide students with a secure and integrated system to create personalized learning environments for CAG classes.Also the CAG environment support assessment in various forms. All assessment information goes into a personal folder or a grade book so that students could follow their learning progression.

Figure 3. Example of Course content

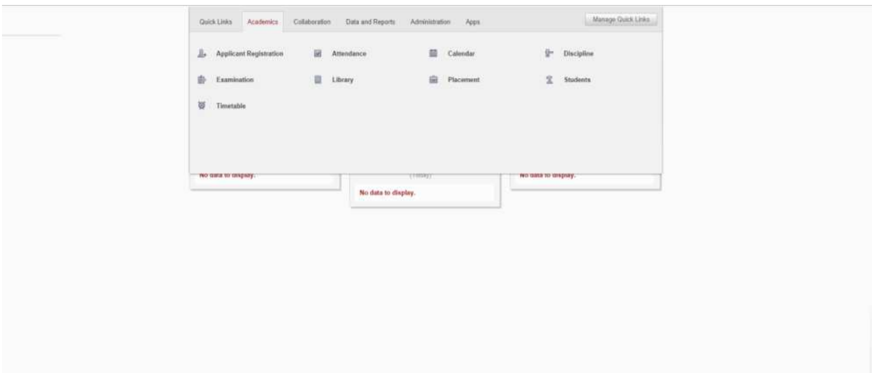

Figure 4. Main page of CAG System

This article proposes a flexible solution to improve the teaching process for CAG classes.The proposed solution is limited just to CAG classes.

4. The evaluationteaching process

An efficient and continuous communication between the student and professors must exist during the whole teaching process. The feedbacks from students will indicate theirinterest for CAG classes. Evaluation module will test the student’s knowledge about descriptive geometry and industrial draw in real time.The evaluation process could be done using homework and tests and also while students are reading the course notes, they could use the CAG teaching material to verify what they have learned or a real time evaluation. Each student could watch score of the process evaluation in real time. The process evaluation for CAG classes must be a real time activity like in computer games (Mohora et al, 2009). The student must choose the right answer. At the end of the evaluation process each student will find out the number of points acquired. Figure 5 will show a test example.

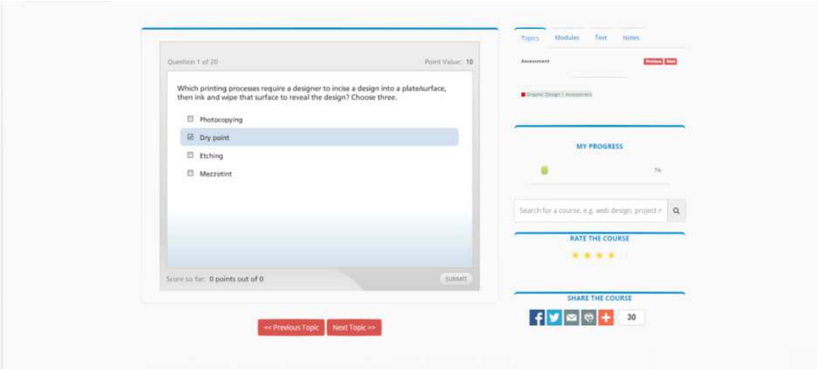

*Figure 5.*Testexample

The test activity in teaching process may be used as a course exam or to provide feedback about student performance.This type of activity lets the professor to communicate tasks, collect homework andgenerate feedback and grades. This activity could also be used to remind students of homework or tests they need to complete offline or classroom presentations. When reviewing assignments, professors can leave feedback comments or documents with comments.

5. Conclusion

The main objective of this paper was to present o solution for improving the learning process in the engineering field. At this moment the proposed solution is a pilot project but after the implementation could become a successful story. The paper presented the challenge of developing a CAG class's environment for the engineering field.The main objective was to find an optimal solution for the development of CAG classes environment considering the following two aspects the solution must be efficient and also the must ask to the specific engineering problems. The main two benefits of using this solution for improving the teaching process are:

- Optimize performance of existing CAG courses by using new teaching methods.
- Improve the quality and the attractiveness of Descriptive geometry and Industrial Draw course.

The benefits of integrating this solution in the education field must be very well understood by the students but also the professors.

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Enhanced AODV Authentication Mechanism in MANET

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Abstract

MANET networks are vulnerable to many security attacks ranging from passive eavesdropping to active impersonation, message replay or message distortion.
To mitigate some of the above issues, this paper will introduce a new authentication mechanism between certain nodes that form a MANET Network.
The protocol studied is AODV (Ad-hoc On-Demand Distance Vector Routing) because of its popularity and lack of many security features. The paper will review the latest research papers on this field and will describe our proposed solution that can mitigate certain security vulnerabilities. Some performance aspects will be also taken into account because any new security enhancements should not have a major impact on the overall network performance.

Keywords: MANET, AODV protocol, Security, Authentication

1 Introduction

An ad-hoc network is a collection of static or mobile communication devices (if they are mobile they are called MANET – Mobile Ad-Hoc Networks) that doesn't have a fixed infrastructure to communicate. (Sumanth and Reddy, 2011) MANET is a system of wireless mobile nodes that dynamically self-organize in arbitrary and temporary network topologies. These type of networks have many applications including distributed databases (Ciobanu-Iacob, 2013a, 2013b; Iacob-Ciobanu, 2012a, 2012b).

In the mobile ad hoc network, nodes can directly communicate with all the other nodes within their radio ranges; whereas nodes that are not in the direct communication range use intermediate node(s) to communicate with each other. (Wenjia and Anupam, 2004).

Because MANETs requires minimal configuration and quick deployment so they are suitable for emerging situations (natural disasters), military conflicts, emergency medical situations and many others.

The security design of such networks represents a challenge due to their unique characteristics: open peer to peer architecture, shared wireless medium, strict resource constraints and dynamic network topology.

In this paper we will present the main security issues related to the AODV ad-hoc networks routing protocol and some proposed methods to improve their security. We will analyze the impact of our changes using some performance tests implemented in OPNET Modeler.

The rest of this paper is organized as follows. In Section 2, we present the common protocols used in MANET networks, then we will describe the AODV protocol and in the next section will cover the most common attacks that can be performed when the AODV protocol is used. In Section 5 we will discuss some proposed methods which can be used to prevent attacks and other routing related problems. In Section 6 we will investigate to see how our proposed security methods affect the network performance. Finally we'll present our conclusions.

2 Routing protocols

In a MANET network, a routing process is required, because before reaching its destination, a packet can pass to multiple notes. A routing protocol selects the best route in order to deliver the packe to the correct destination.

AODV is a distance vector protocol, where each node maintains a table that contains the distance from that node to all other nodes in the network.

Another category of MANET routing protocols are LS (link - state) protocols where each node keeps information about the complete topology of each link costs. To maintain the consistency of these costs, each node periodically broadcasts the costs of its external links to all the nodes using flooding. As each node receives this information, it updates his network information and applies a "shortest route" algorithm to choose the next node for each destination address.

The distance vector protocols, in terms of computation, more efficient and easier to implement, but can lead to formation of routing loops due to the fact that the choice of the next hop is done in a completely distributed manner, based on the possible outdated information.

3 AODV protocol

AODV is a reactive protocol, which means that a route is established only when it is required by a source node for transmitting data packets. The source node and the intermediate nodes store the next hop information corresponding to each flow for data packet transmission.

The absence of source routing and promiscuous listening allows AODV to gather only a very limited amount of routing information with each route discovery. Besides, AODV is conservative in dealing with stale routes. (Mohapatra and Krishnamurthy, 2005).

AODV uses destination sequence numbers (*DSN*) to identify an up-to-date path to the destination. A node update its path information if the *DSN* of the current packet received is greater than the *DSN* stored at the node with smaller hop count. Using destination sequence numbers ensures loop freedom and is simple to program. Given the choice between two routes to a destination, a requesting node is required to select the one with the greatest sequence number.

AODV defines three message types:

- RREQ (Route Request) – used to initiate the route finding process
- RREP (Route Reply) – used to finalize the routes
- RERR (Route Error) – used to notify the network of a link breakage in an active route.

A disadvantage for AODV and reactive protocols, in general, is that route updates often delay traffic initially. But this protocol is suited to be used if the latency is not a problem for an application. Another issue is related to the network overhead caused when there are a lot of changes in the network topology and a lot of requests for sending traffic among multiple nodes.

4 Security issues

Mobile ad-hoc networks have some serious disadvantages in comparison with the common wireless networks, including:

- more dynamic topology
- generally lower memory and processing power
- weaker security.

Also, the routing protocols designed for MANET does not have certain security features that a normal wireless network has since there is no router to encrypt / decrypt the messages transmitted between certain nodes.

We will present below the most dangerous attacks that can be performed against a MANET network that use the AODV protocol:

- **Wormhole attack**

An attacker records packets at one location in the network and tunnels them to another location. By creating this shortcut, they could trick the source node to win in the route discovery process and later launch the interception attacks. Packets from these two colluding attackers are usually transmitted using wired connection to create the fastest route from source to the destination node. In addition, if the wormhole nodes consistently maintain the bogus routes, they could permanently deny other routes from being established. As a result, the intermediate nodes reside along that denied routes are unable to participate in the network operations. (Razak, Furnell and Brooke, 2004) A typical wormhole attack is described in the Figure 1.

Routing can be disrupted when routing control messages are tunneled. This tunnel between two colluding attackers is referred as a wormhole. Wormhole attacks are severe threats to MANET routing protocols. (Sharma, Khandelwal and Prabhakar, 2011)

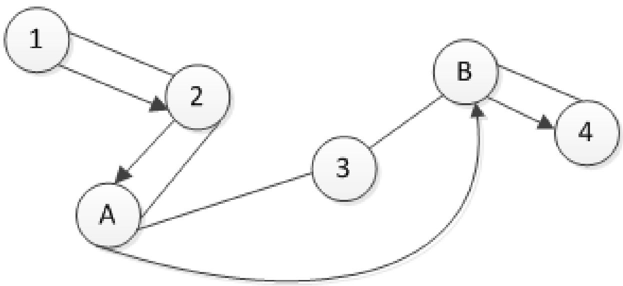

Figure 1. Wormhole attack

- **Denial of Service (DoS)**

Denial-of-service (DoS) attacks consume the resources of a remote host or network, thereby denying or degrading service to legitimate users (see Figure 2). Such attacks are among the most intricate security problems to address because they are easy to implement, difficult to prevent, and very difficult to trace. The most common DoS include attacks similar SYN Flood, Smurf, UDP Flood. Determining the source generating attack traffic is especially difficult when using stateless routing protocols (as in the Internet or geographic routing). Attackers routinely disguise their location using incorrect, or "spoofed", source address. (Yongjin, Vishal and Helmy, 2004)

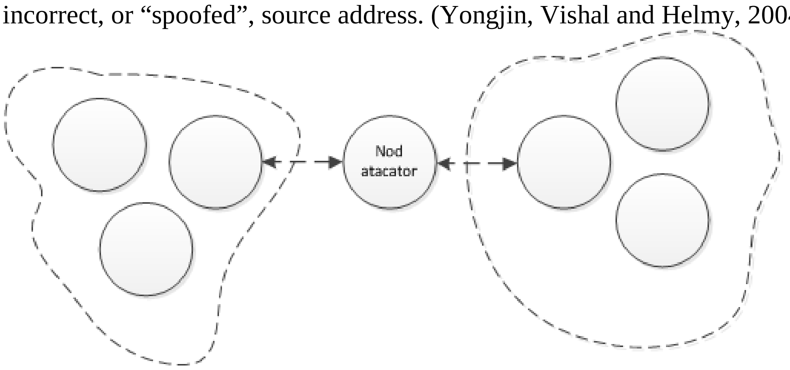

Figure 2. Denial of Service attack

5 Proposed solutions

Many research papers tries to improve MANET network security by assuming that there is a trusted certificate authorization and key distribution system in the MANET and every node in the network has a unique and safe public key pair and can acquire other nodes' public keys if needed.

In author's opinion these conditions are not very easy to be satisfied, especially due to the main constraints of the ad-hoc networks: mobility, limited power (battery), limited processing power (processor, memory, etc.). For this reason, we argue that a shared key authentication is more suited.

K. Sanzgiri and B. Dahill have developed authenticated routing for ad hoc networks on AODV (ARAN). ARAN focuseson securing on demand routing protocols in general. The authors assume that there is a trusted certificate server.

M. Zapata and N. Asokan also proposed a secure AODV protocol (SAODV) [16]. Similar digital signature protection as ARAN is used in SAODV and it further use one-way hash chain to secure the hop_count information from being decreased. SAODV provides features such as integrity, authentication, and nonrepudiation of routing data. SAODV incorporates two schemes for securing AODV.

The ARAN and SAODV security protocols do not consider the intermediate nodes that can join the network during the routing process, so that nodes can perform fabrication attacks. In a fabrication attack, an intruder can generate false routing information. For example, false route error messages (RERR) and routing updates may disturb the network operations or consume node resources. (Jhaveri, Patel, Parmar and Shah, 2010). Some examples of fabrication threats are blackhole and wormhole attacks.

Our goal is to design a schema to perform point – to – point message authentication in order to guarantee the integrity and non-repudiation. In this schema we should not be constrained to have a deployed key management infrastructure.

The shared secret key will be stored in each node routing table into an additional field: security_struct, which will store also the neighbor address and its public key. The authentication will be executed by checking the hashed message which is hashed by the shared key. The key agreement process may look like this:

1. broadcast (agreementRequest, requestId, senderAddr, pkS)
    a. for each (receiverMessage)
        i. if (messageType == agreementRequest)
            1. send(agreementReply, requestId, senderAddr, neighborAddr, pkR);
        ii. else if (messageType == agreementReply)
            1. send(KEY_OFFER, new sharedKey);
        iii. else if (messageType == KEY_OFFER)
            1. get(decrypt(sharedKey));

RREP messages (route requests) will need also to be authenticated, so the request and reply messages will have the following format:

(authRouteReplyReq, destAddr, destSeqNb)
(authRouteReplyReply, destAddr, destSeqNb, hash(routeRep))

The message type for the route error report messages will have the following format:

(authRouteErrorReq, unreachdestAddr, unreachdestSeqNb)
(authRouteErrorReply, unreachdestAddr, unreachdestSeqNb, hash(routeError)).

This schema has the advantage to authenticate intermediate nodes in routing steps and does not require a certificate server like ARAN or a key distribution infrastructure like SAODV. Also it prevents malicious nodes to form loops by spoofing nodes and falsified error messages.

6 Performance evaluation

We have created in OPNET Modeler a basic implementation of AODV point – to – point authentication in order to measure the performances compared to the standard implementation of the protocol.

The network setup is presented in the Figure 3:

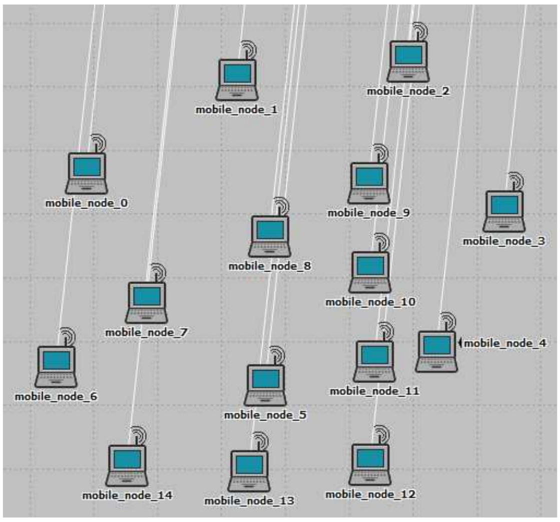

Figure 3. OPNET – AODV network setup

The parameters measured are:

• Throughput - the total number of bits (in bits/sec) forwarded from wireless LAN layers to higher layers in all WLAN nodes of the network.

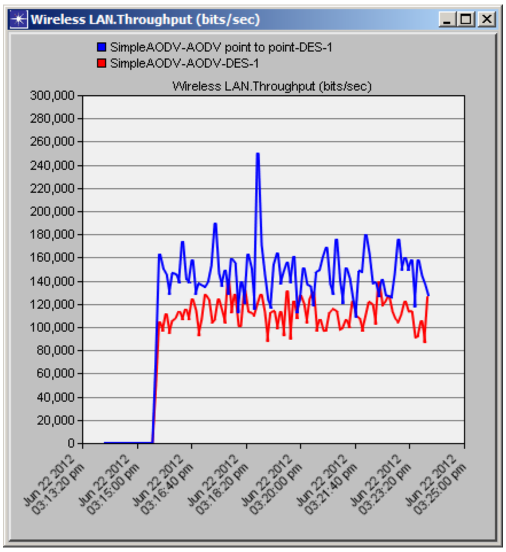

Figure 4. AODV LAN Throughput

• Delay - the end to end delay of all the packets received by the wireless LAN MACs of all WLAN nodes in the network and forwarded to the higher layer. These delays include medium access delay at the source MAC, reception of all the fragments individually, and transfer of the frames via AP, if access point functionality is enabled.

We can observe from the Figures 4 and 5 that the additional overhead added by the point – to – point authentication is not high in any moment of time.

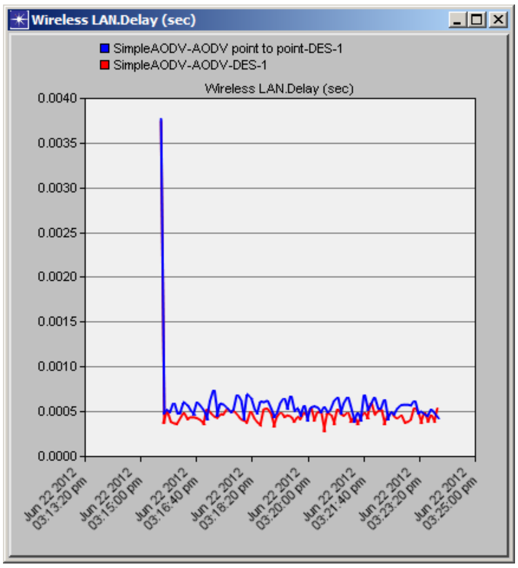

Figure 5. AODV LAN Delay

7 Conclusions

In the first part of this paper we presented the main categories of routing protocols implemented in ad-hoc networks and we briefly described the AODV protocol and the associated security risks and the most common attacks.

In the second part we focused on the MANET security issues and we presented some existing methods that can be used to improve the security of the ad hoc network that uses the AODV protocol. Also, using OPNET Modeler we saw that the point to point authentication add only small performance loss compared to the original AODV implementation.

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Increasing OLSR Protocol Security in Mobile Ad-Hoc Networks

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Abstract

In this paper we will propose some solutions to increase the security of OLSR protocol used in MANET networks. These networks are more susceptible than traditional networks to different kind of vulnerabilities and security attacks due to their wireless nature and dynamic topology. OLSR is one of the most used protocol in ad-hoc networks, but was developed without many built-in security features. A MANET does not have a central routing device, so each node should ensure also this function. Because of this, if one node from the network is compromised, the entire network could be compromised. The paper will describe the proposed solutions and their impact on the overall network performance.

Keywords: MANET, OLSR protocol, Security, OPNET Modeler

1 Introduction

Mobile Ad Hoc Networks (MANET) represented an area of intense research in the past years. Although some problems have been addressed and partially solved, there are still new challenges related especially to wireless mesh networks which generally use the OLSR protocol, vehicular and sensor-based networks.

The security design of such networks represents a challenge due to their unique characteristics:

- open peer – to – peer architecture
- shared wireless medium
- strict resource constraints
- highly dynamic network topology.

Due to the fact that a packet can pass on to more nodes (multi-hop) before reaching the destination, a routing process is required. The routing protocol has two main functions: the selection of routes for different route – destination pairs and the delivery of packets to the correct destination. These type of networks have many applications including distributed databases (Ciobanu-Iacob, 2013a, 2013b; Iacob-Ciobanu, 2012a, 2012b).

In the mobile ad hoc network, nodes can directly communicate with all the other nodes within their radio ranges; whereas nodes that are not in the direct communication range use intermediate node(s) to communicate with each other. (Wenjia and Anupam, 2004).

In this paper we will present the main security issues related to the OLSR ad-hoc networks routing protocol and some proposed methods to improve their security. We will analyze the impact of our changes using some performance tests implemented in OPNET Modeler.

In this paper we will address the problem of securing the OSLR routing protocol developed for ad-hoc networks. In the next chapter we will take an overview of routing protocols used in MANET, then we will identify the main security issues of OLSR protocol and, following that, in the last chapter we will present some proposals to improve its security.

2 Routing protocols

There are two main categories of routing protocols in MANET: DV (distance vector) and LS (link state).

In the LS protocols, each node keeps information about the complete topology of each link costs while in the DV protocols each node monitors only the necessary cost for its external links, but instead of broadcasting this information to all nodes, periodically sends to its neighbors an estimation of the shortest distance to any other node in the network.

To maintain the consistency of these costs, each node periodically broadcasts the costs of its external links to all the nodes using flooding. As each node receives this information, it updates his network information and applies an “shortest route” algorithm to choose the next node for each destination address.

In the DV protocols the nodes that receive this information use it to compute routing tables using an algorithm such as “shortest path”. (Jieanu and Lolea, 2011)

3 OLSR protocol

In OLSR protocol, each node can communicate directly with other nodes from the network. Being a proactive protocol, the network nodes creates routes proactively (by sending periodic routing updates) before there is a need to route traffic from a specific source to a specific destination.

OLSR contains an efficient mechanism for flooding of the routing messages throughout the network. The key concept used in the protocol is that of multipoint relays (MPRs). The purpose of MPR is to optimize flooding of the link-state updates. MPRs are selected nodes which forward broadcast messages during the flooding process. This technique substantially reduces the message overhead as compared to a classical flooding mechanism, where every node retransmits each message when it receives the first copy of the message. (Clausen and Jacquet, 2003)

OLSR uses hello and topology control messages (TC) to discover and disseminate link state information. The network nodes use this topology information to calculate next hop destinations using shortest hop forwarding paths.

4 Security issues

The OSLR protocol does not include special security mechanisms. Among the vulnerabilities there are: confidentiality, integrity and interaction with external routing domains. The network nodes using OLSR regularly broadcasts topological information. So if it is used in an unsecured wireless network, topology can be discovered by any listener of control messages. (Schiller and Defta, 2012)

In the OSLR case, each node sends topological information through the HELLO and TC messages. The exchange of HELLO messages between nodes has the scope of populating the neighborhood table and that of local links. The TC messages (Topology Control) are broadcast by each node to obtain the link-state information. (Zainea, 2009)

OSLR is a target for various attacks, but the most dangerous are presented below. The first category of attacks targets the generation of control messages. In this way, a malicious node sends control messages while pretending to be another legitimate node. HELLO and TC messages with a spoofed originator address can result in conflicting routes to a node with possible loops or connectivity loss, or cause incorrect links to be advertised. A malicious node could also forges an incorrect control message that appears to originate from an authorized node with the aim of making the authorized node appear untrustworthy. (Priyanka and Pritish, 2012)

In another attack scenario, a malicious node can alter control messages originating from other nodes before relaying them in order to have a detrimental effect on routing operation. This could also relay TC messages improperly to cause a breakdown in network connectivity, leaving some nodes unreachable. (Schiller and Defta, 2012)

Another attack common to OLSR protocol is the wormhole tunnel attack (see figure 1). This attack can be established by means of a wired link or another wireless link. After the tunnel is built, an attacker can copy packets from his neighbors and then these packets may be forwarded to other colluding attacker. (Nait-Abdesselam, Bensaou si Taleb, 2008)

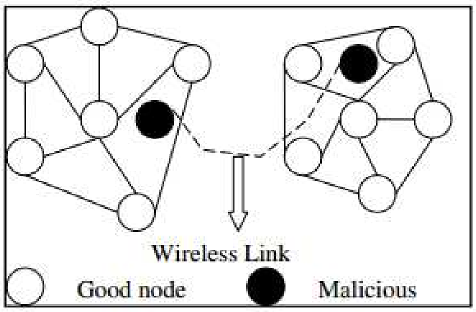

Figure 1. Wormhole tunnel atac

5 Security solutions

T.H. Clausen and others proposed (Clausen, Adjih, Jacquet, Laouiti, Muhltahler and Raffo, 2003) a way of securing OLSR protocol by using digital signatures for the authentication of OLSR messages. Also, they propose a timestamp mechanism against replay attacks, and outline two public key infrastructure systems for MANETs. They propose to include one signature for each OLSR message, not one for each OLSR packet. In addition to this, one timestamp is provided for each signature. (Hafslund, Tønnesen, Rotvik, Andersson and Kure, 2004)

SOLSR (Secure OLSR) was proposed by F. Hong, L. Hong, and C. Fu (F. Hong, L. Hong, Fu, 2005). It uses asymmetric signatures and hash chains to protect the protocol. Similarly to the hybrid protection scheme, the signatures in SOLSR cover all non-mutable fields of the routing messages. But SOLSR assumes all routing messages are signed. Bandwidth efficiency is not considered. The hash chains are used to protect the mutable TTL (time to live) and hop count fields, and do not serve as a proof of authenticity of unsigned messages as in the hybrid protection scheme. Each new SOLSR routing message contains both the seed and the anchor of a new hash chain. The hash anchor is included in the signed part of the routing message. The seed is updated by intermediate nodes. Hashing the seed received a number of times equal to the difference between the TTL and the hop count should return the hash anchor. The hybrid protection scheme leaves the TTL and hop count fields unprotected. (Hegland, Spilling, Nilsen and Cure, 2006)

In order to reduce the computation overhead and to reduce important energy costs, our proposed solution does not use digital signatures nor asymmetric signature. Instead, our proposed solution relies on IBE (identity based) authentication.

Our system contains the following modules: **key management, node reputation evaluation,** control message authentication and MPR nodes monitoring.

The IBE scheme was introduced by Shamir (Shamir, 1984). However, practical IBE schemes were an open problem until Boneh and Franklin (Boneh and Franklin, 2001) presented their scheme based on the Weil pairing. The public key of a node in IBE is easily generated based on its identity (i.e IP address, MAC address), while the private key is calculated by the private key generator (PKG). The purpose of the PKG is to provide a private key to every user in the system, allowing a node to sign and encrypt messages sent through an insecure communication channel and to decrypt and verify the messages received in a totally independent manner. (Ben-Othman and Benitez, 2012).

In the following paragraphs we will briefly describe the most important two modules from the proposed system: key management and reputation evaluation.

The **key management** module contains 4 algorithms for: initialization of system parameters, extraction phase, encryption phase and decryption phase.

In the initialization phase, we calculate the system parameters and the master key. In the extraction phase, the system will compute the public key Q_{ID} and the private key:

$$S_{ID}\ Q_{ID} = H_1(ID) \in K_1^* \tag{1}$$

$$S_{ID} = sQ_{ID} \tag{2}$$

The following notations have been used: $ID \in \{0,1\}^*$ represents the identity, Q_{ID} is the public key, while the H is a cryptographic hash function defined as:

$$H_1 : \{0,1\}^* \to K_1^* \tag{0}$$

The encryption phase calculates the encrypted message C, using the original message M and the node identity. It will select a random value r and will calculate the encrypted message:

$$C = \{rP, M \oplus H_2(g_{ID}^r)\} \tag{4}$$

$$g_{ID} = \varepsilon(Q_{ID}, P_{pub}) \tag{5}$$

The **reputation** module will be used to evaluate the reputation of all nodes from the network using two factors: the level of activity and the old node behavior. The following equations will be used to calculate the overall reputation based on the above defined factors:

$$Trust(a) = \frac{R_Q(a)^{1+R_p(a)} - 1}{R_Q(a) - 1} \tag{6}$$

where:

$$R_Q(a) = \sum_{j=1}^{h} \frac{Q_a[j]}{(h-j+1)^2} \tag{7}$$

and:

$$R_p(a) = \sum_{i=1}^{m} \beta_i C_i^P(a) \tag{8}$$

C_i^P represents the relative contribution factor of one node which was split in m areas. Each contribution should have different levels of importance in the system, so we noted β_i being the importance of the C_i^P. The used model is based on the model describes in (Ren and Boukerche, 2008). The essential difference between the metric used in (Ren and Boukerche, 2008) and the one proposed is that the new one considers the newest evaluations from the other nodes being more important than the older ones.

The node reputation will change based on their level of participation in the process of messages exchanged, but also according to the integrity of messages sent to other nodes. Finally, the overall node reputation will tend to represent the real level of confidence across the nodes in the network.

6 Performance evaluation

We have created in OPNET Modeler a basic implentation of our proposed enhanced OLSR protocol in order to measure the performances compared with its standard implementation. The network setup is presented in the Figure 2:

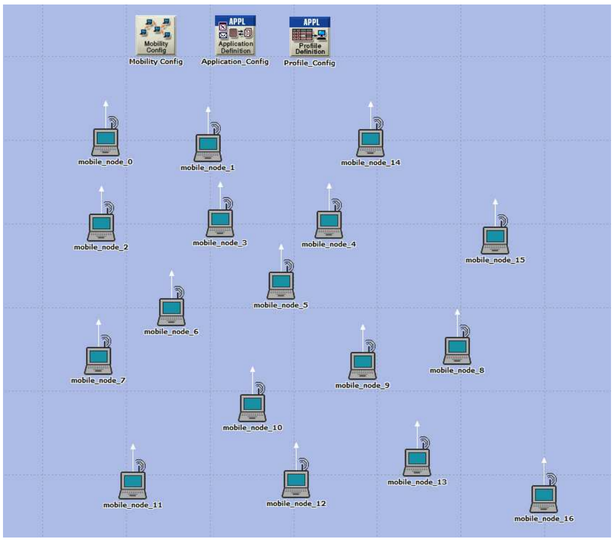

Figure 2. OPNET – OLSR network setup

The parameters measured are:

- Hello messages traffic – the total number of HELLO messages sent into the network. We can observe that there is a surplus of HELLO messages traffic, but the amount of new messages is within the normal operating system parameters, so the performance of the system is not affected.

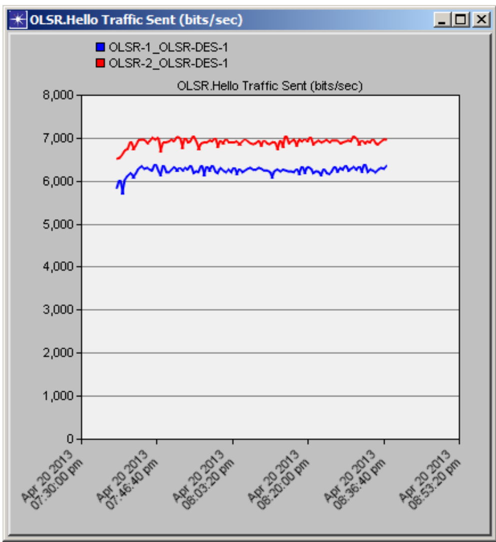

Figure 3. OLSR Hello messages traffic

• Routing traffic received – the total number of received traffic in bytes / second through all MANET nodes. During the simulation we can observe a small increase in the received traffic, but the difference is highly negligible, so the system performance is not affected at all.

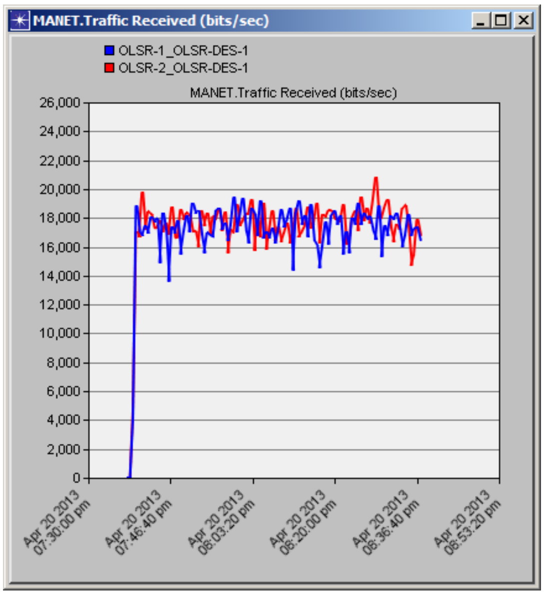

Figure 3. OLSR

7 Conclusions

In the first part of this paper we presented the main categories of routing protocols implemented in ad-hoc networks and we briefly described the OLSR protocol.

In the second part we focused on the MANET security issues and we presented also the security solutions proposed to solve certain vulnerabilities in the OLSR protocol. Also, using OPNET Modeler we demonstrated that the performance loss of the enhanced OLSR protocol is highly negligible in a common MANET environment (in this case with 17 stations).

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Information Security for Web and SQL Services

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Abstract

Over the past years, e-learning portals helped teachers to streamline learning process, users to decrease associated costs involved in traditional learning process and in this way customer satisfaction was increased and the impact of this teaching method increased worldwide.
Web and sql servers are two fundamental components for almost every e-learning application. In this paper we will categorize the most frequent security threats associated with these services and present the ways to mitigate an application security threat such as sql injection attack using the capabilities of a network device from a recognized leader in network security.

Keywords: Distributed databases, E-learning, Security, Web and SQL Services

1 Introduction

E-learning platforms have drastically improved the way people learn today. Users can easily access the learning application on their personal devices at any time, flexibility being one of the main advantages of such an application. Additionally, each user is able to learn according to his preferred strategy and in his own pace and so everyone can benefit from the value added learning process that the platform offers and enjoy learning. In this way, these types of online platforms help increase the productivity of the students and help them find a learning style that suits their needs.

Such an e-learning application model (Iacob-Ciobanu, 2012a; 2012b) based on Oracle Application Express web platform and Oracle distributed databases was developed in thesis "*Distributed databases. A dynamic model fully decentralized and automated*" (Ciobanu-Iacob, 2012). But this model require networks that support big data traffic, and these networks must be scalable to support increasing numbers of users to address the need for greater capacity and performance. As networks grow and support more and more services and applications, they become more vulnerable to security threats. To combat those threats and ensure that electronic applications are not hacked, security techniques (Ciobanu-Defta, 2011; 2012a; 2012b; Defta, 2010; Ciobanu-Defta and Ciobanu-Iacob, 2012) must play a fundamental role in any type of environment.

2 Web and sql servers security threats

Web applications are exposed to some specific vulnerabilities due to their method of access (web browsers) and integration with databases in backend. The actual web servers configurations commonly presents to users multiple web applications running on a single server and available through some standard network ports (80 and 443), giving attackers a big area to compromise.

There are many common attacks that can occur against different applications servers and they depend on the installed applications (for example web, sql, erp etc), operating system running on the server (for example Windows or Linux), and environment (network where the server is running). In this section we will briefly describe some of the generic attacks that can compromise the server (Boyles, 2010).

- Denial of service (DoS) - is an attack in which one system attacks another with the intent of consuming all the resources on the system (such as bandwidth or processor cycles), leaving nothing to use for other legitimate requests from normal clients. This is accomplished by increasing traffic on web site so much that the victim's server becomes unresponsive.
- Distributed denial of service (DDoS) – is an attack similar with DoS, but at a larger scale, because the attack is orchestrated from multiple systems from many countries around the globe.

  The most common DDoS attacks are:
    - Port scanning attack. A port scanning attack is performed by systematic scanning of a host using some programs. For example, an attacker can scan a Web server with the intention of finding exposed services or other vulnerabilities that can be further exploited.
    - Ping flooding attack. A ping flooding is a classical type of attack where the attacker send sends ICMP echo requests packets as fast as possible without waiting for replies.
    - SYN flooding. This attack requires knowledge of the TCP/ IP protocol suite because this is a network protocol targeted type of attack. In SYN flood the attacker sends a SYN packet to target host which then respond with SYN acknowledgement. In the end of communication, the attacker does not send any ACK packet back to the target host and this causes the connection to remain in half open state. TCP connection established to the attacker host is not ending, waiting for the session to expire. The attacker continue sending new SYN packets until TCP SYN queue is filled and cannot accept any new connections.
    - IP packet fragmentation attack. In this attack, an attacker change the TCP/IP protocol behavior to break packets up into smaller pieces, or fragments, that bypass most intrusion-detection systems.
- Password attacks. Password attacks can be implemented using different methods, including brute-force attacks and packet sniffers. Although packet sniffers can reveal user accounts and passwords, from network packet captures where an attacker can see in clear or decrypt some passwords, password attacks usually refer to specific attempts to identify a user account, password, or both. A brute-force attack is performed using some programs that run across the network and attempt to log in to the attacked server using various users and passwords. When a user account is compromised and if this account has enough privileges, the attacker can gain access to the system.
- Cross-site scripting or XSS is a technique that makes use of vulnerabilities in web applications. In a cross-site scripting attack, data is entered into an application which is later written back to another user. If the application is not coded is such a way to validate the data correctly, it may simply echo the input back allowing the insertion of malicious code into the web page.
- SQL injection type of attack search for a vulnerability in the database associated with a web application. The malicious code is inserted into strings that are later passed to the SQL server, parsed, and executed.
- Malware is a malicious software. It consist of viruses, bots, spyware, worms, trojans, rootkits, and any other software intended to disrupt normal user activity and collect personal data.

3 E-learning platforms security

In the diagram below (Figure 1), we figured a typical network and systems architecture for an e-learning platform (Baron et al, 2014), consisting of a database server and a web server to serve client requests. We choose an Adaptive Security Appliance from Cisco to defend servers from various security threats. Cisco ASA provide an end to end security solution, offering protection from OSI (Open Systems Interconnection model) layer 2 to 7. The built in IPS (Intrusion Prevention System) enhance firewall protection by looking deeper into the packets to provide real-time ip protection against worms, trojans, and exploits against application and operating systems vulnerabilities.

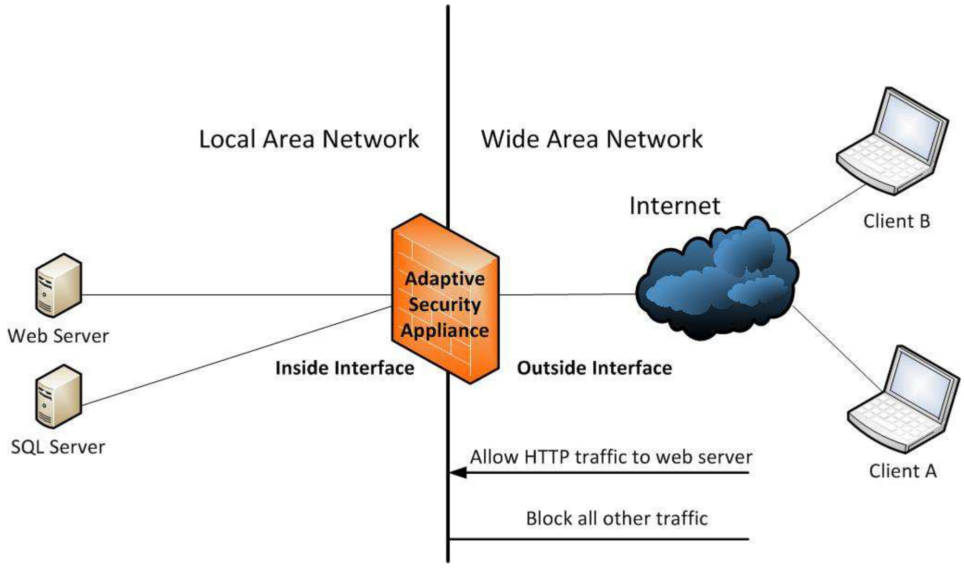

Figure 1. Typical network and systems architecture

The proposed defense system will be active at 2 osi layers:

- Layer 3 – ip layer;
- Layer 7 – application layer.

As a layer 3 firewall, we configured an access list on appliance that permits to enter in local area network only http traffic destined for the web server and have applied this access list on outside interface (the interface facing Internet). All other traffic will be dropped at the outside interface by the security appliance. By using such an inbound ip packet filter, the sql server is not exposed to the internet and web server is exposed only on port 80 (required to server http requests to students using e-learning web platform). If a packet is denied by the access list, the security appliance discards the packet and generates a syslog message indicating that such an event has occurred.

As a layer 7 – application firewall, we configured the appliance to protect servers from a sql injection attack. Those types of application attacks are frequently successful due to a number of factors:

- Secure programming techniques are not widespread. Programmers are usually under the pressure to deliver programming code as quickly as possible, so security is often forgotten.
- The layer 3 firewall described above is bypassed, because with public web services, the application is already accessible to the Internet users on port 80.

To understand what is a sql injection attack, we analyze the implementation of a login page that searches for records in a database which match the given username and password, like in example below:

```
$sql = "SELECT * FROM users WHERE username=\'$username\' AND password=\'$password\'; ";
```

If the input is not validated correctly, it would be possible to set $username and $password to be "' OR '1'='1". The resulting SQL query would be:

```
SELECT * FROM users WHERE username='' OR '1'='1' AND password='' OR '1'='1';
```

This SQL query will always return a non-empty result, bypassing the login procedure and enabling the attacker to access the application. By successfully exploiting an SQL injection vulnerability, the attacker could gain administrator access to the application or even the operating system where database is installed.

In order to detect the SQL injection attack, adaptive security appliance uses regular expressions (regex) embedded with Modular Policy Framework to inspect specific HTTP data patterns (Cisco, 2014). It will check for the SQL command “UNION ALL SELECT”. With the regex supplied from vendor documentation, this is the configuration on the appliance:

```
regex SQL_regex_1
“[uU][nN][iI][oO][nN]([%]2[0bB]|[+])([aA][lL][lL]([%]2[0bB]|[+]))?[sS][eE][lL][eE][cC]
[tT]“
regex SQL_regex_2
“[Ss][Ee][Ll][Ee][Cc][Tt](%2[0bB]|+)[^\r\x00-\x19\x7f
\xff]+(%2[0bB]|+)[Ff][Rr][Oo][Mm](%2[0bB]|+)”    //regex definition

class-map WebServers
match port tcp eq www
class-map type inspect http match-any SQL-map
match request body regex SQL_regex_1
match request body regex SQL_regex_2

policy-map type inspect http drop-SQL
parameters
body-match-maximum 3000
class SQL-map
drop-connection log     // when is a regular expression match, the ASA will drop the HTTP
connection   and generate a log
policy-map SQL-traffic
class WebServers
inspect http drop-SQL

service-policy SQL-traffic interface outside  //service policy for sql is applied in interface
outside
```

Beside the described techniques, some other protective measures (Tracy et al, 2007) must be taken into account to ensure systems security will be preserved:

- Updated systems – patches, service packs or updates that address bugs or system vulnerabilities should be applied to existing deployments.
- Systems permissions – least privilege principle should be implemented (the users that access the systems must have only the required set of permissions to be able to accomplish their work).

- Services and protocols – only those services and protocols required for the platform to function should be enabled, because other service or protocol that is present and enabled is just another potential hole that an attacker could further exploit.
- Network ports – monitor the opened network ports and close the others using an osi layer 3 firewall like the one described in this article.
- Antivirus software – this type of software must be updated daily and must be running on servers.
- Intrusion prevention systems should be implemented to detect suspicious network traffic.
- Web application firewalls should be installed to protect in depth against application layer attacks and information leakages.
- Application code – poor written code that does not adhere to the established security practices could let an attacker exploit major security holes found in it.
- Monitor and audit systems – permanently monitor applications and servers logs to track any suspicious activity.

4 Conclusion

Securing any type of server that run in a network environment is not an easy task. Web and sql servers are one of the most critical type of servers, because of the sensitive data they usually host. Appropriate security practices are essential to operating and maintaining a secure server, because security practices help ensure the confidentiality, integrity and availability of information system resources. All the security techniques described in this article help assure a very good protection for information systems and are the baseline for searching the perfect protection.

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Concurrency problems in distributed databases

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Abstract

Given the fact that the volume and the diversity of data grow considerably year by year, and an increased number of applications are available to more and more users, the problem of efficient data management rise because the data must be available at any time and must be accurate.

In this paper are presented the methods to prevent and solve the problems related to execution of distributed queries (transactions that operate in parallel, access common data and eventually can interfere one with another) by using concurrency control algorithms implemented in Java programming language. A client receives information in two scenarios: as a result of his primary request of receiving an object or as a server request sent to serve the primary request of another client. To avoid overlapping this actions (concurrency between primary actions and concurrency between a primary action and inter clients actions), a mutual exclusion mechanism is needed.

Keywords: Distributed databases, Distributed transaction, Concurrency control

1 Introduction

Definition 1.1. A distributed database (DDB) is a collection of relational data, logically interconnected but physically distributed on many workstations from a network (Ciobanu-Iacob, 2013; 2012a) that have a transparent distributed management system. The objective of transparency is to assure that a distributed system appear to users like a centralized one – this is often named the fundamental principle of a distributed database management system.

Definition 1.2. The concurrency control in a distributed database is the management of transactions that operate in parallel (the database is simultaneously accessed by many users), access common data and can eventually interfere one with another.

2 Concurrency problems

In case of a simultaneous update to an object performed by many users, the mutual exclusion mechanism is used. The method to solve concurrency problems is based on the following restricted problem, which does not affect the generality aspect of the theory.

Every client has a table b of elements from {0,1}, where b[i]=1 if and only if the client possess in his database object *i*. The clients are connected to the same server that does not have an owned database. The activity of a client *i* consist of requesting a specific object. For this request, it transmits to the server the object number. The server queries the clients and determines a client *j* that has this object. Client *j* returns the object to the server and the server returns the object to client *i*.

A client receive data in two contexts:

- As a result of his primary request of receiving an object
- As a server request received to satisfy the primary request of another client.

To avoid overlapping this actions (concurrency between primary actions and concurrency between a primary action and an inter-clients action) is necessary to realize a mutual exclusion. The solution consist of connecting every client to server using two separate threads (Georgescu, 2000; 2002; Georgescu and Vertan, 2000; Balanescu et al, 1999; Cowling et al, 2000):

- One thread allocated exclusively to primary request and, by mutual exclusion, does not permit to another client to connect to server for a similar request;
- The second thread to manage the object flow between clients.

Similarly, on the server are started two execution threads for solving the two actions described above on ports 1234, respectively 4321.

The class Client includes the client activity:

- On the first execution thread, corresponding to graphical interface, the client is connecting to server on port 1234 for primary requests.
- On the second execution thread, the connection to server is established on port 4321 for the second category of requests.

For connections the sockets are used. Java implementations are described below (Ciobanu-Iacob, 2012b).

```
import java.util.*;import java.awt.*; import java.awt.event.*;import java.io.*; import java.net.*;
public class Client {
  public static void main(String[] qqq) {
    Scanner sc = new Scanner(System.in);
    System.out.print("Name/Nume = "); String nume = sc.next();
    System.out.print("Server = "); String server = sc.next();
    C c = new C(nume,server);
    c.setSize(400,200); c.setVisible(true); }}

class C extends Frame {
  int nr = 5;  int[] b = new int[nr];
  Scanner sc = new Scanner(System.in);
  TextField tf = new TextField(); TextArea ta = new TextArea();
  Socket cs1,cs2;
  DataOutputStream dos1,dos2; DataInputStream dis1,dis2;

  public C(final String nume, String server) {
    System.out.print("b = ");
    for(int i=0; i<nr; i++) b[i] = sc.nextInt();
    System.out.print("I have objects/Am obiectele : ");
    for(int i=0; i<nr; i++)
      if(b[i]==1) System.out.print(i +" ");
    System.out.println();
    setTitle(nume);
    setLayout( new BorderLayout() );
    add("North",tf); add("Center",ta);
    tf.addActionListener( new ActionListener() {
      public void actionPerformed(ActionEvent e) {
        try {
          System.out.println("Object request/Cer obiectul "+tf.getText());
          dos1.writeUTF(e.getActionCommand());
```

```
      System.out.println("I have received/Am primit " + dis1.readInt());      }
    catch(IOException ioe) { }     }    } );
  addWindowListener(
    new WindowAdapter() {
      public void windowClosing(WindowEvent e)
        { System.exit(0); }     }    );
  try {
    cs1 = new Socket(server,1234);
    System.out.println("Connecting to/Conectare la " + server + " on port/pe portul 1234");
    dos1 = new DataOutputStream(cs1.getOutputStream());
    dis1 = new DataInputStream(cs1.getInputStream());
    dos1.writeUTF(nume);
    dos1.writeInt(b.length);
    for (int k=0; k< b.length; k++) dos1.writeInt(b[k]);
    // Fir1 fir1 = new Fir1(this); fir1.start();
    cs2 = new Socket(server,4321);
    System.out.println("Connecting to/Conectare la " + server + " on port/pe portul 4321");
    dos2 = new DataOutputStream(cs2.getOutputStream());
    dis2 = new DataInputStream(cs2.getInputStream());
    dos2.writeUTF(nume);
    dos2.writeInt(b.length);
    for (int k=0; k< b.length; k++) dos2.writeInt(b[k]);
    Fir2 fir2 = new Fir2(this); fir2.start();    }
  catch(IOException ioe) { }  }}

class Fir1 extends Thread {
  C Ob1;
  Fir1(C Ob1) { this.Ob1 = Ob1; }
  public void run () { }}

class Fir2 extends Thread {
  C Ob2; int i;
  Fir2(C Ob2) { this.Ob2 = Ob2; }
  public void run () {
    try {
      i = Ob2.dis2.readInt();
      System.out.println("Object requested/Mi se cere obiectul " + i);
      Ob2.dos2.writeInt(i);
      System.out.println("I sent the object to server/Am trimis serverului obiectul " + i);    }
    catch(IOException e) { }  }}
```

The server activities are described like this:

- It is mentioned first the class Elem which encapsulates for every client the socket where is connected and the related flows, the name of the client and table b that contains the client objects index.

```
import java.io.*; import java.net.*;
class Elem {
  Socket cs; String nume;
```

```
DataOutputStream dos; DataInputStream dis;
int[] b;
Elem(Socket cs, DataInputStream dis,
    DataOutputStream dos, String nume, int[] b) {
  this.cs = cs; this.nume = nume; this.dis = dis; this.dos = dos; this.b = b;  }}
```

The main class is Server class, which start an execution thread (type S1) for the communication through port 1234 and an execution thread (type S2) for the communication on port 4321.

```
class Server {
  static int i = -1;
  public static void main(String[] qqq) throws Exception {
    new S1(1234).start();;
    System.out.println("Port was activated/A fost activat portul 1234");
    new S2(4321).start();;
    System.out.println("Port was activated/A fost activat portul 4321");  }}
```

The execution thread of type class S1 creates in a collection al of type ArrayList an object of type Elem for every client and start an execution thread of type ServerFir1 for every client. The main action, which correspond to method tranzactie, performs mutual exclusion through synchronization of object al. Additionally, the case in which a client disconnects from server is taken into account.

```
import java.io.*; import java.util.*; import java.net.*;
class S1 extends Thread {
  ServerSocket ss;
  ArrayList<Elem> al = new ArrayList<Elem>();
    S1(int port) throws IOException {
    ss = new ServerSocket(port);  }
  public void run() {
    try {
      while(true) {
        Socket cs = ss.accept();
        DataInputStream dis = new DataInputStream( cs.getInputStream() );
        String nume = dis.readUTF(); int nr = dis.readInt(); int[] b = new int[nr];
        for(int k=0; k<nr; k++) b[k] = dis.readInt();
        System.out.println("Connection from/Conexiune de la " + nume +  " on port/pe portul 
1234");
        DataOutputStream dos = new DataOutputStream( cs.getOutputStream());
        Elem elem = new Elem(cs,dis,dos,nume,b);
        al.add(elem);
        new ServerFir1(this,elem);      }     }
    catch(Exception e) { }  }

void tranzactie() {
    synchronized(al) {
      while(Server.i != -1);    }  }

void removeConnection(Elem elem) {
```

```
Elem e;
synchronized(al) {
  System.out.println("Delete connection with/Sterge conexiunea cu " + elem.nume);
  for(Iterator i = al.iterator(); i.hasNext(); ) {
    e = (Elem) i.next();
    if(e.cs == elem.cs) {
      try { e.cs.close(); } catch(IOException w) { }
      break;        }      }    }  }}
```

In class ServerFir1 are stipulated the following actions: read of a primary request, the waiting time to solve it and the return of a message (the equivalent of sending the requested object).

```
import java.io.*; import java.net.*;
class ServerFir1 extends Thread {
  S1 server; Elem elem;
  ServerFir1(S1 server, Elem elem) {
    this.server = server; this.elem = elem;
    start();  }
  public void run() {
    try {
      while(true) {
        int i = Integer.parseInt(elem.dis.readUTF());
        Server.i = i;
        System.out.println(elem.nume + " request/cere : " + i);
        server.tranzactie();
        System.out.println("Send to/Trimit lui " + elem.nume + " object/obiectul " + i);
        elem.dos.writeInt(i);      }     }
    catch(EOFException e) { }
    catch(IOException e) { }
    finally { server.removeConnection(elem); }  }}
```

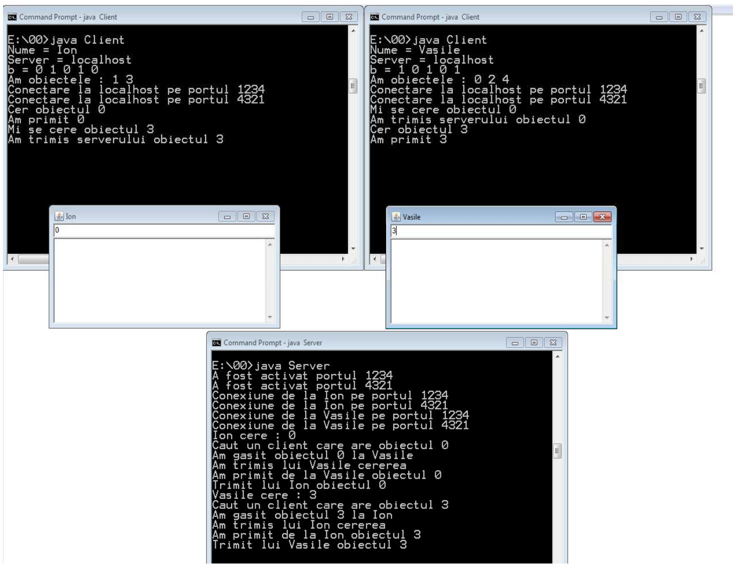

Figure 1. Request exemple

The execution thread of type class S2 creates in a collection al of type ArrayList an object of type Elem for every client and start an execution thread of type ServerFir2 for every client. The main action, which correspond to method cauta, returns the information about the client which contains the object requested in primary request. Additionally, the case in which a client disconnects from server is taken into account.

```
import java.io.*; import java.util.*; import java.net.*;
class S2 extends Thread {
  ServerSocket ss;
  ArrayList<Elem> al = new ArrayList<Elem>();
    S2(int port) throws IOException {
    ss = new ServerSocket(port);  }
  public void run() {
    try {
      while(true) {  .....    // Similar with action from S1, but on port/Analog cu actiunea din
S1, dar pe portul 4321      .....
        new ServerFir2(this,elem);      }    }
    catch(Exception e) { }  }

Elem cauta(int j) {
    Elem e; ObjectOutputStream dos;
    for(Iterator i = al.iterator(); i.hasNext(); ) {
      e = (Elem) i.next();
      if(e.b[j]==1) return e;    }
    return null;  }

  void removeConnection(Elem elem) {
    Elem e;
    synchronized(al) {         .....      // Similar with action from S1, but on port/Analog cu
actiunea din S1, dar pe portul 4321       .....} }}
```

In class ServerFir2 are stipulated the following actions: the identification of a client that owns the requested object, the request to this client, the answer received and the return of a message (the equivalent of sending the object to the client that sent the primary request). Additionally, the client that initiated the request is unlocked on port 1234.

```
import java.io.*; import java.net.*;
class ServerFir2 extends Thread {
  S2 server; Elem elem;
  ServerFir2(S2 server, Elem elem) {
    this.server = server; this.elem = elem;
    start();  }
  public void run() {
    int i;
    try {
      while(true) {
        while(Server.i==-1) ;
        i = Server.i; Server.i = -1;
```

```
System.out.println("Looking for a client that has the object/Caut un client care are obiectul " + i);
elem = server.cauta(i);
System.out.println("I found the object/Am gasit obiectul " + i + " la " +  elem.nume);
elem.dos.writeInt(i);
System.out.println("I sent to/Am trimis lui " + elem.nume + "   request/cererea");
System.out.println("I received from/Am primit de la " + elem.nume + " object/obiectul " + elem.dis.readInt());
try { Thread.sleep(50); } catch(Exception e) { }
Server.i = -1;      }    }
catch(EOFException e) { }
catch(IOException e) { }
finally { server.removeConnection(elem); }  }}
```

In the figure 1 is described a request from Ion for object 0, followed by a request from Vasile for object 3.

3 Conclusion

In conclusion, the process of creating a distributed database system is suitable when there are big databases storing big volumes of data, when there is the necessity to integrate various applications that run on different platforms or when the existing systems are frequently extended to support big volumes of data requested to support the actual business needs. In this paper is described the concept of concurrency control in distributed databases, showing the methods to avoid and solve the unexpected events using concurrency control algorithms implemented in Java programming language.

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An educational simulation tool to explore consumer behaviour in tourism

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Abstract

This paper presents a simulation environment to study consumer behaviour in the tourism market and aims to introduce students to the real world of work. After a brief description of the effectiveness of simulation in education, the paper describes the simulation tool and gives examples of tasks undertaken by students.

Keywords: Educational Simulation, Multi Agent based Simulation, Experential Learning

1 Introduction

Simulation is a representation of a real-world environment, system or process; it represents a natural solution for studying a real system that may not be observed directly due to inaccessibility, cost or danger (Rieber, 1996). Moreover, simulation is a research tool that provides useful and often essential insights into a large number of scientific and application sectors (Conte et al., 1998).

The effectiveness of simulation in education has been extensively demonstrated for teaching various topics as well as at different levels of education.

For example, according to a meta-analysis of 32 studies (Vogel et al.,2006), subjects utilizing interactive games or simulations show significantly higher cognitive gains and better attitudes toward learning compared to those using traditional teaching methods of education.

In the specific context of science education, a meta-analysis of 51 publications published in the period 2001-2010 shows the effectiveness of simulations to enhance or replace traditional means of testing results in science education (Rutten et al., 2012).

A more recent meta-analysis (Merchant et al., 2014) has further confirmed this result, highlighting the role of simulation as a robust addition to the existing traditional teaching methods.

In K-12 and higher education a meta-analysis of 7,078 articles (Kincaid & Westerlund, 2009) reports a positive effect of virtual reality technology-based instruction (i.e. games, simulation and virtual worlds).

All the studies report positive effects of using simulation, whether simulations are used as an addition to existing traditional teaching methods or as a replacement of parts of the curriculum.

Anyway, there are specific contexts (e.g. social phenomena) where computer simulations are the only way to support students in understanding phenomena by means of what Epstein called a generative approach (Epstein, 2007).

Since the seminal works of Schelling (Schelling, 1971; Schelling, 1978), the agent-based approach has been proposed as a natural paradigm to study social phenomena and it has become increasingly popular in recent decades with the development of artificial intelligence and computational theory. In fact, in the last few years the use of multi-agent based simulation

(MABS) as an approach that provides useful and often essential insights into a large number of scientific and application sectors has risen continuously (Salamon, 2011; Grogoul et al., 2003; Gentile et al., 2004; Epstein, 1999).

Moreover, numerous authors have recognized the effectiveness of MABS for the investigation of social and biological systems (Lopez-Paredes, 2012).

In recent years, the use of the agent-based approach to create simulations for the analysis of consumer behaviour has steadily increased (Said et al., 2001; (Brannon et al, 2000; Corniglion et al., 2011).

The aim of this paper is to present a simulation environment to study consumer behaviour in the tourism market. It was developed at our Institute to provide high school students with experience in managing a tourism company in a complex market in which players compete with other companies/players.

2 The simulated environment

The main feature of the proposed simulation environment is the flexibility in customizing the behaviour of each agent in the market, ensuring simplicity and usability of the system.

Thus the students work on the system by applying changes in real time to the various parameters that control the behaviour of individual agents in the market without having to modify the source code.

The behaviour of each agent is linked to a set of parameters that define their activation and the consequent effect on the market.

In order to explain the proposed environment, some basic considerations that define and regulate the simulation are set out.

The simulation was designed bearing in mind a segmented market. The students have the opportunity to segment the market into different customer categories , defining the characteristics of each category and the relative distribution in the market (Fig. 1). The customer types are defined by means of the distribution of five parameters that define the preferences of each customer with regard to a tourist product. These five parameters of the i-th type of customer define a characteristic vector named c_i.

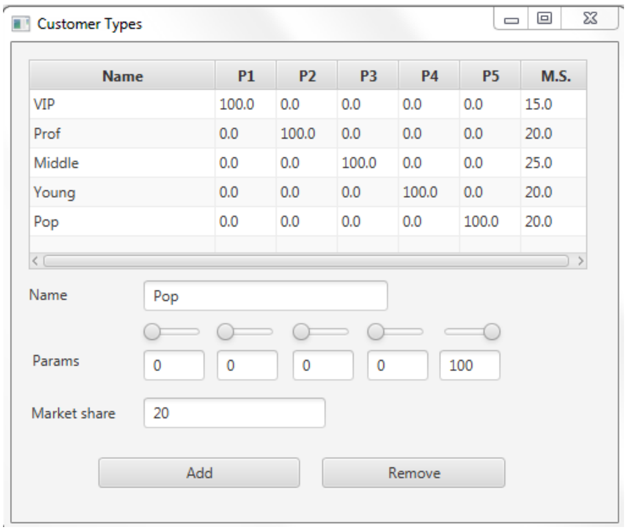

Figure 1. Customization of market customer types

Similarly, every other element (feature) involved in the simulation is characterized by a distribution of five parameters that can be summarized by the vector f_k .

[1] $$p_j = \sum_k a_{jk} f_k$$

The j-th tourism product p_j is defined as the linear combination of features where the parameter a_{jk} is the weight of the feature f_k in the composition of supply of the j-th village [1].

[2] $$b_{ij} = c_i \cdot p_j$$

For example, the simulation environment allows the users to modify the accommodation on offer in each village (Fig 2).

A comparison between the characteristic vector of the i-th customer and the characteristic vector of the j-th tourist product by means of the internal product [2] defines the closeness between the two vectors and therefore the value that the i-th customer gives to the j-th product.

Moreover, the simulation environment allows the students to change both the composition of the competing tourist products (changing the coefficients of the linear combination) and the intrinsic characteristics of the features that compose them (operating on the characteristic parameters of each feature).

Of course, the consumer's decision making process is not based exclusively on an evaluation of the quality of the products; in fact, the customer type is characterized by a specific propensity to spend that moderates his/her evaluation of each product.

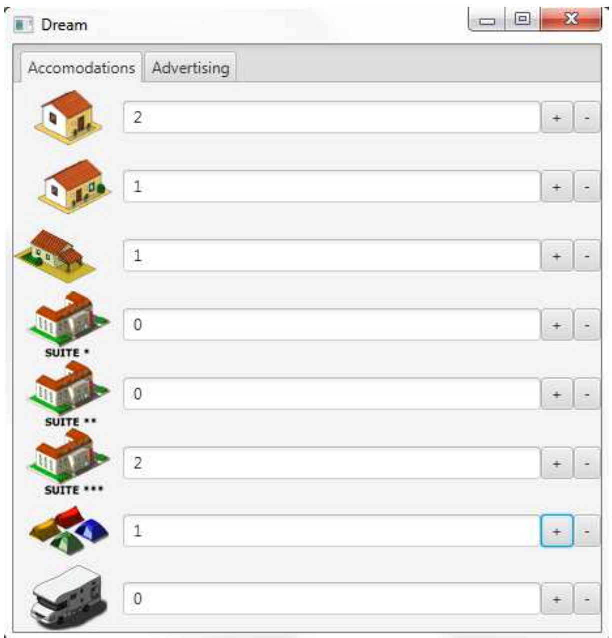

Figure 2. The village configuration interface

Finally, the simulation places great emphasis on communication and advertising aspects. In fact, the proposed simulation model is based on the assumption that a customer can only choose from the products that he actually familiar with; that knowledge is the result of advertising campaigns enabled by each company.

These campaigns are carried out using a set of communication channels that have different market penetration rates within the various customer categories. In this case, too, the student has the opportunity to define different communication channels and their penetration rate for each category of customer.

Once the communication channels have been defined, it is possible for each company to decide how much to invest in each communication channel (Fig.3).

While the simulation is running, the students will be able to monitor the degree of penetration of each company within the communication channels.

All of these issues have an impact on the evolution of the simulation. In order to understand the features of the simulation environment, the following section presents the contracting protocol of the vacation packages.

3 Contracting of vacation packages

This section describes the negotiation protocol of vacation packages and the behaviour of the agents involved. The negotiation protocol is based on a hybrid model of programming and exploits the characteristics of the event-driven systems as well as those which are time-driven. Messages exchanged between agents are the events that determine the timing and the evolution of the protocol. Moreover, some agents exploit an internal clock to activate specific behaviors.

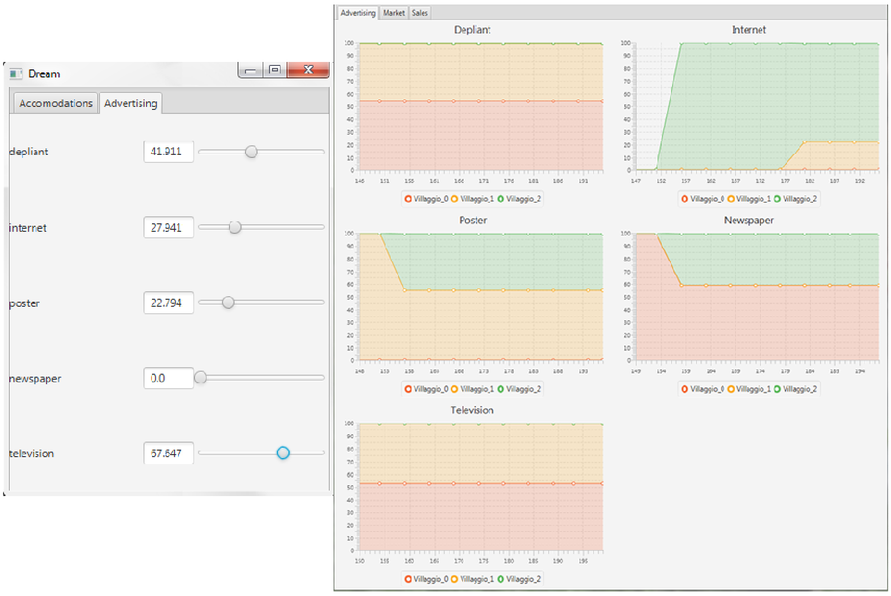

Figure 3. Monitoring of the advertising campaigns

The agents taking part in the contracting process are: Village, Advertising Broker, Campaign, Customer and Directory Facilitator.

The aim of the agent-village is to sell the vacation packages. The sales process consist of the following steps:

- advertising a vacation village

- collecting customer requests
- sending an offer
- communicating a booking

The agent-broker’s task is to collect requests for advertising services from the agent-villages and create advertising packages to be sent through promotional channels

The goal of the campaign-agent is to contact potential customers of the vacation package and advertise the villages’ offers. There are different types of campaign-agents, each specializing in a particular field of communication with a specific customer target.

The customer-agent has the goal of buying a vacation package which meets his requirements.

The Director Facilitator is a service agent that provides a yellow pages service. The facilitator keeps a list of all the agents in the system and makes access points available to contact the interested agents.

From the functional point of view of the simulation, students can exploit the user interface to modify the parameters determining market evolution. Any changes will be updated in real time in the contracting protocol and will immediately affect the agents’ behaviour and the evolution of the system.

The contracting process is a procedure that repeats itself in an infinite loop (Fig. 4). At each cycle of interaction, the village agent requests a service from the advertising agency broker-agent by sending the message "Service Request".

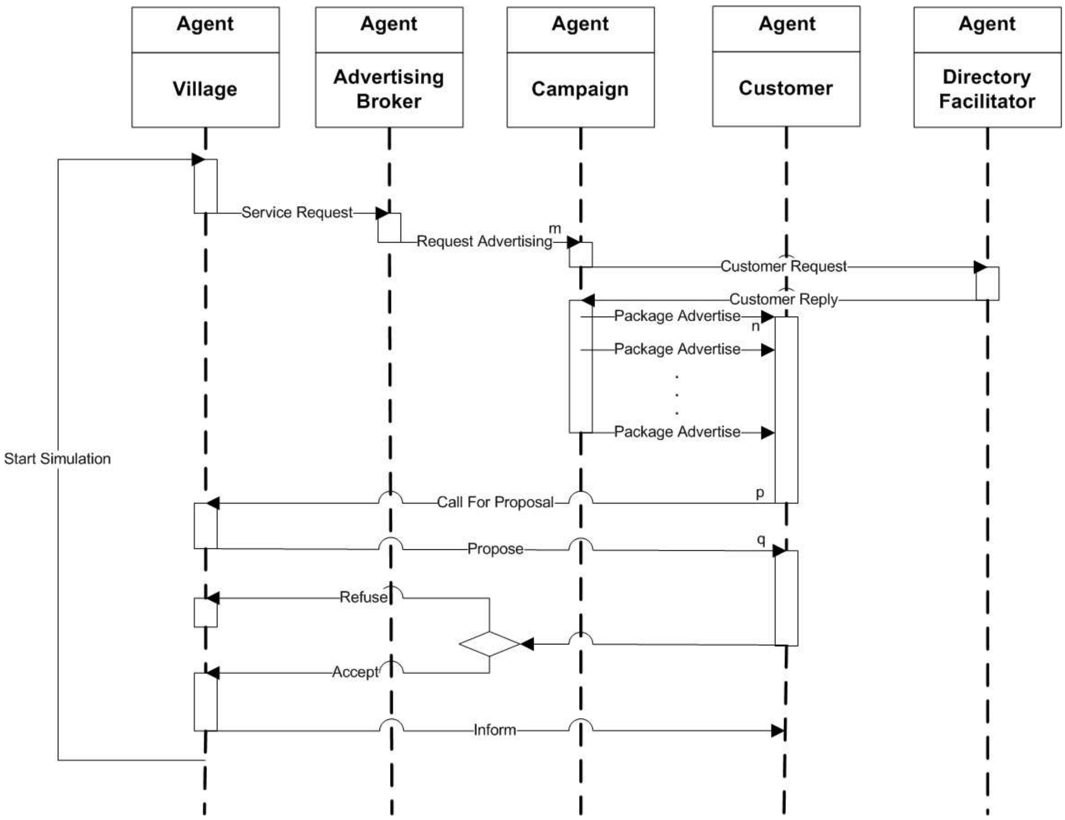

Figure 4. The contracting protocol

The request specifies the values that allow the broker to select the most suitable campaign-agents for the tourism advertising service. After selecting the communication channels, the broker sends a message (Request Advertising) containing the amount of advertising required and asking the campaign agent to initiate the advertising service. The campaign-agent who receives the request, first contacts the directory facilitator to have an updated list of agent-customers in the system (Customer Request and Customer Reply) and then begins to send advertisements by Package Advertise.

The amount of package advertising depends on how much money a player has invested in advertising.

To allow the customer to choose between the different villages' proposals, we have synchronized the entire village selection process.

After receiving the first Package Advertise, the customer agent will start a timer while waiting for Package Advertise from other villages; when the timer expires, the customer agent will start the decision making process and choose which villages to contact. The probability that the advertising persuade a customer agent to buy a vacation package depends on:

- specific client parameters,
- communication channels,
- the number of advertising messages.

In the event of a willingness to purchase, the customer agent sends a Call for Proposal message to the village. After the village Agent has received a Call for Proposal, he responds with a Proposal that sets out specifications of the vacation package. Finally, all the village agents' proposals are collected. The customer agent accepts or rejects the proposal by sending the messages Accept or Refuse.

When the village agent receives a message accepting a proposal, he sends an Inform message, informing the customer that the holiday has been booked.

5 Conclusion

In this paper a simulation environment to study consumer behaviour in the tourism market is presented.

The purchase decision-making process is a complex phenomenon that involves various areas of research such as psychology, marketing, sociology, economics and engineering.

Currently researchers are interested in using agents and multi-agent systems to simulate consumer behaviour and marketing dynamics (Zhang et al., 2007).

Even in the specific sector of tourism, the agent-based approach has confirmed its validity (Liang, 2014).

The efficacy of the agent-based approach to simulate market dynamics, combined with the flexibility of the approach and the relative simplicity of the models, makes it an effective tool for the definition of educational simulations.

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Distributed databases system model. Disaster recovery methods

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Abstract

As a result of increased demands for flexibility and high availability of big data volumes, the distributed database systems became a critical component for many systems implementations. In this paper is presented a system model and methods for data recovery. The proposed model is not affected by a single site failure, because data are replicated and the client requests will be served by other sites that contain valid replicas; if the entire database is affected, a restore process is initiated to bring system to the most recent database version.

Keywords: Distributed databases, System model, Disaster recovery

1 Introduction

Definition 1.1 A *distributed database system* is composed of a collection of local databases (Iacob-Ciobanu, 2012a; 2012b), placed in different geographical sites and logically connected by functional relations that appear to users as a single database, thus assuring the transparency.

2 System model

Let's consider an unbalanced distributed database system (Figure 1) that is formed by a number of *n* sites, (S_1, S_2,...S_n) and a global table *T*. A table *T* can be entirely stored on a single site S_i, i=1,n or can be horizontally fragmented (F_1,F_2,…,F_m) on a number of *m* sites (Ciobanu-Iacob, 2013; 2012a; 2012b; Șerb et al, 2014; Baron et al, 2014).

The dynamic characteristic of the model consist in the fact that the change of access models (read, write) must lead to the re-fragmentation and reallocation of fragments and creation or deletion of fragments replicas (the fragments replicas can change their rights) depending on the users data access histograms.

Database data access is continuously made. The old data is periodically removed and statistics will only include the recent visits. The statistics are stored using dynamic histograms. Whenever a tuple is accessed in one of the local replicas, the histogram is updated accordingly. Each site offers a set of histograms for each fragment that has a local replica.

Informations regarding fragmentation, the nodes where the copies are stored and the rights of the fragments (read/write) in nodes are realized by a common catalog service using a *distributed hash table*.

The proposed system model for an unbalanced distributed database system has two major components (Hauglid et al, 2010):

- the detection of replicas access models and
- given those statistics, decisions on re-fragmentation and reallocation will be made (the replicas of some fragments can change their own rights).

These decisions are taken by algorithms utilizing cost function which estimate the difference in future communication costs between the change of a given replica and keeping that replica on the actual condition. The proposed model is also efficient, a major concern being to obtain the best system response time with a minimum cost (Baron and Iacob-Ciobanu, 2014).

The model can also be applied in parallel databases, because each site takes decisions to partitionate, migrate and/or replicate fragments based on the available informations and the decisions are taken without statistics report or synchronization between sites.

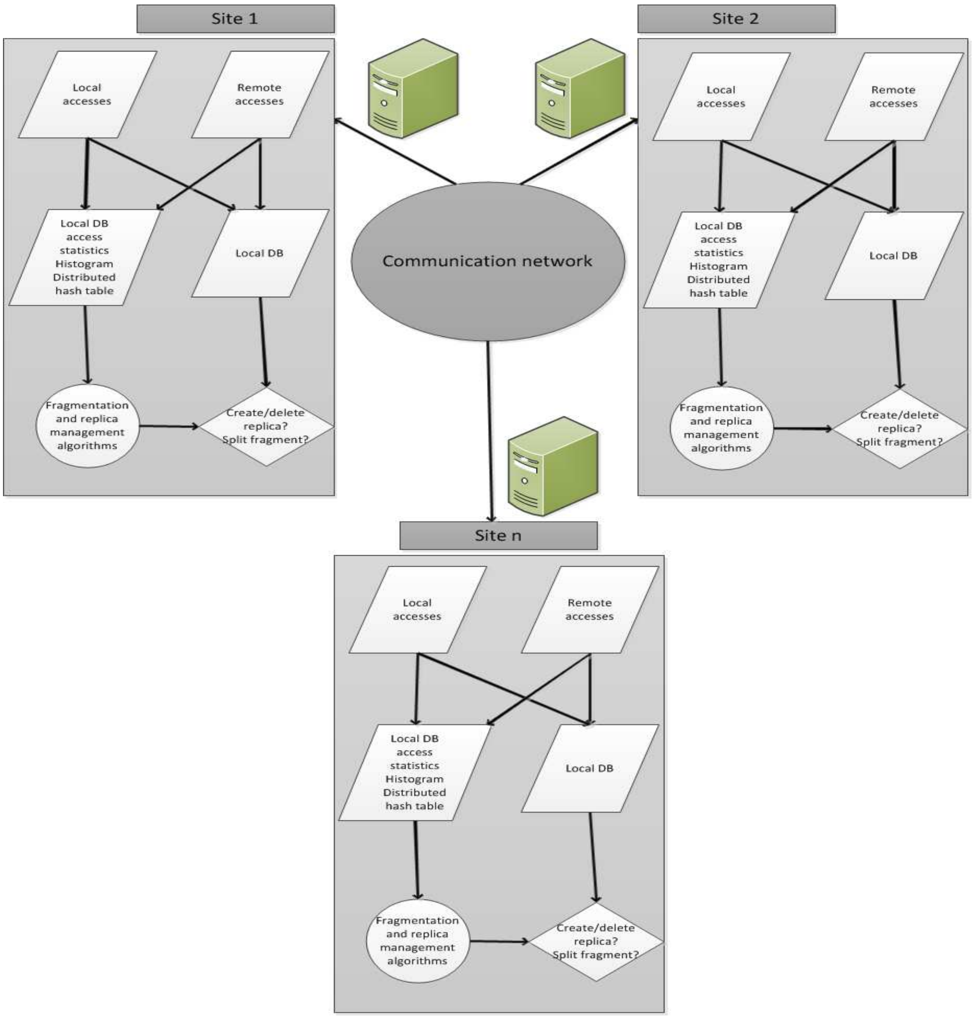

Figure 1. The distributed database from the proposed system model

3 Disaster recovery

In the described model two types of errors can appear:

- human errors (transactions successfully committed on some sites and unsuccessfully committed in other, blocks in one or many sites etc.);
- system errors (one or many sites failures, network problems etc.).

Data recovery is made depending on error type:

- data consistency affected when replication is made (because the update of the read replicas is made only after the update of master replica, some data accuracy problems may occur). The problem is solved in the beginning of an update transaction (Ciobanu-

Defta, 2011; 2012a; 2012b; Defta, 2010) by sending alert messages to sites that contain replicas with write access to data that will be updated (A read operation does not implies changes, but a write operation must be propagated to all the replicas found on network nodes; Ozsu and Valduriez, 2011);

- single site failure. The described model is not affected in case of a single site failure, because data are replicated and the future requests will be served by other sites which contains data replicas;
- entire database affected. The database will be restored from backup to latest state.

Given the fact that the proposed system model is based on Oracle object-relational database management system, the rman (Oracle Recovery Manager) utility will be used to perform database system backups and restores.

4.1 Database backups

In the proposed model, the three locations (site 1 - "BUCURESTI", site 2 – "TIMISOARA", site 3 - PARIS) are configured to run daily backup scripts using rman tool. The example below is based on BUCURESTI site, but is similar for the other sites. A script that will call file backup.rmn will be executed daily.

Script 4.1 Database backup procedure

Definition 4.1 Database backup is the activity of copying databases content so that they will be preserved in case of software or hardware failure.

set LOCAL_DIR=G:\Scripts //the path where the files will be saved
SET ORACLE_SID=BUCUREȘTI //database id
D:\ora10g\BIN\rman target sys/change2sys @%LOCAL_DIR%\backup.rmn //path where are located oracle binaries and rman

The content of file backup .rmn is explained below:

```
CONFIGURE CONTROLFILE AUTOBACKUP ON;  //to contain control file backup
CONFIGURE RETENTION POLICY TO REDUNDANCY 7; //to assure backup for 7 days
 CONFIGURE MAXSETSIZE TO UNLIMITED;
RUN {
  ALLOCATE CHANNEL disk1 DEVICE TYPE DISK format 'G:\%U_%n_%T_%s';
  ALLOCATE CHANNEL disk2 DEVICE TYPE DISK format 'G:\%U_%n_%T_%s';
  BACKUP DATABASE filesperset=2;    }
RUN {
  ALLOCATE CHANNEL disk1 DEVICE TYPE DISK format 'G:\%U_%n_%T_%s';
sql 'ALTER SYSTEM ARCHIVE LOG CURRENT';
crosscheckarchivelog all;
delete force noprompt expired archivelog all; //expired files are deleted (older than 7 days)
backup (archivelog all delete input);
crosscheckarchivelog all;
delete force noprompt expired archivelog all;
 }
```

Script 4.2 Database restore procedure

Definition 4.2 Database restore is the activity of recovering data consistency that has been altered.

For the proposed model, database restore is done by calling the following script:

```
C:>\set ORACLE_SID=<ORACLE_SID>
C:>\oradim –NEW –SID <ORACLE_SID> –STARTMODE m
C:>\orapwd  file=<ORACLE_HOME>\PWD<ORACLE_SID>.ora entries=10 password=xxxx
C:>\rman
RMAN>connect target sys/xxxxnocatalog;
RMAN>set DBID yyyyyyyyy     //initial database id
RMAN>startup force nomount;
RMAN>run { ALLOCATE CHANNEL disk1 DEVICE TYPE DISK format 'G:\%U_%n_%T_%s';
Restore sp file from autobackup;
release channel disk1;  }
RMAN>run { ALLOCATE CHANNEL disk1 DEVICE TYPE DISK format 'G:\%U_%n_%T_%s';
Restore control file from autobackup;
release channel disk1;  }
RMAN>run { ALLOCATE CHANNEL disk1 DEVICE TYPE DISK format 'G:\%U_%n_%T_%s';
restore database;
recover database;
}
```

Oracle recovery manager implementation

```
run
{
// Communication channel with database C1 is allocated. Backup set name is formatted and the read rate is limited to 8 Mbit/second to have available bandwidth for other database operations.
ALLOCATE CHANNEL C1 DEVICE TYPE DISK FORMAT 'C:\ora10\BUC%T_%p_%t%s' MAXPIECESIZE 4 G RATE 8 M CONNECT 'system/test@BUC';
// An entire database backup is done, including a copy of control file backup incremental level 0 cumulative as COMPRESSED BACKUPSET tag 'BUC0' database include current controlfile;
sql 'alter system archive log current';
backup as COMPRESSED BACKUPSET tag 'BUCARCHIVE1' archivelog all not backed up delete all input;
// Obsoleted backups are deleted
delete noprompt obsolete device type disk;
// Free channel and resources
RELEASE CHANNEL C1;
}
```

4 Conclusion

In today’s world, business applications availability is a permanent concern for every company and database backups are a critical component of every business continuity plan. It is important to categorize possible incidents and plan how the business will operate following an incident and how it expects to return to normal activity in the quickest possible time afterwards. In this article we presented a distributed database model and described disaster recovery methods depending on various type of incidents that could potentially lead to data loss.

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Designing a Virtual Physics Lab Using Labview

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Abstract

Physics experiments based on the use of traditional laboratory kits can no longer match up to the requirements of modern day teaching. The need to expand the frontiers of physics experiments beyond the common investigation area and the desire to reduce the data processing time have led us to the establishment of a virtual physics laboratory. Drawing on the didactically relevant results obtained by using virtual physics experiments in LabView, we decided to expand their area, so that the students could gain a broader and qualitatively enhanced perspective on the studied phenomenon. In the present paper we will illustrate the design of virtual experiments and we will provide some concrete examples from the fields of Mechanics, Thermodynamics, Electromagnetism and Optics which make up this virtual laboratory.

Keywords: LabView, Virtual laboratory, Ideal gas processes, Archimedes' Law, Refraction of light, Capacitor charge and discharge

1. Introduction

LabView is a graphic programming environment and an educational software which enables a teacher to design scientific and didactically relevant materials for his students which they may find very appealing and engaging, as the authors of some studies have pointed out (Cotfas, 2000; Munteanu and Logofătu, 2003; Oidov et al., 2012; Oprea and Miron, 2013). The wide range of instruments offered by LabView enabled us to build virtual experiments from all the fields of Physics through which we achieved a long-sought goal: the setup of a virtual laboratory. The presence of such a lab was a natural consequence of the development and implementation of the latest digital technologies in the Physics class. By adding a virtual component to the learning process we managed to enhance its quality and actively involve more student in the study of Physics.

We have to mention the fact that, although the virtual lab we developed in LabView includes many interesting experiments, we selected only a few examples for the present paper, from the field of Fluid Mechanics (Archimedes' Law), Thermodynamics (Ideal Gas Processes), Electricity (The Study of the Transient RC Series Circuit) and Optics (Refraction of Light – Critical Angle).

2. Virtual experiment of Fluid Mechanics – Archimedes' Law

On the Front Panel of the LabView application we designed three containers holding a liquid in which homogenous objects of different densities are immersed (Fig. 1).

Based on the value of the relation between the weight (G) and the archimedic force (F_A), the immersed objects:

1. may fully sink (immersion) – case (a): $G > F_A$
2. may float in balance at any level within the liquid – case (b): $G = F_A$
3. may rise to the surface of the liquid (ascension) – case (c): $G < F_A$

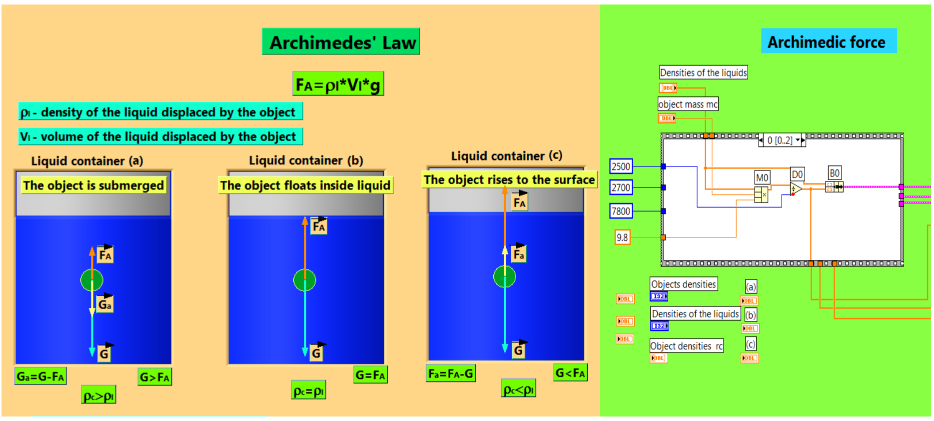


Figure 1. Archimedes' Law – LabView Front Panel and Block Diagram

Through this virtual experiment the students will study the dependence of the archimedic force F_A on the density of a liquid ρ_l in which an object is fully immersed.

The calculations are performed based on the relation $F_A = \rho_l \cdot \frac{m_c}{\rho_c} \cdot g$, where m_c and ρ_c stand for the mass and the density of the submerged object and where g reflects the value of the gravitational acceleration. The density values of the liquids and of the immersed objects are found in the tables within the application and must be introduced in the corresponding boxes (Fig. 2).

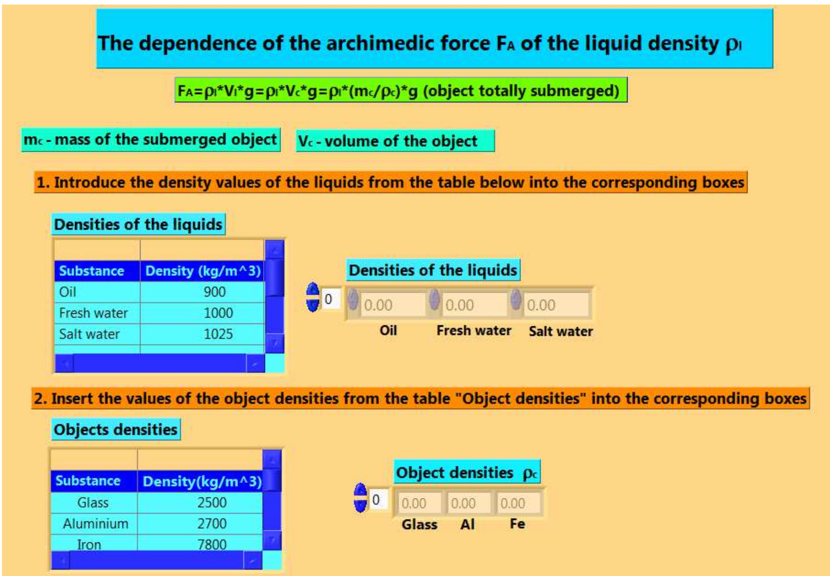


Figure 2. Archimedes' Law – LabView Front Panel (2)

For the case in which three objects of different materials (glass, aluminium, iron) of identical mass (m=0,5 kg) immersed in liquids such as oil, fresh water and salt water, the dependence of the archimedic force on the density of the liquid can be observed in the diagram below (Fig. 3).

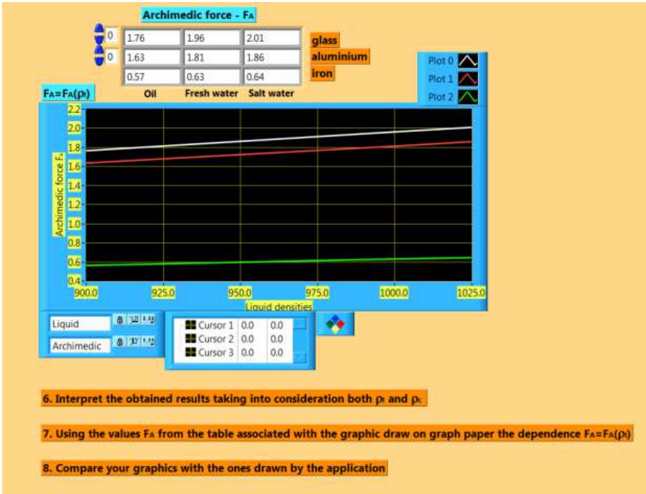


Figure 3. Virtual experiment results

3. Virtual experiment of Thermodynamics – The simple ideal gas processes

The simple ideal gas processes are: the isochoric process, the isobaric process, the isothermic process, the adiabatic process and the polytropic process (Fig. 4).

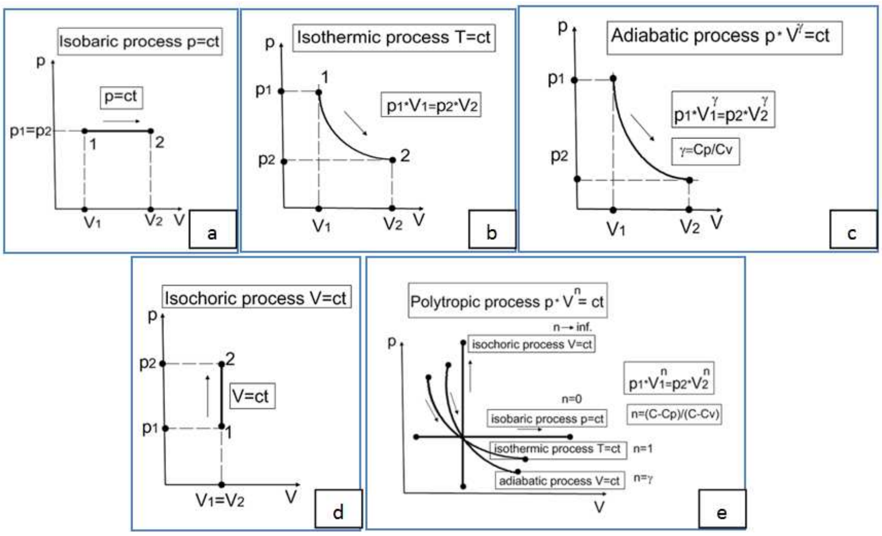


Figure 4. Ideal gas processes: (a) isobaric; (b) isothermic; (c) adiabatic; (d) isochoric; (e) polytropic

The Front Panel of the LabView application contains synthetic aspects of these processes (Fig. 5).

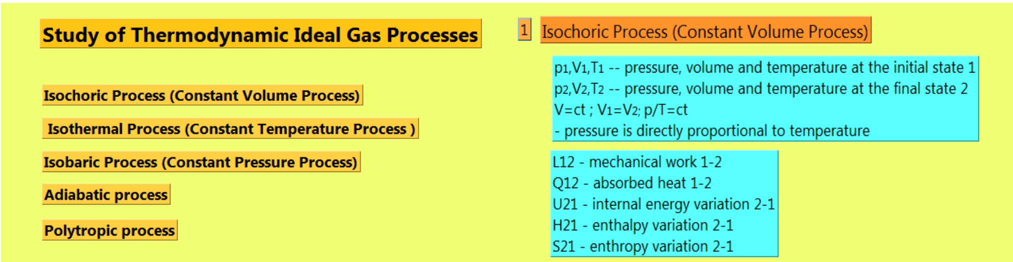


Figure 5. Study of Thermodynamic Ideal Gas Processes – LabView Front Panel

We will provide an example on how to design such an experiment focusing on the part dedicated to the isochoric process. In this section we introduced controls for the gas mass $\mathbf{m}$ found in the enclosure in which the experiment takes place, for the enclosure volume $\mathbf{V}$, for the initial temperature $\mathbf{T_1}$ and for the initial pressure $\mathbf{p_1}$ of the enclosed gas. Moreover, we placed the indicators for the calculated values of the mechanical work $\mathbf{L_{12}}$, for the heat $\mathbf{Q_{12}}$, for the internal energy variation $\mathbf{\Delta U_{21}}$, for the enthalpy variation $\mathbf{\Delta H_{21}}$ and for the entropy variation $\mathbf{\Delta S_{21}}$ (Fig. 6).

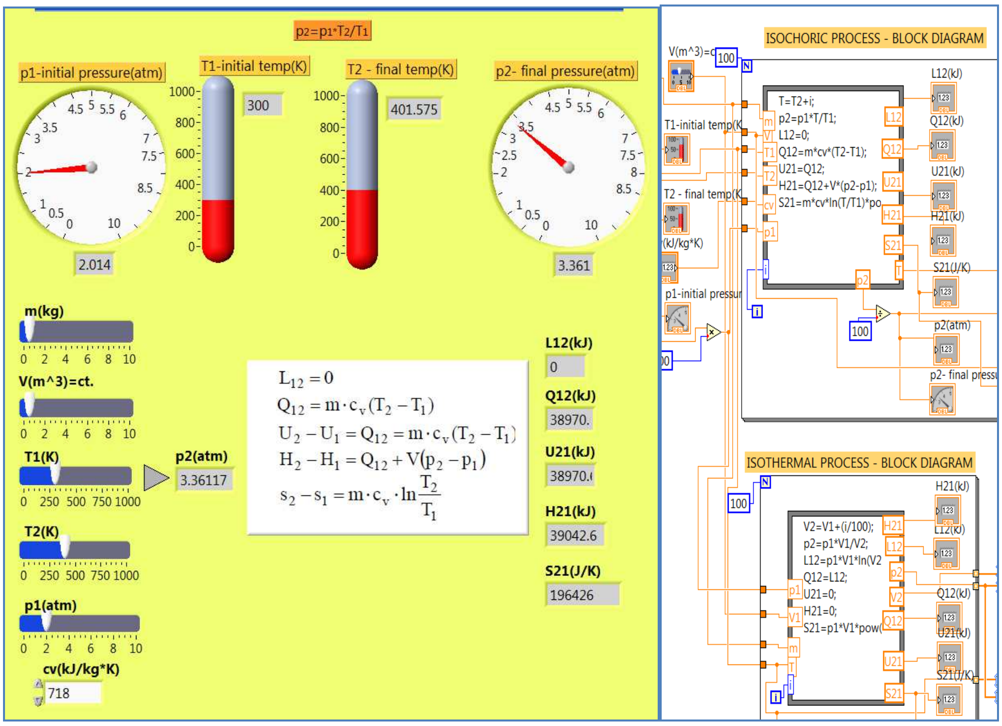
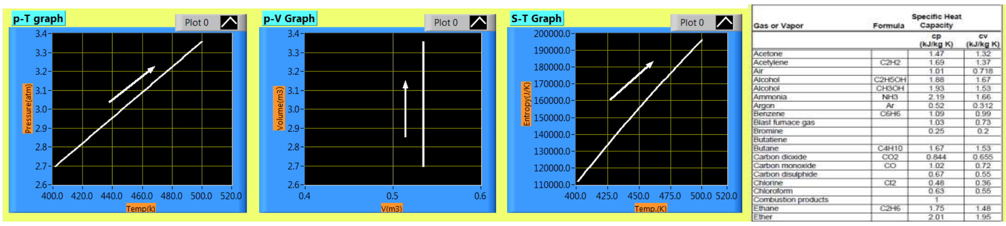


Figure 6. Isochoric process experimental values – LabView Front Panel and Block Diagram

Three diagrams p-T, p-V, S-T provide complex information on this thermodynamic process. A table which illustrates the specific heat $\mathbf{c_v}$ and $\mathbf{c_p}$ of certain gases completes the data base of the virtual experiment (Fig.7).



Gas or Vapor	Formula	Specific Heat Capacity cp (kJ/kg K)	cv (kJ/kg K)
Acetone		1.47	1.32
Acetylene	C2H2	1.69	1.37
Air		1.01	0.718
Alcohol	C2H5OH	1.88	1.67
Alcohol	CH3OH	1.93	1.53
Ammonia	NH3	2.19	1.66
Argon	Ar	0.52	0.312
Benzene	C6H6	1.09	0.99
Blast furnace gas		1.03	0.73
Bromine		0.25	0.2
Butatiene			
Butane	C4H10	1.67	1.53
Carbon dioxide	CO2	0.844	0.655
Carbon monoxide	CO	1.02	0.72
Carbon disulphide		0.67	0.55
Chlorine	Cl2	0.48	0.36
Chloroform		0.63	0.55
Combustion products		1	
Ethane	C2H6	1.75	1.48
Ether		2.01	1.95

Figure 7. Isochoric process diagrams p-T, p-V, S-T; table specific heats

4. Virtual experiment of Electricity - The Study of a transient RC series circuit

The purpose of this virtual experiment consists in the study of the charging and discharging of an electric capacitor (Fig.8).

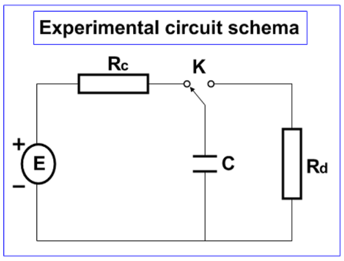


Figure 8. Experimental circuit schema

From a constant DC power supply E a capacitor C is charged through a series resistor R_c. The discharging of the capacitor is done through the R_d resistance. During the charging of the capacitor, its voltage varies according to the relation:

$$U_C(t) = E \cdot \left(1 - e^{-\frac{t}{\tau}}\right).$$

In the case of discharge, the variation of the voltage on the capacitor is based on the relation:

$$U_D(t) = E \cdot e^{-\frac{t}{\tau}}$$

In these two formulas, τ is the time constant of the circuit: $\tau = R \cdot C$, where R can take the values R_c and R_d. After a time interval $T = 5 \cdot \tau$, the transient regime comes to an end and the stationary regime is obtained.

We will further present some procedural aspects in the design of the virtual experiment. On the Front Panel we schematically drew a RC circuit powered from a DC power supply, whose functional regime (charge-discharge) is controlled through a toggle switch K (Fig.9).

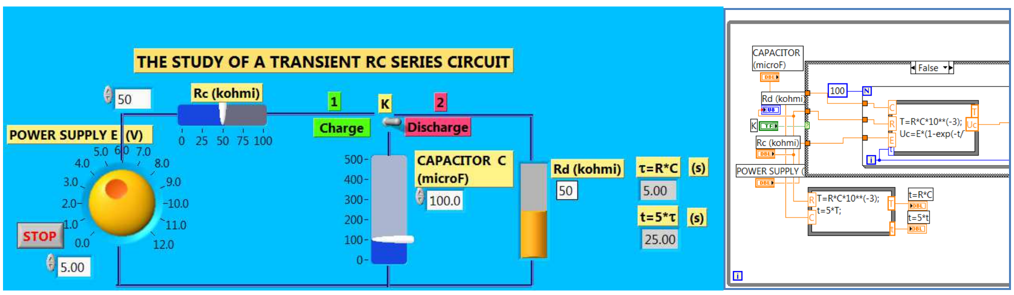


Figure 9. The Study of a transient RC series circuit - LabView Front Panel and Block Diagram

The capacitor is charging through the resistor R_c when the toggle switch K is in position 1 (charge) and is discharging through the R_d resistance when the toggle switch commutes on position 2 (discharge). The values of the time constant τ and of the duration T required to end the transient regime and reach the stationary regime T can be visualized in the corresponding boxes on this Front Panel. The experiment can be performed for different values of the voltage E and of the the groups (R_c, C) and (R_d, C). The charging and discharging graphics can be visualized in the diagrams $U_c(t)$, $U_d(t)$.

In the following section we included, as an example, the results obtained for different sets of values R_c, R_d, C, E (Fig.10).

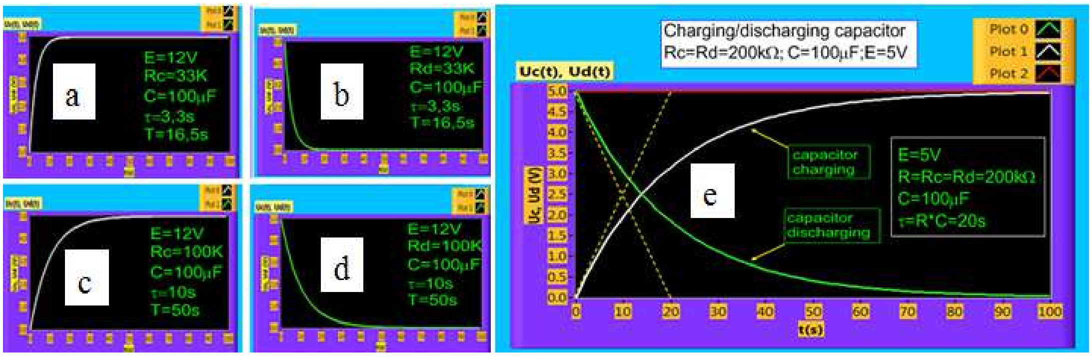


Figure 10. (a,b) $E = 12V$, $R_c = R_d = 33\text{kohmi}$, $C = 100\mu F$; (c,d) $E = 12V$, $R_c = R_d = 100\text{kohmi}$, $C = 100\mu F$; (e) $E = 5V$, $R_c = R_d = 200\text{kohmi}$, $C = 100\mu F$

5. Virtual Experiment of Optics. Refraction of light – Critical Angle

Through this virtual experiment we emphasize the dependence of the value of the refraction angle $\hat{r}$ on the value of the incidence angle $\hat{i}$ and on the relation of the refraction indexes $\frac{n_1}{n_2}$ for two adjacent physical environments crossed over by a ray of light. From the second law of light refraction $n_1 \cdot \sin i = n_2 \cdot \sin r$ we can determine the value of the refraction angle: $r = \arcsin(\frac{n_1}{n_2} \cdot \sin i)$.

For a certain value of the incidence angle, the refraction phenomenon no longer takes place and the total reflection of light occurs ($\hat{r} = 90^\circ$). This particular value of $\hat{i}$ is called critical angle and its notation is $\hat{l}$, while its value is $l = \arcsin(\frac{n_2}{n_1})$.

On the Front Panel of the LabView application we placed: a numeric control for the values of the incidence angle, two numeric indicators for the values of the reflection and refraction angle, a display for tracking the position of the incident, reflected and refracted rays compared to the normal one, as well as a table with the refraction indexes of some materials with optical properties of practical use. For example, when we have an optic interface water-air, given an incidence angle of 30°, we obtain a refraction angle of 22,08°. The value of the critical angle for this interface is aproximately 48,75° (Fig.11).

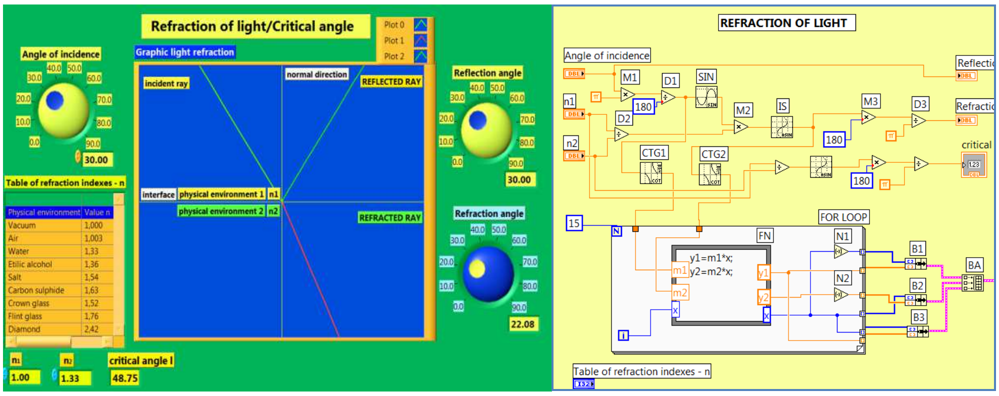


Figure 11. Refraction of light (water-air interface): i=30°, r=22,08 (left); Block Diagram (right)

We measured other values of l for the following interfaces: crown glass (n=1,52) – air (n=1,003), $l \approx 41{,}3^\circ$; diamond (n=2,42) – air(n=1,003), $l \approx 24{,}5^\circ$; diamond (n=2,42) – water (n=1,33), $l \approx 33{,}3^\circ$.

6. Conclusions

The simulation of Physics experiments using an application such as LabView is desirable when the studied physical phenomena may not be fully explored through common lab instrumentation. Thus, the implementation of a virtual lab in the Physics class becomes a necessary endeavour, which does not require considerable financial investments, but merely creativity and resourcefulness in working with a graphic programming environment such as LabView. It is worth noting that not only the teacher, but also the students can be involved in the design of a virtual experiment, a process through which the latters get a chance to significantly improve their capacity to work with physical and mathematical concepts.

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An Artificial Intelligence Software Application for Solving Job Shop Scheduling Problem

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Abstract
Job Shop Scheduling is an NP-hard problem and due to his complexity the researcher's attention was focused in this area in order to find the most suitable approaches. The current paper presents an implementation in this field of an artificial intelligence technique: Ant Colony Optimization. This probabilistic technique is inspired by the behavior of ants in their search of a source of food. The algorithm consists in a system of artificial ants that are able to communicate thru the pheromone trail and identify the best solution for the proposed problem. The algorithm is tested for different production scenarios and in order to identify the algorithm performance, a comparison with two classical scheduling algorithms is presented.

Keywords: Job Shop Scheduling Problem, Ant Colony Optimization, artificial intelligence, production scheduling

1 Introduction

Job Shop Scheduling (JSS) represents a complex optimization problem specific to operation research or computer science area that refers to the resource allocation to specific jobs a specific time values. This problem is considered to be a part of the NP-hard category given his complexity coming from the multiple constraints and objectives that needs to be fulfilled.

A new class of computational artificial intelligence techniques represented by Swarm Intelligence Techniques present a new approach for solving this challenging problem. These techniques represented by Genetic Algorithms (GA), Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO) and Artificial Bee Colony (ABC), are inspired by nature and are based on a population of agents-solutions that are able to interact with one another and with the surrounding environment in order to cover the solution search space.

In this paper is presented the implementation of the ACO technique adapted for solving Job Shop Scheduling Problem (JSSP). The proposed algorithm is tested for different production scenarios and different production demands and the obtained results are compared with a classical scheduling algorithm (First Come First Served).

2 Job Shop Scheduling Problem

Scheduling can be defined as the allocation strategy for all the shared resources in time for completing all the proposed activities. A scheduling problem complexity is proportional to the set of factors that are taking into consideration such as number of machines, number of products, machines breakdown and so on (Davis, 1985).

From the mathematically point of view the JSSP can be described as a set of n jobs $\{j_1, j_2 \dots j_n\}$, each job consisting in a specific set of operations, that must be processed on a set of m machines $\{m_1, m_2 \dots m_n\}$ (Yamada and Nakano, 1997). The solution of the JSSP is represented by a schedule composed by the accessing order of the machines for each job and the completion times associated with each operation.

The optimization of the JSSP consists in minimizing the total completion time (the required time for all the jobs to be completed).

In order to solved the JSSP, a set of constraints is imposed:

- At the start moment, all the machines and all the products are ready for processing;
- Each product is processed on a single machine at a time;
- Each machine can process a single product at a time;
- The operations are not preemptive;
- The transportation time is considered null.

Due to the JSSP complexity different approaches have been proposed in order to find an optimal solution: approximation methods (priority dispatch rules (Shahzad and Mebarki, 2010), shifting bottleneck (Balas et al, 1988), etc), stochastic methods (Simulated Annealing (Najid et al, 2002), Tabu Search (Ponnambalam et all, 2000), Genetic Algorithms (Pezzella et al, 2008), Ant Colony Optimization (Montgomery, 2007) and so on).

3 Ant Colony Optimization

The Ant Colony Optimization (ACO) method is based on a high structured organization of individuals that manage to complete tasks in a more efficient way that single individual are able to do (Dorigo and Stutzle, 2004). A set of software agents called artificial ants search the best solution by incrementally moving into the search space.

The artificial ant behavior is influenced by the communication with the other ants. The communication channel is inspired by nature and is represented by the pheromone trail which can guide them in the right direction. Pheromone values are modified and updated during the entire ACO algorithm.

The artificial ant probability to switch to a next state is influenced by two important values (Dorigo and Stutzle, 2004):

- The new state attractiveness calculated by a heuristic function which represent the general probability of moving to a new state;
- The pheromone trail level which indicates how efficient was that move into the past for other ants.

ACO Pseudocode

```
Begin
    for i=1 to nuber_of_ants do
        initialize_ant()
    while (!completion_criteria) do
            for i=1 to nuber_of_ants do
                while (current_state ≠ target_state) do
                        Calculate_movement_probability()
                        Update_ant_position()
                        Update_pheromone_trail ()
                evaporate_pheromone()
    Display solution
End
```

The candidate solution structure is adapted to the problem that needs to be solved. In figure 1 is presented a sample of the artificial ant representation that can be detailed as follow: first product that enters in the production process is the product type 3, series2, after that enters the product type 1, series 3 and so one until the end of the production sequence.

(3,2)	(1,3)	(3,1)	(3,3)	(1,1)	(2,1)	(1,2)	(2,2)	(2,3)

Figure 1. Artificial ant sequence sample

Each artificial ant represents a possible solution and in order to test the quality of the proposed solution a fitness function f was implemented. This function is calculated by taking into consideration the total completion time (C_{max}) for the proposed schedule and the total idle time for each machine in the system (I_{total}) as presented in equation 1 and need to be minimized.

[1] $$f = \frac{1}{C_{\max} + I_{total}}$$

4 Experimental Results

The ACO algorithm was designed using C++ language and QT creator development environment. The input data are composed of:

- The list of available machines;
- The list of products that needs to be processed and the number of required series for each one;
- The set of operations required for each product;
- The set of machines required for the operation set;
- The processing times for the operation set;
- The number of available artificial ants;
- Pheromone evaporation rate;
- Pheromone trail influence.

The production process requirements that represent the input data for the tested algorithm are presented in table 1.

Table 1. Production process requirements

Production Scenario	**List of available machines**	**Available products**	**Processing machine sequence**	**Processing time (minutes)**	**Required series**
S1	M1, M2, M3	P1_1	M1-M3	10-30	30
		P1_2	M2-M1-M3	25-10-10	30
S2	M1, M2, M3, M4, M5	P2_1	M1-M2-M5	15-20-10	40
		P2_2	M2-M3-M4-M5	10-10-10-10	20
S3	M1, M2, M3, M4, M5, M6, M7	P3_1	M2-M4-M7-M6	10-15-10-15	40
		P3_2	M1-M2-M4-M3	15-15-15-10	20
		P3_3	M2-M3-M5-M6	20-5-10-15	30
S4	M1, M2, M3, M4, M5, M6, M7	P4_1	M1-M2-M3-M7	10-10-5-10	50
		P4_2	M1-M2-M6-M5	15-10-15-10	20

		P4_3	M4-M5-M6-M7	20-15-10-10	30
		P4_4	M1-M4-M7	10-10-10	20
		P4_5	M1-M2-M3-M4-M5-M6	5-10-15-20-10-20	20
S5	M1, M2, M3, M4	P5_1	M1-M3	20-20	30
		P5_2	M1-M2-M4	15-15-15	30
		P5_3	M2-M3-M4	10-15-10	20
		P5_4	M1-M3-M2	20-5-10	30
		P5_5	M2-M1-M4	15-5-10	30

The input test parameters specific to ACO technique considered are presented in table 2.

Table 2. ACO parameters

Parameters name	Notation	Possible values
Number of ants	NA	10, 20, 30, 40
Pheromone evaporation rate	PER	0.2, 0.4, 0.6
Pheromone trail influence	PTI	0.2, 0.4, 0.6

The implemented algorithm was tested for all the production scenarios presented in table 1 and for all the ACO specific parameters included in table 2. In order to evaluate the algorithms' performance, the fitness function value of final solution is compared with the value of the fitness function calculated for the solution returned by a classical scheduling algorithm First Come First Served (FCFS). The synthesis of the final results is presented in table 3.

Table 3. Final results

Production Scenario	NA/PER/PTI	Best ACO fitness	Best FCFS fitness
S1	30/0.6/0.4	0.0271	0.1432
S2	40/0.6/0.4	0.0265	0.1784
S3	40/0.6/0.4	0.0841	0.4915
S4	30/0.6/0.4	0.0960	0.4582
S5	40/0.6/0.4	0.0561	0.2991

The final results presented in table 3 highlight the fact that the results obtain with ACO algorithm for solving the JSSP are superior to the results obtained by using a classical scheduling algorithm. It also can be stated that the best results are obtained for a higher number of ants and the more suitable values for the two ACO parameters (pheromone evaporation rate and pheromone trail influence) are equal to 0.6 and 0.4.

5 Conclusions

In this paper is presented an implementation of the ACO technique for solving a complex optimization problem – Job Shop Scheduling. The solution of this problem is represented by a schedule plan that manages to successfully allocate all the shared resources and to complete all the proposed activities, with the main objective of minimizing the total completion time of all the production process.

The implemented algorithm was tested for different production scenarios and production demands and the algorithms parameters were adjusted in order to obtain the best results.

A fitness function was implemented for testing the solution quality and measure the algorithm performances in comparison with a classical scheduling algorithm FCFS. The final results lead to the conclusion that the implementation of the ACO technique manages to obtain high quality solution, especially for a certain set of specific algorithms parameters.

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S e c t i o n

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Competitive design of the mechanical structure for a flying robot

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Abstract

Abstract: The paper presents the competitive development of the mechanical structure for a flying robot. Starting from a predetermined set of requirements, based on the present state of knowledge in the field, using competitive design tools and techniques the requirements were evaluated. Afterwards, they were used to identify the critical characteristics needed by the flying structure. The critical characteristics were evaluated against the requirements in order to identify the most important characteristics. The functions of the flying robot structure were also identified and evaluated. A series of constructive variations for the mechanical structure were design using computer aided graphics and evaluated through the use of computer aided engineering tools. In order to identify the most appropriate structure for the initially identified requirements, the constructive variants were evaluated against the critical characteristics. For the constructive variant identified as the most appropriate a set of studies were undertaken to determine the wing spam and the joining points for the wing elements. Using competitive development tools through a dedicated software package, combined with the use of computer aided engineering software packaged, all interested parties in the development of the robot were able to collaborate in an effective and efficient manner. The effect of the collaboration resulted in a biomimetic mechanism that closely replicates the wing movements of birds.

Keywords: competitive design, robots, mobile robot, flying robot

1. Introduction

The article presents the development of a concept of mechanical structure for a remote controlled spy drone. Starting from a set of restraints regarding the functionality, costs and weight, the authors made a literature study in order to identify the current status of the research. Based on the literature study were identified 4 architectural characteristics of the mobile flying platforms (drones), and they will be presented in the following paragraphs.

The first representative architecture is the *RQ-1 Predator model* (figure 1). This is an unmanned aircraft system, of medium altitude and high resistance (MALE UAV) used in surveillance and reconnaissance missions. The surveillance images captured with the synthetic angle radars, video cameras and infrared perspective (forward-looking infrared, FLIR) can be distributed in real time not only to the soldiers on the field but to the commanding officer, or at a global level through communications satellites.

Habu 2 EDF from *Parkzone* (figure 2). The aircraft has the following specifications: 920 mm wide, 1100 mm length, 1470 g weight, the brushless engine is 3200 kV (rotations per minute per volt), and engine controller of 60 A.

The AR. 2.0 Quadrocopter from Parrot (figure 3) is a four propeller drone, with a robust structure which weighs only 420 grams. The drone is equipped with an HD video camera, at 30 frames per second, a 32 de bits ARM processor with a 1Ghz frequency, 1GB DDR2 RAM, wireless, gyroscope, accelerometer and magnetometer, each on 3 axes, and pressure and ultrasound sensors. Each propeller is driven by a brushless engine of 14.5 W and 28500 rotations/minute [www11].

Fig. 1 MQ-9 Reaper Drone [www01]

Fig. 2 Habu 2 EDF [www02]

The Ornitopter (figure 4) is an aircraft powered by the beating wings. These miniature aircrafts are meant to imitate birds and insect in order to achieve unseen flying abilities. [Jac09].

Fig. 3 AR. Drone 2.0 [www03]

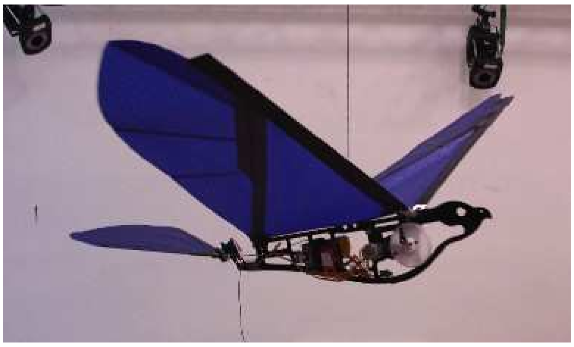


Fig. 4 Ornitopterul Kestrel [Jac09]

2. The competitive development of the concept

The development of the concept was performed during three stages. ***The first stage*** consisted in the identification of the specifics and their importance, identifying the critical characteristics for flying mobile platforms, their functions, the relations between these elements and the existing architectural analysis regarding their ability to satisfy the demanding requirement. ***The second stage*** consists on the development of its own architecture, followed on ***the third stage***, by the architectural detailing identified as the most appropriate.

2.1. *Stage 1*

Based on the literature study were identified a series of demands. Using the “Voice of the people” method were determined critical demands for the platforms and the functions which these must satisfy (figure 5). The voice of the people represents a process in which are met the requirements, needs, preferences and expectations of the product.

Having identified the requirements, the hierarchic analysis process (figure 6) was used for in order to identify the relative importance of each demand. The first 3 more important requirements which were identified are: being hard to detect (12.6%), flying (12.5%) low noise (12.2%).

Fig. 5 The table representing the "Voice of the people" method

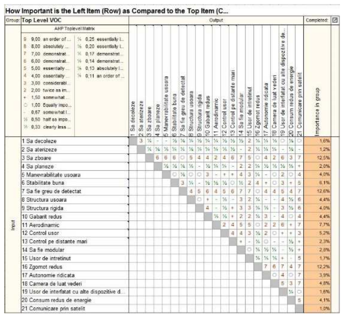


Fig. 6 Determining the relevant importance of the requirements

For attaining the results, the geometric mean method was used. The formula used is [Ber95]:

$$R_i = \frac{(\Pi_{j=1}^{n} a_{ij})^{\frac{1}{n}}}{\Sigma_{i=1}^{n} (\Pi_{j}^{n} a_{ij})^{\frac{1}{n}}} \tag{1}$$

Where:

- R_i represents the importance index of requirement "i"
- a_{ij} represents the relation between element "i" and element "j"

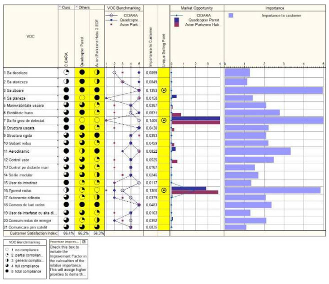


Fig. 7 Benchmarking comparative with the clients requirements

CTQs	Specification Data			Optimization	Specification Range	
	Measurement Standard	Metric Unit	Data Type		Ideal value	Marginal value
1 Masa mai mica de 5 kg	ISO	kg	numeric	↓	3,00	5,00
2 Volum mai mic de 0.7 m cubi	N/A	m cubi	numeric	↓	0,40	0,70
3 Viteza mai mare de 2.22 m/s	ISO	m/s	numeric	↑	4,16	2,22
4 Zgomot mai mic de 80 dB	N/A	dB	numeric	↓	30,00	80,00
5 Distanta mai mare de 500 m	ISO	m	numeric	↑	1.000,00	500,00
6 Frecventa mai mare de 3 Hz	ISO	Hz	numeric	↑	6,00	3,00
7 Inaltime mai mare de 185 m	ISO	m	numeric	↑	200,00	185,00
8 Timp de asamblare mai mic de 60 s	ISO	s	numeric	↓	60,00	120,00
9 Tensiune electrica de 5 V	ISO	V	numeric	○	5,00	5,00
10 Curent electric mai mic de 2 A	ISO	A	numeric	↓	1,00	2,00

CTQs Optimization	
Optimization	
↑ 1,00	maximize
○ 0,00	exact

Fig. 8 Defining the quality characteristics of the product

The comparative Benchmarking of the clients' requirements (figure 7) presents the way in which the three constructive versions, meaning *the Ornitopter*, *the Quadrocopter*, *the Parrot* and the *Parkzone's Habu 2 EDF*, can satisfy each requirements. Considering the analysis, the satisfaction indices which were determined for each version are: 86.4% for *the Ornitopter*, 66.2% for *the Quadrocopter* respectively 56.3% for the *Parkzone aircraft*. Therefore, the constructive version which satisfies best the identified requirements is the *Ornitopter*.

Figure 8 presents the critical technical characteristics of the product. It specifies the standard, the measuring unit and their type of data. They are optimized to show their tendencies: maximum, minimum or exact. The ideal and marginal values are also specified.

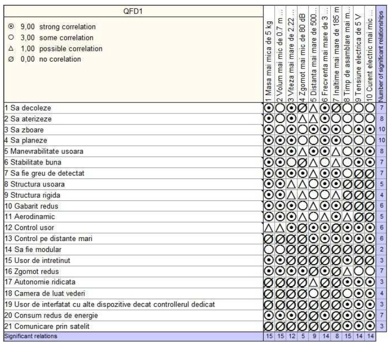


Fig. 9 QFD1

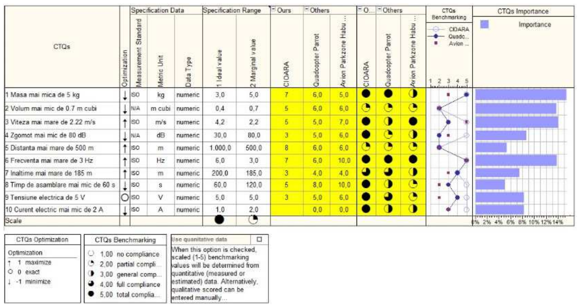


Fig. 10 Technical characteristics comparative benchmarking

The QFD1 method (figure 9) shows the correlations between the client's requirements and the technical quality characteristics, meaning how much contribution the improvements of the latter have on achieving the requirements. The strong correlation is ranked with 9 points, a certain correlation with 3, and possible correlation with 1 and no correlation with 0 points. The comparative Benchmarking of the characteristics (figure 10) show how much the quality technical characteristics are met by each constructed version and also their importance.

The importance value of each characteristic is obtained with the formula [Ber95]:

$$W_j = \sum_{i=1}^{n} R_i \cdot a_{ij} \qquad j=1,...,m \tag{2}$$

where:

- 'a_{ij}' represents the relation between element "i" and element "j"
- 'R_i' represents the requirement importance index 'i', i=1,...,n,
- 'W_i' the walue weight of characteristic 'j', j=1,...,m

The relative importance value of each characteristic is obtained with the formula:

$$W_j^{rel} = \frac{W_j \cdot 100}{\sum_{t=1}^{m} W_t} \qquad j=1,...,m \tag{3}$$

The QFD1 method* shows the correlation between the clients demands and the product's function meaning in which manner the implementation of the functions satisfies the requests.

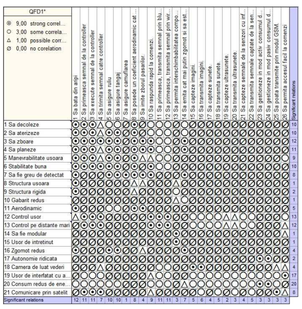


Fig. 11 QFD1*

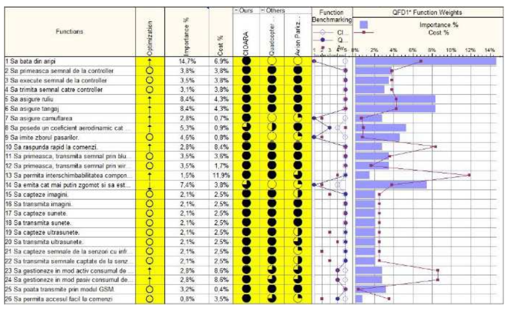
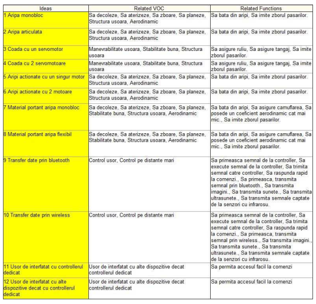


Fig. 12 The comparative Benchmarking of the functions

Figure 12 presents the comparative Benchmarking of the functions. The most important functions which were identified are: flapping their wings, ensure the roll, to ensure the pitch, to poses an aerodynamic coefficient as high as possible, to imitate the birds' flight, to make as less noise as possible and to subdue the noise it makes.

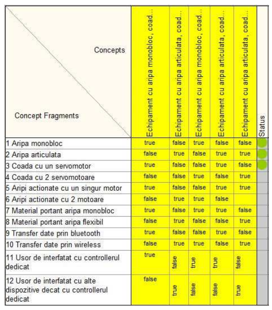
2.3 <u>*Stage 2*</u>

The concept's fragments (figure 13) present several solutions, ideas regarding the embodiment of the constructive version. For each idea will be noted the associated the requirements and functions. The morphological analysis (figure 14) offers the possible solutions by combining the concept's fragments. Five fragments will form a constructive solution. In the central area will be mentioned which fragments will form the solution.



Ideas	Related VOC	Related Functions
1 Aripa monobloc	Sa decoleze, Sa aterizeze, Sa zboare, Sa planeze, Structura usoara, Aerodinamic	Sa bata din aripi, Sa imite zborul pasarilor.
2 Aripa articulata	Sa decoleze, Sa aterizeze, Sa zboare, Sa planeze, Structura usoara, Aerodinamic	Sa bata din aripi, Sa imite zborul pasarilor.
3 Coada cu un servomotor	Manevrabilitate usoara, Stabilitate buna, Structura usoara	Sa asigure ruliu, Sa asigure tangaj, Sa imite zborul pasarilor.
4 Coada cu 2 servomotoare	Manevrabilitate usoara, Stabilitate buna, Structura usoara	Sa asigure ruliu, Sa asigure tangaj, Sa imite zborul pasarilor.
5 Aripi actionate cu un singur motor	Sa decoleze, Sa aterizeze, Sa zboare, Sa planeze, Structura usoara, Aerodinamic	Sa bata din aripi, Sa imite zborul pasarilor.
6 Aripi actionate cu 2 motoare	Sa decoleze, Sa aterizeze, Sa zboare, Sa planeze, Structura usoara, Aerodinamic	Sa bata din aripi, Sa imite zborul pasarilor.
7 Material portant aripa monobloc	Sa decoleze, Sa aterizeze, Sa zboare, Sa planeze, Stabilitate buna, Structura usoara, Aerodinamic	Sa bata din aripi, Sa asigure camuflarea, Sa posede un coeficient aerodinamic cat mai mic., Sa imite zborul pasarilor.
8 Material portant aripa flexibil	Sa decoleze, Sa aterizeze, Sa zboare, Sa planeze, Stabilitate buna, Structura usoara, Aerodinamic	Sa bata din aripi, Sa asigure camuflarea, Sa posede un coeficient aerodinamic cat mai mic., Sa imite zborul pasarilor.
9 Transfer date prin bluetooth	Control usor, Control pe distante mari	Sa primeasca semnal de la controller, Sa execute semnal de la controller, Sa trimita semnal catre controller, Sa raspunda rapid la comenzi., Sa primeasca, transmita semnal prin bluetooth., Sa transmita imagini., Sa transmita sunete., Sa transmita ultrasunete., Sa transmita semnale captate de la senzori cu infrarosu.
10 Transfer date prin wireless	Control usor, Control pe distante mari	Sa primeasca semnal de la controller, Sa execute semnal de la controller, Sa trimita semnal catre controller, Sa raspunda rapid la comenzi., Sa primeasca, transmita semnal prin wireless., Sa transmita imagini., Sa transmita sunete., Sa transmita ultrasunete., Sa transmita semnale captate de la senzori cu infrarosu.
11 Usor de interfatat cu controllerul dedicat	Usor de interfatat cu alte dispozitive decat controllerul dedicat	Sa permita accesul facil la comenzi
12 Usor de interfatat cu alte dispozitive decat cu controllerul dedicat	Usor de interfatat cu alte dispozitive decat controllerul dedicat	Sa permita accesul facil la comenzi

Fig. 13 The concept's fragments

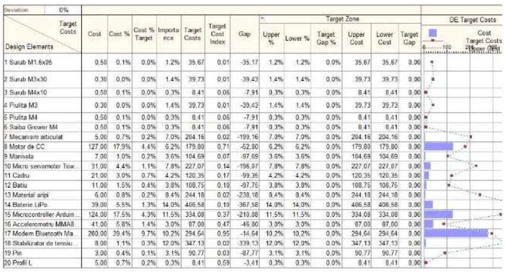


Concept Fragments / Concepts	Echipament cu aripa monobloc, coad...	Echipament cu aripa articulata, coad...	Echipament cu aripa monobloc, coad...	Echipament cu aripa articulata, coad...	Echipament cu aripa articulata, coad...	Status
1 Aripa monobloc	true	false	true	false	false	
2 Aripa articulata	false	true	false	true	true	
3 Coada cu un servomotor	true	false	false	true	false	
4 Coada cu 2 servomotoare	false	false	true	false	true	
5 Aripi actionate cu un singur motor	true	false	false	true	true	
6 Aripi actionate cu 2 motoare	false	true	true	false		
7 Material portant aripa monobloc	true	false	true	true	false	
8 Material portant aripa flexibil	false	true	false	false	true	
9 Transfer date prin bluetooth	true	false	false	true	false	
10 Transfer date prin wireless	false	true	true	false	true	
11 Usor de interfatat cu controllerul dedicat	true	false	true	true	false	
12 Usor de interfatat cu alte dispozitive decat cu controllerul dedicat	false	true	false	false	true	

Fig. 14 The morphological analysis

2.3 <u>*Stage 3*</u>

The table with the target costs (figure 15) of the design elements is calculated considering the importance of the target costs of the elements. It is determined the inferior and superior limits of the target costs. The diagram on the right side of the table show in which manner the costs are within the calculated limits considering the correlations established in the previous phase.



Deviation 0%

Design Elements / Target Costs	Cost	Cost %	Cost % Target	Importance	Target Costs	Target Cost Index	Gap	Target Zone: Upper %	Lower %	Target Gap %	Upper Cost	Lower Cost	Target Gap
1 Surub M1.6x05	0,50	0,1%	0,0%	1,2%	35,67	0,01	-35,17	1,2%	1,2%	0,0%	35,67	35,67	0,00
2 Surub M3x30	0,30	0,0%	0,0%	1,4%	39,73	0,01	-39,43	1,4%	1,4%	0,0%	39,73	39,73	0,00
3 Surub M4x10	0,50	0,1%	0,0%	0,3%	8,41	0,06	-7,91	0,3%	0,3%	0,0%	8,41	8,41	0,00
4 Piulita M3	0,30	0,0%	0,0%	1,4%	39,73	0,01	-39,43	1,4%	1,4%	0,0%	39,73	39,73	0,00
5 Piulita M4	0,50	0,1%	0,0%	0,3%	8,41	0,06	-7,91	0,3%	0,3%	0,0%	8,41	8,41	0,00
6 Saiba Grower M4	0,50	0,1%	0,0%	0,3%	8,41	0,06	-7,91	0,3%	0,3%	0,0%	8,41	8,41	0,00
7 Mecanism articulat	5,00	0,7%	0,2%	7,0%	204,16	0,02	-199,16	7,0%	7,0%	0,0%	204,16	204,16	0,00
8 Motor de CC	127,00	17,9%	4,4%	6,2%	179,80	0,71	-52,80	6,2%	6,2%	0,0%	179,80	179,80	0,00
9 Manivela	7,00	1,0%	0,2%	3,6%	104,69	0,07	-97,69	3,6%	3,6%	0,0%	104,69	104,69	0,00
10 Micro servomotor Tow...	31,00	4,4%	1,1%	7,8%	227,07	0,14	-196,07	7,8%	7,8%	0,0%	227,07	227,07	0,00
11 Cadru	21,00	3,0%	0,7%	4,2%	120,35	0,17	-99,35	4,2%	4,2%	0,0%	120,35	120,35	0,00
12 Batiu	11,00	1,5%	0,4%	3,8%	108,75	0,10	-97,75	3,8%	3,8%	0,0%	108,75	108,75	0,00
13 Material aripi	6,00	0,8%	0,2%	8,4%	244,18	0,02	-238,18	8,4%	8,4%	0,0%	244,18	244,18	0,00
14 Baterie LiPo	39,00	5,5%	1,3%	14,0%	406,58	0,10	-367,58	14,0%	14,0%	0,0%	406,58	406,58	0,00
15 Microcontroller Arduin...	124,00	17,5%	4,3%	11,5%	334,08	0,37	-210,08	11,5%	11,5%	0,0%	334,08	334,08	0,00
16 Accelerometru MMA8...	41,00	5,8%	1,4%	3,0%	87,00	0,47	-46,00	3,0%	3,0%	0,0%	87,00	87,00	0,00
17 Modem Bluetooth Ma...	280,00	39,4%	9,7%	10,2%	294,64	0,95	-14,64	10,2%	10,2%	0,0%	294,64	294,64	0,00
18 Stabilizator de tensiu...	8,00	1,1%	0,3%	12,0%	347,13	0,02	-339,13	12,0%	12,0%	0,0%	347,13	347,13	0,00
19 Pin	3,00	0,4%	0,1%	3,1%	90,77	0,03	-87,77	3,1%	3,1%	0,0%	90,77	90,77	0,00
20 Profil L	5,00	0,7%	0,2%	0,3%	8,41	0,59	-3,41	0,3%	0,3%	0,0%	8,41	8,41	0,00

Fig. 15 Table with the target costs of the design elements

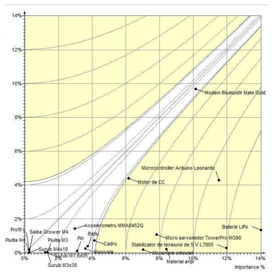


Fig. 16 The diagram of the target costs

The diagram of the target costs of the design elements (figure 16) allows a better visualization of the relative costs on the important determination of the elements. If the elements are found on the white area of the diagram, their costs are according to the importance. If they are found under the diagonal, it means that for their importance the acquisition price is lower. If the elements are located above de diagonal, this indicates the fact that their price exceeds their importance. In this case, other pieces or other suppliers must be chosen. In this case, all the pieces are found below the cost limit.

Deviation 0%								Target Zone						FN Target Costs
Functions \ Target Costs	Cost	Cost %	Cost % Target	Importance	Target Costs	Target Cost Index	Gap	Upper %	Lower %	Target Gap %	Upper Cost	Lower Cost	Target Gap	Cost / Target Costs 0 100 200 300 400
1 Sa bata din aripi	48,77	6,9%	1,7%	14,7%	424,85	0,11	-376,07	14,7%	14,7%	0,0%	424,85	424,85	0,00	
2 Sa primeasca semnal ...	27,10	3,8%	0,9%	3,8%	111,07	0,24	-83,96	3,8%	3,8%	0,0%	111,07	111,07	0,00	
3 Sa execute semnal de...	27,10	3,8%	0,9%	3,5%	102,37	0,26	-75,26	3,5%	3,5%	0,0%	102,37	102,37	0,00	
4 Sa trimita semnal catr...	27,10	3,8%	0,9%	3,1%	88,45	0,31	-61,34	3,1%	3,1%	0,0%	88,45	88,45	0,00	
5 Sa asigure ruliu	30,51	4,3%	1,1%	8,4%	242,15	0,13	-211,64	8,4%	8,4%		242,15	242,15		
6 Sa asigure tangaj	30,51	4,3%	1,1%	8,4%	242,15	0,13	-211,64	8,4%	8,4%		242,15	242,15		
7 Sa asigure camuflarea	4,95	0,7%	0,2%	2,8%	81,78	0,06	-76,83	2,8%	2,8%		81,78	81,78		
8 Sa posede un coeficie...	6,19	0,9%	0,2%	5,3%	154,57	0,04	-148,38	5,3%	5,3%		154,57	154,57		
9 Sa imite zborul pasaril...	5,61	0,8%	0,2%	4,6%	134,27	0,04	-128,66	4,6%	4,6%		134,27	134,27		
10 Sa raspunda rapid la ...	59,52	8,4%	2,1%	2,8%	81,20	0,73	-21,67	2,8%	2,8%	0,0%	81,20	81,20	0,00	
11 Sa primeasca, trans...	25,73	3,6%	0,9%	3,5%	102,37	0,25	-76,63	3,5%	3,5%	0,0%	102,37	102,37	0,00	
12 Sa primeasca, trans...	11,99	1,7%	0,4%	3,5%	102,37	0,12	-90,37	3,5%	3,5%		102,37	102,37		
13 Sa permita interschi...	84,25	11,9%	2,9%	1,5%	43,79	1,92	40,47	1,5%	1,5%	1,4%	43,79	43,79	40,31	
14 Sa emita cat mai put...	27,04	3,8%	0,9%	7,4%	215,47	0,13	-188,43	7,4%	7,4%		215,47	215,47		
15 Sa capteze imagini.	18,00	2,5%	0,6%	2,1%	61,77	0,29	-43,76	2,1%	2,1%		61,77	61,77		
16 Sa transmita imagini.	18,00	2,5%	0,6%	2,1%	61,19	0,29	-43,18	2,1%	2,1%		61,19	61,19		
17 Sa capteze sunete.	18,00	2,5%	0,6%	2,1%	61,77	0,29	-43,76	2,1%	2,1%		61,77	61,77		
18 Sa transmita sunete	18,00	2,5%	0,6%	2,1%	61,19	0,29	-43,18	2,1%	2,1%		61,19	61,19		
19 Sa capteze ultrasune...	18,00	2,5%	0,6%	2,1%	61,77	0,29	-43,76	2,1%	2,1%		61,77	61,77		
20 Sa transmita ultrasu...	18,00	2,5%	0,6%	2,1%	61,19	0,29	-43,18	2,1%	2,1%		61,19	61,19		
21 Sa capteze semnale ...	18,00	2,5%	0,6%	2,1%	61,77	0,29	-43,76	2,1%	2,1%		61,77	61,77		
22 Sa transmita semnal...	18,00	2,5%	0,6%	2,1%	61,19	0,29	-43,18	2,1%	2,1%		61,19	61,19		
23 Sa gestioneze in mo...	61,22	8,6%	2,1%	2,8%	81,20	0,75	-19,98	2,8%	2,8%	0,0%	81,20	81,20	0,00	
24 Sa gestioneze in mo...	61,22	8,6%	2,1%	2,8%	81,20	0,75	-19,98	2,8%	2,8%	0,0%	81,20	81,20	0,00	
25 Sa poata transmite p...	2,54	0,4%	0,1%	3,2%	93,09	0,03	-90,54	3,2%	3,2%		93,09	93,09		
26 Sa permita accesul f...	25,16	3,5%	0,9%	0,8%	21,75	1,16	3,41	0,8%	0,8%	0,1%	21,75	21,75	2,90	

Fig. 17 Table with the target costs of the functions

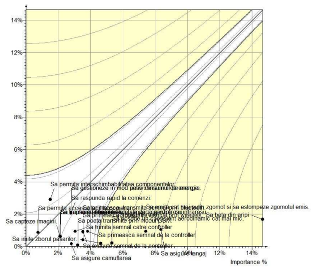


Fig. 18 Diagram of the target functions

The tables with the target costs of the functions are calculated based on the importance of the functions of the target costs. It is determined the lower and the upper limit of the target costs. The diagram on the right side of the table shows in which manner the functions costs are within the calculated limit. As in the previous case, the diagram allows a better view of the costs considering their importance. The functions located on the diagonal are better optimized with the prices. Those under the diagonal indicate a higher importance considering the costs of achieving. The functions located above the diagonal show a price too much higher for their construction and their execution method must be modified. In this case we are situated below the cost limit as well.

The table in figure 19 presents the design elements ordered according to their importance and the estimated costs for the flying platform.

Deviation 0%								Target Zone						FN Target Costs, Design Elements by TC
Design Elements by TC \ Target Costs	Cost	Cost %	Cost % Target	Importance	Target Costs	Target Cost Index	Gap	Upper %	Lower %	Target Gap %	Upper Cost	Lower Cost	Target Gap	Cost / Target Costs / Upper Cost / Lower Cost 0 100 200 300 400
14 Baterie LiPo	39,00	5,5%	1,3%	14,0%	406,58	0,10	-367,58	14,0%	14,0%	0,0%	406,58	406,58	0,00	
18 Stabilizator de tensiun...	8,00	1,1%	0,3%	12,0%	347,13	0,02	-339,13	12,0%	12,0%	0,0%	347,13	347,13	0,00	
15 Microcontroller Arduino...	124,00	17,5%	4,3%	11,5%	334,08	0,37	-210,08	11,5%	11,5%	0,0%	334,08	334,08	0,00	
17 Modem Bluetooth Mat...	280,00	39,4%	9,7%	10,2%	294,64	0,95	-14,64	10,2%	10,2%	0,0%	294,64	294,64	0,00	
13 Material aripi	6,00	0,8%	0,2%	8,4%	244,18	0,02	-238,18	8,4%	8,4%	0,0%	244,18	244,18	0,00	
10 Micro servomotor Towe...	31,00	4,4%	1,1%	7,8%	227,07	0,14	-196,07	7,8%	7,8%	0,0%	227,07	227,07	0,00	
7 Mecanism articulat	5,00	0,7%	0,2%	7,0%	204,16	0,02	-199,16	7,0%	7,0%	0,0%	204,16	204,16	0,00	
8 Motor de CC	127,00	17,9%	4,4%	6,2%	179,80	0,71	-52,80	6,2%	6,2%	0,0%	179,80	179,80	0,00	
11 Cadru	21,00	3,0%	0,7%	4,2%	120,36	0,17	-99,36	4,2%	4,2%	0,0%	120,36	120,36	0,00	
12 Batiu	11,00	1,5%	0,4%	3,8%	108,75	0,10	-97,75	3,8%	3,8%	0,0%	108,75	108,75	0,00	
9 Manivela	7,00	1,0%	0,2%	3,6%	104,69	0,07	-97,69	3,6%	3,6%	0,0%	104,69	104,69	0,00	
19 Pin	3,00	0,4%	0,1%	3,1%	90,77	0,03	-87,77	3,1%	3,1%	0,0%	90,77	90,77	0,00	
16 Accelerometru MMA84...	41,00	5,8%	1,4%	3,0%	87,00	0,47	-46,00	3,0%	3,0%	0,0%	87,00	87,00	0,00	
2 Surub M3x30	0,30	0,0%	0,0%	1,4%	39,73	0,01	-39,43	1,4%	1,4%	0,0%	39,73	39,73	0,00	
4 Piulita M3	0,30	0,0%	0,0%	1,4%	39,73	0,01	-39,43	1,4%	1,4%	0,0%	39,73	39,73	0,00	
1 Surub M1.6x05	0,50	0,1%	0,0%	1,2%	35,67	0,01	-35,17	1,2%	1,2%	0,0%	35,67	35,67	0,00	
3 Surub M4x10	0,50	0,1%	0,0%	0,3%	8,41	0,06	-7,91	0,3%	0,3%	0,0%	8,41	8,41	0,00	
5 Piulita M4	0,50	0,1%	0,0%	0,3%	8,41	0,06	-7,91	0,3%	0,3%	0,0%	8,41	8,41	0,00	
6 Saiba Grower M4	0,50	0,1%	0,0%	0,3%	8,41	0,06	-7,91	0,3%	0,3%	0,0%	8,41	8,41	0,00	
20 Profil L	5,00	0,7%	0,2%	0,3%	8,41	0,59	-3,41	0,3%	0,3%	0,0%	8,41	8,41	0,00	

Fig. 19 The target costs according to their importance

3. The final structure

Based on the analysis which was presented in chapter 2 was developed a mechanical platform able to accurately imitate the flight of medium height birds (eg. seagull).

Figure 20 presents the final mechanical structure of the robot. The assembly method of each part can be observed.

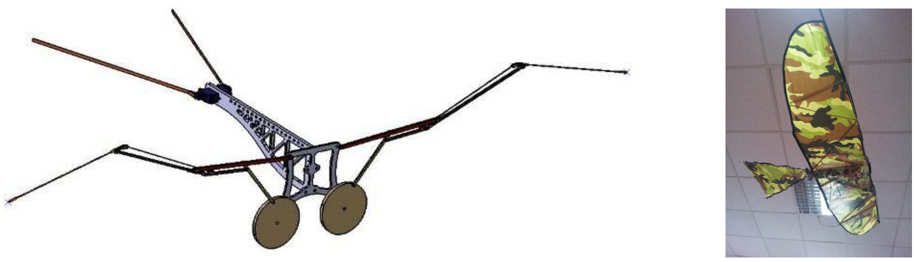


Fig. 20 The final structure of the robot

4. Conclusions

Competitive design is not a novel approach to product development. It proved useful in numerous cases. The implementation of quality specific tools like Quality Function Deployment, Analytic Hierarchy Process, benchmarks, etc. leads to a more detailed view of the concept then otherwise possible.

Using the approach presented in the article the concept can be clearly followed based on critical characteristics and functionality, giving the development team a tool that can help in properly calibrating the final products structure with the costs involved.

Unlike regular products, the development of mechatronic products present several challenges: balancing functionality and critical characteristics, harmoniously integrating electrical, electronic and mechanical parts. These problems are more stringent to solve in case of mobile robots where the energy consumption plays a major role.

Being able to choose the appropriate components both from the functionality point of view and with respect to the critical characteristics that the mobile robot must have could lead to the development of a cost effective and efficient product.

The use of electronic means of communication greatly increased the productivity regarding the concept development. A full on-line development platform would be useful in the development of such products.

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Using Excel spreadsheets to process data in Physics didactic experiments

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Abstract

This paper presents the mode in which Excel spreadsheets can be utilized to process data in Physics didactic experiments. It describes the making of a tool with interactive spreadsheets to check the linear dependence of the absolute extension on the applied force in an elastic spring and the determination of the spring constant. The results are presented in a synthesized way, both as tables and graphs, in the main spreadsheet. The paper shows how certain Excel functions can be utilized to perform the regression analysis with the help of the method of least squares and to perform the calculation of errors. There are also highlighted the mathematical capacities and the graphical facilities offered by spreadsheets. The tool is useful for Physics laboratory lessons and it can easily be adapted for the whole range of didactic experiments by which a linear relation between two physical measures is verified.

Keywords: Spreadsheets, Excel, the method of least squares, spring constant, Physics didactic experiments, Physics Education.

1 Introduction

In the teaching and learning of Physics, the experiment plays a central part as a source of knowledge and as a research method for students. In a conventional classification of Physics didactic experiments, there is a category of experiments by which various laws of Physics are verified (Malinovschi, 2003). Thus, in certain experiments associated with the Physics introductory course, a linear dependence between two physical measures is verified, and the constants that appear in the respective equation are determined, as in the following example:

- Verifying the law of refraction of light and determining the absolute refractive index of a transparent material. It is thus verified the linear dependence between the sinus of the refraction angle and the sinus of the incidence angle;
- Verifying the linear dependence of the sliding force of friction on the normal force at the contact surface and determining the coefficient of sliding friction;
- Verifying Ohm’s Law for a portion of the circuit and determining the electric resistance of a resistor.

This paper demonstrates the way in which Excel spreadsheets can be used to process data in an experiment that enters the previously-mentioned category. It describes a tool made up of three interactive spreadsheets with the aim of verifying the linear dependence of the absolute extension on the applied force in an elastic spring, and the determination of the spring constant. It is shown how certain Excel functions can be utilized in order to perform the regression analysis of the data acquired from the experiment and the calculation of errors. The results are presented in a synthesized manner in the main spreadsheet in the form of tables and in a graphic form, as two graphs. The first graph renders the dependence of the absolute extension on the applied force by emphasizing the application of the method of least squares. The second graph renders the values calculated for the spring constant following each measurement by comparison to the average value. The use of spreadsheets represents an advantage both to their mathematical capacities and their special graphical facilities (Subedi, 2007). Moreover, spreadsheets represent a mathematical tool that is easily accessible on computers, and students become more aware that they need spreadsheet abilities in order to find future jobs (Arganbright, 2005). This paper continues the authors' efforts to explore the possibilities offered by spreadsheets in the process of teaching and learning of Physics (Grigore et al, 2013; Grigore, 2013).

2 Regression analysis

The processing of data in an experiment aims at the establishment of a dependence between two physical measures x and y. In order tot determine the dependence y=y(x) the values of x are modified and the values of y corresponding to x are measured.

Thus, for the set of values $(x_1,x_2,...,x_n)$ of the measure x, we measure y and find the set of values $(y_1,y_2,...,y_n)$. The regression analysis approximates a function, f(x) so that it best matches the set of experimental values y.

When processing the data from the experiments mentioned above we use the linear regression. In this type of regression the approximating function is of first degree and, therefore, can be written:

[1] $$f(x) = ax + b$$

From a geometrical point of view, relation [1] constitutes the equation of a straight line that has the slope equal to a and the intercept equal to b. To determine the constants a and b we use the method of least squares by which we minimize the sum of the squares of the deviations, named S, from the given values, y_i, and the ones calculated with the function $f(x_i)$:

[2] $$S = \sum_{i=1}^{n} [y_i - f(x_i)]^2$$

By applying the minimization procedure, which is largely presented in literature (Popovici, 2013), we obtain the following relations to calculate the coefficients a and b:

[3] $$a = S_{xy}/S_x \qquad b = \langle y \rangle - a\langle x \rangle$$

where <x>, <y> represents the average values of the measures x and y:

[4] $$\langle x \rangle = \frac{1}{n}\sum_{i=1}^{n} x_i \qquad \langle y \rangle = \frac{1}{n}\sum_{i=1}^{n} y_i$$

and the parameters S_x and S_y are given by the relations:

[5] $$S_x = \sum_{i=1}^{n} x_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} x_i\right)^2$$

[6] $$S_{xy} = \sum_{ki=1}^{n} x_i\, y_i - \frac{1}{n}\left(\sum_{i=1}^{n} x_i\right)\left(\sum_{i=1}^{n} y_i\right)$$

By the introduction of the parameter S_y, defined by analogy to S_x, we can calculate the coefficient of linear correlation, R, of the dependence y=y(x) with the relation:

[7] $$R = S_{xy}/\sqrt{S_x S_y}$$

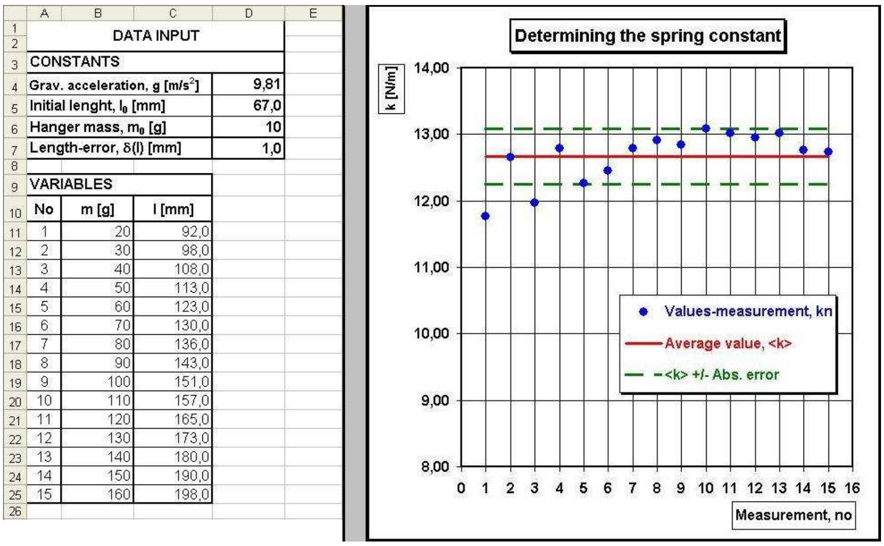
In the literature, it has been shown how spreadsheets can be utilized to perform the regression analysis (De Levie, 2004). It has also been described an approach of the multi-linear regression with spreadsheets with examples from chromatography (Ogren et al, 2001). Besides the linear regression, there have been discussed problems connected to the application of the nonlinear regression with functions at the users' disposal in the Microsoft Excel program (Brown, 2001; Kemmer and Keller, 2010). Theoretical calculations have been thoroughly presented in the case of the logarithmical and exponential nonlinear models and it has been shown how they can be applied with the help of different software, including the Excel program (Vlada, 2013).

3 Organization of spreadsheets

The experiment for which the Excel tool has been elaborated was described in the literature in the case in which the applied force does not exceed the elastic limit of the spring. Practically, a hanger is attached to a spring suspended from a carrier, and discs engraved with the known mass. The role of the applied force is played by the weight suspended by the spring. Initially, the length of the spring in undeformed state is measured with a ruler. Afterwards, the length of the spring in deformed state is measured for each weight obtained by adding the discs one by one. The values of the discs masses, added together with the corresponding values of the length of the spring, constitute the necessary data to determine the spring constant. We assume that the errors in measurement come solely from the reading of the spring length (Argesanu, 2011). Next, we show how we can utilize spreadsheets to process the data from this experiment.

The Excel tool is made up of three interactive spreadsheets, namely: the spreadsheet in which we introduce the data from the experiment, named “Data_Input”, the main spreadsheet named “Report” which presents the input data and the results, plus a secondary spreadsheet for intermediary calculations. The main spreadsheet offers complete information on the data processing and it is aimed for printing.

The data input spreadsheet, rendered in the left panel from figure 1, has a simple structure, being made up of two sections. In the former, entitled “Constants”, we introduce: the gravitational acceleration, g, in cell D4, the initial undeformed length of the spring, l_0, in cell D5; the mass of the hanger attached to the spring and in which we introduce the engraved discs, m_0, in cell D6; the absolute error when measuring the length, $\delta(l)$, in cell D7. The section “Variables” comprises the field A9:C25 and it represents a table with three columns. The first column represents the serial number of the measurement, the second column the value of the mass of the discs hung by the spring, m, whereas the third column the length of the extended spring, l, measured for each value of the mass from the second column.



DATA INPUT

CONSTANTS

Grav. acceleration, g [m/s^2]	9,81
Initial lenght, l_0 [mm]	67,0
Hanger mass, m_0 [g]	10
Length-error, $\delta(l)$ [mm]	1,0

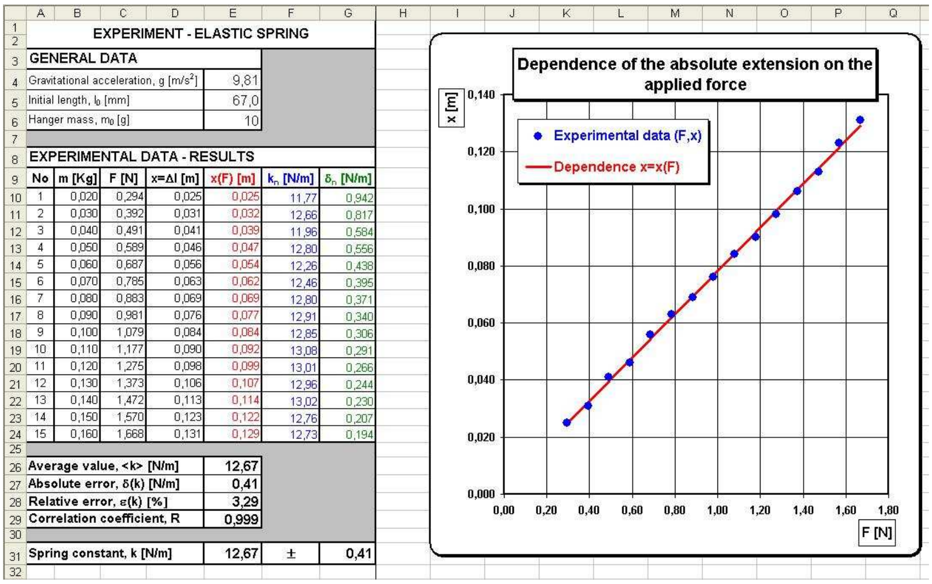
VARIABLES

No	m [g]	l [mm]
1	20	92,0
2	30	98,0
3	40	108,0
4	50	113,0
5	60	123,0
6	70	130,0
7	80	136,0
8	90	143,0
9	100	151,0
10	110	157,0
11	120	165,0
12	130	173,0
13	140	180,0
14	150	190,0
15	160	198,0

Figure 1. a) The partial representation of the spreadsheet “Data Input”; b) The graph of the values calculated at each measurement for the spring constant

We introduce the following cell names: “Acceleration_G” for cell D4, “Lenght_0” for cell D5, “Mass_H” for cell D6 and “Error_L” for cell D7. The gravitational acceleration is expressed in meters per square second, m/s^2, the length and error in length measurement, introduced in cells D5, C10:C24, respectively D7, in millimeters, mm, while the mass, in cell D6, respectively B10:B24, in grams, g.

The spreadsheet “Report”, as observed in figure 2, is divided in two sections, entitled “General Data”, respectively “Experimental Data-Results”. In the former the data from the rubric “Constants” in the “Data_Input” spreadsheet are imported. The latter contains three tables of different sizes in which the data processing is done and the final results are displayed. In these three tables all the measures are expressed in I.S. of measurement units.



EXPERIMENT - ELASTIC SPRING

GENERAL DATA	
Gravitational acceleration, g [m/s^2]	9,81
Initial length, l_0 [mm]	67,0
Hanger mass, m_0 [g]	10

EXPERIMENTAL DATA - RESULTS

No	m [Kg]	F [N]	x=Δl [m]	x(F) [m]	k_n [N/m]	δ_n [N/m]
1	0,020	0,294	0,025	0,025	11,77	0,942
2	0,030	0,392	0,031	0,032	12,66	0,817
3	0,040	0,491	0,041	0,039	11,96	0,584
4	0,050	0,589	0,046	0,047	12,80	0,556
5	0,060	0,687	0,056	0,054	12,26	0,438
6	0,070	0,785	0,063	0,062	12,46	0,395
7	0,080	0,883	0,069	0,069	12,80	0,371
8	0,090	0,981	0,076	0,077	12,91	0,340
9	0,100	1,079	0,084	0,084	12,85	0,306
10	0,110	1,177	0,090	0,092	13,08	0,291
11	0,120	1,275	0,098	0,099	13,01	0,266
12	0,130	1,373	0,106	0,107	12,96	0,244
13	0,140	1,472	0,113	0,114	13,02	0,230
14	0,150	1,570	0,123	0,122	12,76	0,207
15	0,160	1,668	0,131	0,129	12,73	0,194

Average value, <k> [N/m]	12,67
Absolute error, δ(k) [N/m]	0,41
Relative error, ε(k) [%]	3,29
Correlation coefficient, R	0,999

Spring constant, k [N/m]	12,67	±	0,41

Figure 2. The main spreadsheet of the tool with the graph that renders the dependence of the absolute extension on the applied force

The first table corresponds to the field A8:G24. In the seven columns from A to G we have the following sets of data:

- Column A contains the serial number of the measurement from 1 to 15;
- In column B there are imported from the “Data_Input” spreadsheet the values for the mass of the discs attached to the hanger hung from the spring;
- In column C the applied force is calculated for each value of the discs mass from the previous column. For this we transcribe in Excel the relation:

  [8] $F = (m + m_0)g$

  With the cell names previously described we write in cell C10 the Excel formula “=(B10+0,001*Mass_H)*Acceleration_G”. The data field C10:C24 has been entitled Force_D.
- In column D we calculate the values of the absolute extension of the spring corresponding to the values of the applied force from the previous column. For this we transcribe in Excel the relation:

  [9] $x = \Delta l = l - l_0$

  In cell D10 we write the Excel formula “=(Data_Input_!C11-Length_0)*0,001”. We have imported from the Data_Input spreadsheet the values for the length of the extended spring, l. The data field D10:D24 has been entitled Extension_A.
- In column E we perform in Excel the linear regression of the data from columns C and D to verify the linear dependence of the applied force on the absolute extension. For this, we write in cell E10 the Excel formula:

"=SLOPE(Extension_A;Force_D)*C10+INTERCEPT(Extension_A;Force_D)".

The SLOPE function calculates the slope of the straight line drawn through the method of least squares, while the INTERCEPT function calculates the intercept for the same straight line. The results given by the relations [1], [3]-[6] have been transposed in Excel.

- In column F we calculate the spring constant for each set of values from columns C and D. For this we transcribe in Excel the relation:

[10] $k = F/x$

In cell F10 we write the Excel formula "=C10/D10". The data field F10:F24 has been entitled Constant_kD.

- In column G we calculate the absolute error for each value of the spring constant from the previous column. For this we transcribe in Excel the relation:

[11] $\delta = k \cdot [2\delta(l)/x]$

The term from the right bracket is the relative error, ε, when measuring x. In cell G10 we write the Excel formula "=F10*(2*Error_L*0,001/D10)''. The data field G10:G24 has been entitled Error_AD.

The formulas written in cells C10, D10, E10, F10 and G10 are propagated along columns C, D, E, F and G from line 10 to line 24, namely between the lines corresponding to the first and the last measurement.

The second table corresponds to the field A26:E29. This table presents the final results of the data processing. In cell E26 the average value for the spring constant, <k>, is displayed. For this, we calculate the arithmetic mean of the data from column F of the previous table with the formula "=AVERAGE(Constant_KD)". In cell E27, the absolute error when determining the spring constant, δ(k), is displayed. For this we calculate the arithmetic mean of the data from column G of the previous table with the formula "=AVERAGE(Error_AD)". In cell E28 the relative error when determining the spring constant, ε(k), is displayed, expressed in per cent. For this, we calculate the arithmetic mean of the relative errors resulted from each measurement with the formula "=AVERAGE(Error_RD)". We have entitled Error_RD the field of individual relative errors placed in the secondary sheet reserved for intermediary calculations. In cell E29 the correlation coefficient, R, is displayed from among the values of the absolute extension and the values of the applied force. This parameter is calculated with relation [7] transposed in Excel with the data from columns C and D utilizing the formula "=CORREL(Force_D;Extension_A)". The final result for the spring constant is given in cells A31:G31, as average value, <k>, plus/minus the absolute error, δ(k).

Besides the tables with results, Figure 2 displays the graph of the dependence of the absolute extension on the applied force. Each dot colored in blue represents the pair of experimental values (F, x), while the line colored in red represents the dependence x=x(F). The source table of the graph is given by the field C10:E24. The role of this graph is to aid the graphical visualization of the application of the linear regression to the experimental data.

The second graph of the instrument is rendered in the right panel from figure 1. The values calculated for the spring constant following each measurement, k_n, are represented by the blue dots while the average value, <k>, by the red line. The dotted line colored in green marks the interval <k>±δ(k). The source table of the graph is placed in a secondary sheet of the file. This contains the column with the serial number of the measurement, n, the column with the values of the spring constant, k_n, imported from the sheet Report, plus supplementary lines and columns to mark the average value <k> and the values <k>±δ(k). The role of this graph is to aid the graphical visualization of the interval <k>±δ(k) and the spread of the values k_n compared to the average value, <k>. Through the option freeze panel, each of the two graphs can be placed near the results tables in order to track the feedback when changing the data.

4 Conclusions

In this paper, the authors have presented different aspects connected to the processing of experimental data, choosing concrete examples, since preparing a laboratory experiment implies not only adjusting to the experimental assembly, but also to the investigation methods employed and the different ways of processing the recorded results.

The created tool is useful for laboratory Physics lessons in school education. Students achieve a better grasp of the data processing procedure in an experiment and can track, step-by-step, the propagation of the measurement errors in the final results. Through students' participation in the making-of this Excel tool, creativity and strong motivation can be stimulated in the study of science.

The presented tool can be easily adapted so that it can process data from any of the didactic experiments that verify the linear dependence between two physical measures. Data processing is rapid and the laboratory Physics lesson can be optimized by the introduction of supplementary activities that are connected to the respective theme, as for example problem solving or other work tasks which are executable in a virtual environment, with the help of Excel spreadsheets.

Acknowledgments. This work was supported by the strategic grant POSDRU/159/ 1.5/S/137750, "Project Doctoral and Postdoctoral programs support for increased competitiveness in Exact Sciences research" cofinanced by the European Social Found within the Sectorial Operational Program Human Resources Development 2007 – 2013.

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Understanding of Coupled Oscillators by Building Mathematical and Virtual Models

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Abstract

Understanding oscillatory phenomena and the associated mathematical models can be improved by the deployment of complex modeling activities in an interdisciplinary framework. The learning activities that we propose involve transferring and applying knowledge from the area of Mathematics, Physics and Information Technologies, engaging the students in building virtual, dynamic and interactive models for the studied oscillatory phenomena. The simulations of different systems of coupled oscillators and the representation of their physical parameters were achieved using GeoGebra mathematical educational software, which allows simultaneous operation with graphical and algebraic representations of objects. The proposed teaching approach is participatory and constructivist. Firstly, students build a mathematical model of the physical phenomenon and then mathematical formulas will result in visual and interactive simulations of the physical processes. Students are able to view, step by step, the implementation of mathematical models by generating dynamic virtual models and to verify in this way the validity of their reasoning.

Keywords: Physics Education, Oscillatory Motion, GeoGebra, Learning by Modeling, Virtual Models

1 Introduction

Using simulations in the study of Physics, as part of inquiry based learning activities, has well documented advantages in the specialized literature (Perkins et al, 2006; De Jong, 2006; Dinica and Dinescu, 2013), benefiting from dedicated educational sites. In Romania, the SEI (IT-Based Education System) national program, implemented in all high schools in Romania, has developed a comprehensive package of educational software (AEL), including interactive simulations of physical phenomena (Vlada et al, 2009).

Educational research related to improving the understanding of physical concepts by modelling activities has a long history (Hestenes, 1987; Halloun, 1996; Etkina et al, 2006). Educational programmes carried out on a large scale have proven the effectiveness of learning based on modelling in the study of Science (Jackson et al, 2008). Building models and interacting with models elicit conceptual changes, improving students' ability to develop model-based reasoning, as a fundamental skill in scientific thinking (Barab et al, 2000; Ornek, 2008).

Research in this area indicates that mathematical modelling should be the central theme for a deep learning in Physics (Hestenes, 1987). The wide variety of available information technologies comes with the opportunity to concretize mathematical models as visual and dynamic computer models that can be created by the students themselves (Sins et al, 2005; Jonassen et al, 2005).

Hestenes identifies four stages needed for the mathematical modelling:

- *description stage*, the stage in which we determine the objects involved in the process, the interactions between them, the constraints of movements and the mathematical variables that will be used;

- *formulation stage*, the stage of creating an abstract model, in which the interactions that occur are analysed, the theoretical laws are applied and the equations of motion are inferred, depending on the initial conditions;
- *ramification stage*, the stage of analysing the implications of inferred equations; the time dependence of derived descriptors is determined; we create not just the model of a system, but also for the physical process taking place;
- *validation stage*, the stage of checking the consistency of the created model, which is compared with the real system, through experiment.

The same steps can be followed in the development of a virtual model, based on the mathematical model. The visualizations at different stages of development of the virtual model and the confrontations with the real experiments will create the premises for conceptual change and meaningful learning.

One of the frequently encountered types of movement is oscillatory movement, which can be explained using computer simulations (Stoica, 2004; Moraru et al., 2011). Simulations of oscillatory phenomena can be accomplished using Excel spreadsheets, one of the useful tools in teaching physics, accessible to students (Grigore and Barna, 2014). In order to get animations that simulate the movements of oscillators, applications can be created in Flash (Ezrailson, 2005). The GeoGebra mathematical software, also allows building interactive applets that can be uploaded and included in various websites (Mussoi et al, 2011). GeoGebra combines both the capabilities of a DGS (Dynamic Geometry System) and those of a CAS (Computer Algebra System) in one tool, being useful in the study of Mathematics and Science (Hohenwarter and Fuchs, 2004).

2 Simulating motion of two coupled oscillators

In this paper we refer to a didactic activity consisting of modelling the system of two coupled oscillators. The proposed teaching approach is based on constructivist learning principles and involves connections between different school subjects. Students are guided to build a mathematical model and then, using the GeoGebra software, the computer simulation for the considered system.

The modelling activity described in this section has been deployed with the twelfth grade students. To achieve the mathematical model, the students need to know the motion equation of a body acted by an elastic force (Hristev, 1984). The students already know calculus and they can show that for a mass m acted by an elastic force, $F = -kx$, Newton's second law leads to a differential equation,

[1] $$\ddot{x}(t)+\omega^2 x(t)=0, \text{ where } \omega=\sqrt{\frac{k}{m}}.$$

The solutions of the equation [1] are

[2] $$x(t)=A\cos(\omega t)+B\sin(\omega t), \text{ with } A=x(0), \quad B=\frac{\omega}{\dot{x}(0)}.$$

Using trigonometry, students can show that solutions [2] can be written in the form

[3] $$x(t)=C\cos(\omega t-\varphi), \text{where } C=\sqrt{A^2+B^2}, \quad \varphi=\operatorname{sgn}(B)\cdot\arcsin\frac{A}{C}.$$

To be able to develop the simulation of the coupled oscillators system in GeoGebra, students should be familiar with GeoGebra, through creating several simpler models (Marciuc and Csereoka, 2014; Marciuc and Miron, 2014).

2.1 Building the mathematical model of the coupled oscillators system

The proposed activities start with the presentation of a real system. The system consists of two identical horizontal elastic pendulums coupled by a third spring. Alternatively, we can present a model developed using the tools of the virtual lab included in DGS Cinderella software (Richter-Gebert and Kortenkamp, 2012). Then, the four specific stages for modelling in Physics are discussed. Working in small teams, students will create a mathematical model of the system, under the teacher's guidance. Each team will present their findings, structured according to the four indicated steps. The results are compared and the necessary corrections are discussed. The final report should be similar to the following.

Description stage. The system consists of two bodies with masses equal to *m*, fixed on two vertical walls through two springs of elastic constants k_1 and connected to each other through a third spring of elastic constant k_2. The oscillations occur on a horizontal plane, along a straight line. Friction is negligible. The line along which movements are performed is set as the reference axis. We denote by $x_1(t)$ and $x_2(t)$ the elongations of the two oscillators at time *t*.

Formulation stage. The diagram of the forces acting on the two bodies is outlined and the second principle of dynamics is applied to each body. The following equations are obtained:

[4] $$m\ddot{x}_1 = -k_1 x_1 + k_2\left(x_2 - x_1\right)$$

[5] $$m\ddot{x}_2 = -k_1 x_2 - k_2\left(x_2 - x_1\right)$$

Ramification stage. The system of equations [4] and [5] can be easily solved by the students in the particular case in which the constants k_1 and k_2 are equal. By addition and subtraction of equations [4] and [5] we obtain two equations like equation [1], in which the sum and the difference of the two elongations are the unknown functions. After expressing the sum and difference of elongations in the form given by relation [3], we add and subtract the obtained relations and we deduce the motion equations of the two bodies:

[6] $$x_1\left(t\right) = \frac{1}{2}\left[A_+\cos\left(\omega t - \varphi_+\right) + A_-\cos\left(\sqrt{3}\,\omega t - \varphi_-\right)\right]$$

[7] $$x_2\left(t\right) = \frac{1}{2}\left[A_+\cos\left(\omega t - \varphi_+\right) - A_-\cos\left(\sqrt{3}\,\omega t - \varphi_-\right)\right]$$

The values of constants A_+, A_-, φ_+, φ_- result from the four conditions on the initial positions and velocities. In cases where one of the constants A_+, A_- is null, we get the normal modes of oscillation, in which the two bodies oscillate with the same frequency. By derivation of the relations [6] and [7], we deduce expressions of velocities, after which we can compute kinetic and potential energies, using the known formulae.

For solving the system consisting of differential equations [4] and [5], in the general case in which the constants k_1 and k_2 are not equal, we use the matrix method (Luca and Stan, 2007) and we find the normal vibration modes. Equations [4] and [5], after replacing

[8] $$x_1\left(t\right) = C_1\cos\left(\omega t - \varphi\right),\quad x_2\left(t\right) = C_2\cos\left(\omega t - \varphi\right)$$

become

[9] $$\left(\omega^2 - \frac{k_1 + k_2}{m}\right)x_1 + \frac{k_2}{m}x_2 = 0$$

[10] $$\frac{k_2}{m}x_1 + \left(\omega^2 - \frac{k_1 + k_2}{m}\right)x_2 = 0$$

The system of equations [9] and [10] has non-zero solution when the determinant of the system is null, hence we obtain the pulsations for the normal vibration modes:

$$[11] \quad \omega_1 = \sqrt{\frac{k_1}{m}}, \quad \omega_2 = \sqrt{\frac{k_1 + 2k_2}{m}}.$$

From the relations [9] and [10] we notice that if $\omega = \omega_1$, then x_1 and x_2 have equal value, and if $\omega = \omega_2$, then x_1 and x_2 have opposite values.

General solutions for each oscillator represent superposition of contributions given by the two normal modes:

$$[12] \quad x_1(t) = a_1 \cos(\omega_1 t - \varphi_1) + a_2 \cos(\omega_2 t - \varphi_2)$$

$$[13] \quad x_2(t) = a_1 \cos(\omega_1 t - \varphi_1) - a_2 \cos(\omega_2 t - \varphi_2).$$

The constants a_1, a_2, φ_1, φ_2 depend on the initial positions and velocities of the two bodies. By derivation of relations [12] and [13], we deduce the expressions of instantaneous velocities of the two bodies, and then we calculate kinetic and potential energies.

Validation stage. First, we check the consistency of the mathematical model built. We will sum the calculated energies and we will verify the principle of conservation of energy. We observe that by substituting k1 = k2 = k in [11], the relations [12] and [13] lead to solutions [6] and [7], that we have determined in the particular case studied in the beginning. The comparison of the motion described by the created mathematical model and the real system will be carried out after the construction of the animated virtual model, based on relations [11], [12] and [13].

2.2 Building a virtual model with GeoGebra

For achieving the virtual model in GeoGebra we use two graphic panels (Fig. 1). The first panel contains the graphical representation of the time dependence of the elongations of the two pendulums and a slider for time variable *t*. The animation for variable t will be turned on in order to simulate the motion of the system, in the second panel.

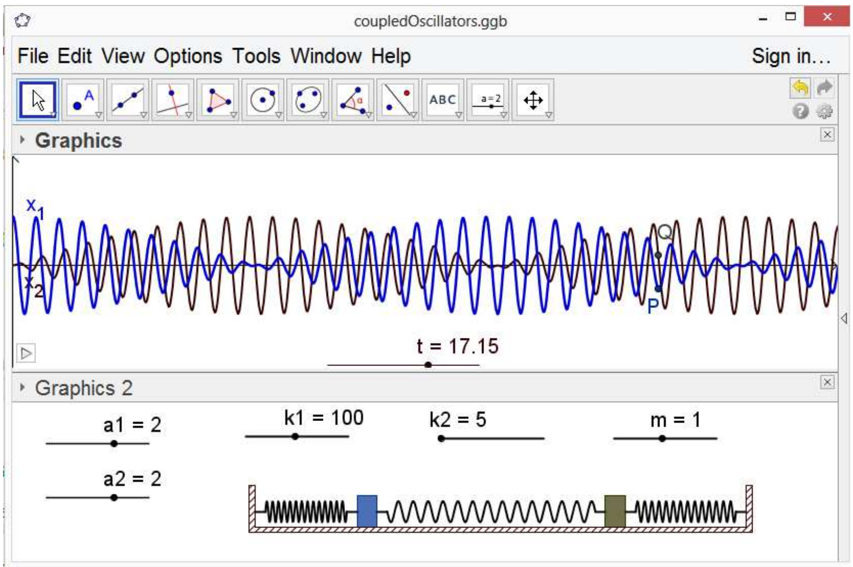

Figure 12. Simulation of the coupled oscillators' system in GeoGebra

The second panel contains a graphical model of the system of coupled oscillators and includes sliders for the system parameters: mass *m* of the two bodies, elastic constants k_1 and $k_{2,}$ and constants a_1 and a_2 for the motion equations [12] and [13]. These sliders allow an easy modification of the system parameters and to observe the effect of the changes on the motion of the two bodies.

The realisation of the animations for the two bodies is based on relationships [11], [12] and [13]. Table 1 presents the main commands that were introduced by the input bar of the GeoGebra software. The two moving bodies have been represented around points M and N, whose coordinates vary over time according to relations [12] and [13].

Table 2. Commands used to simulate the motions of the two bodies

Command	Result
k1=100; k2=5; m=1;	The characteristics of the elastic pendulums are defined.
ω1=sqrt(k1 / m); ω2=sqrt((k1+2 k2) / m);	The pulsations of normal modes are defined based on relation [11].
a1=2; φ1=0; a2=2; φ2=0;	The parameters of motion equations [12] and [13] are defined.
x1(t) = a1 cos(ω1 t + φ1) + a2 cos(ω2 t + φ2); x2(t) = a1 cos(ω1 t + φ1) - a2 cos(ω2 t + φ2);	Definition of the elongations depending on time, represented in the first panel.
x01=0; x02=6;	The equilibrium positions of the two bodies are defined.
t=0;	The *time* variable is initialized.
xM= x01 + x1(t); xN= x02 + x2(t);	Abscissae of the two bodies at time t are defined.
M=(xM,0); N=(xN,0);	Time-varying positions of the two bodies are defined.

The animations for points *M* and *N* are triggered by turning on the animation of time variable *t* and by setting the repeat type as increasing, through the *Properties* dialog box. The bodies were represented by rectangles, and the springs by sinusoids. Table 2 shows the commands entered in the input bar in order to plot the sinusoid for one of the three springs, using the parametric equation.

Table 2. GeoGebra commands used to represent a spring

Command	Explanation
n1=14; m1=0.3;	Number of turns and radius of the spring.
xA= x01 - a1 – 2;	Abscissa of the fixed end of the spring.
r1=xM-xA;	Length of the spring, time-varying.
p1= 2n1 π / r1; q1= -p1 xA;	Parameters for a sinusoid with *n*1 periods between fixed point A and mobile point M.
Curve[u, m1 sin(q1 + p1 u), u, xA, xA + r1]	Parametric representation of the spring.

3 Conclusions

By involving students in the construction of mathematical and virtual models of physical phenomena, several core objectives are achieved:

- formation of competencies in Mathematics; knowledge of mathematics has been used both to understand a physical phenomenon and to achieve the animated computer model of a phenomenon; the applicability of abstract mathematical knowledge in real and practical situations is highlighted;

- formation of competencies in using Information Technologies; the use of educational software GeoGebra does not require knowledge of programming; the application interface is friendly, the effect of the commands is immediately visible to students, which conducive the understanding of mathematical concepts; the software is free, created applets can be uploaded and accessed through the internet;
- formation of competencies in Science; the student is introduced in the modelling activities, one of the essential components in scientific research; the laws of Physics, expressed in mathematical form, processed with Mathematical tools, allow the making of predictions in the evolution of a process and analysing of various possible situations.

In particular, the model presented in this paper allows the understanding of an important phenomenon in the study of oscillations: the phenomenon of *beats*, which involves the transfer of energy between the two coupled oscillators. Changing system parameters using sliders included in the second panel allows us to demonstrate that the phenomenon of beats occurs when the elastic constant of the connection spring is much smaller than the elastic constants of the two springs with a fixed end. The presented model can be extended with the graphical representation of the energy in the system, thus viewing the manner in which the energy is transferred between the two oscillators.

Creating mathematical models and implementing their computer simulations, bring multiple benefits in the scientific training of students. Given their complexity, these activities should be rigorously planned. Information will be given to pupils gradually, thus avoiding the occurrence of cognitive overload.

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Using digital tools to develop collaborative problem solving skills

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Abstract

The competence of solving problems collaboratively currently makes the subject of international assessments, being considered the foundation of a good social and professional insertion of young people. Students must demonstrate that they have the competence before graduating high school. This is why teachers are concerned with establishing training programs and also finding appropriate means and methods for training and development this specific competence. In this paper, we are going to present a method of developing students' collaborative problem solving abilities through the use of digital tools, in order to increase their motivation to solve problems, as well as to favor their efficient cooperation while learning Physics.

Keywords: collaborative problem solving, problem situation, mechanical energy

Introduction

Creating and solving problem situations are the most productive learning processes as they make students become active while increasing their desire for knowledge and encouraging their inventiveness (Gok, 2010). Learning through problem solving ensures the active/interactive involvement of students in teaching process (Miron, 2008).

The effectiveness of problem solving increases when the problem is of a difficulty which does not greatly exceed the student's level of development, as well as when its content and practicability are intrinsically motivating. It is advisable to have a divergent problem with alternative ways of solving and also multiple possible solutions, an attractive form so as to determine their willingness to explore the unknown (Ornek et al, 2008).

Solving problems is the most frequently used method of learning Physics. Students need to understand the phenomena so as to correctly solve a problem and not just be confined to memorizing formulas and results.

Collaborative Problem Solving

The Programme for International Student Assessment (PISA) evaluates education systems worldwide by testing the skills and knowledge of 15-year-old students.

For PISA 2003 the definition accepted of problem solving was: “Problem solving is an individual’s capacity to use cognitive processes to confrunt and resolve real, cross-disciplinary situations where the solution path is not immediately obvious.”

For PISA 2012 the definition accepted of problem solving was: “Problem-solving competency is an individual’s capacity to engage in cognitive processing to understand and resolve problem situations where a method of solution is not immediately obvious.” This includes the intention to engage in such situations. Unlike the definition of the problem solving competence in 2003, which had only a cognitive component, the definition in 2012 has also an emotional one.

A novelty in 2015 will be to assess ability to solve problems collaboratively. While problem solving relates mainly to individual work to solve problem situations when the solving method is not found immediately, using collaborative problem solving means that a group brings together their knowledge and work together to solve these problematic situations. The benefits of collaboration are the effective division of labor, incorporating information from multiple sources of knowledge, perspectives and experiences, the improvement of creativity and quality in those solutions driven by the ideas of other group members.

Social interaction is necessary but not sufficient for this sort of collaboration as shared goals, accommodation of different perspectives and organization are also needed to achieve the objectives.

Teaching and assessment requirements of collaborative problem solving skills derive from the need to prepare students for careers that require working effectively in groups and also applying their solving skills in social situations.

For PISA 2015, the following definition of collaborative problem solving competence is supported: “Collaborative problem solving competence is a person's ability to engage effectively in a situation in which two or more people try to solve a problem by sharing knowledge and actively finding a solution by sharing knowledge, skills and an effort to find this solution”.

The effectiveness of this skill depends on the ability of group members to collaborate and prioritize common success at the expense of the individual one.

Collaborative problem solving competences which derive from the combination of individual and collaborative processes of solving the problem are: to establish and maintain a common understanding, to take appropriate action to address and solve the problem and the establishment and maintenance of team organization. Thus, when we talk about collaborative problem solving, we should add to the above mentioned problem solving processes factors such as: workload, team composition, the specific environment in which workload is applied.

To assess the competence of collaborative problem solving it is advantageous to use an electronic platform

Collaborative Problem Solving in Physics teaching and learning process

To develop one’s competence related to solving methods for Physics problems, we combined audio-visual methods with the strategy of composing and solving problems, first individually and then collaboratively.

To exploit the interest of the students to explain the phenomena of everyday life and the study of some devices encountered in real life, we suggested composing problems with applications of mechanical energy conservation whose practical example was the roller-coaster (Figure 1).

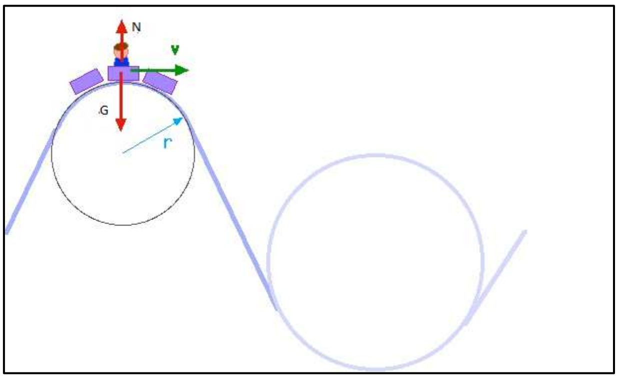

Figure 1. Roller-coaster modelling

A roller coaster ride illustrates the work and energy relationship. The amount of work done by the external forces upon the object is equal to the amount of change in the total mechanical energy of the object.

The only forces acting upon the coaster cars are the force of gravity, the normal force and dissipative forces such as air resistance. The force of gravity (G) is an internal force and thus any work done by it does not change the total mechanical energy of the train of cars. The normal force of the track (N) pushing up on the cars is an external force and all times directed perpendicular to the motion of the cars and thus is incapable of doing any work upon the train of cars. Due to the complexity of the air resistance force and its small contribution to the large quantity of energy possessed by the cars, it is often neglected.

This may be considered the total mechanical energy of the train of cars is conserved during the ride. Energy is neither gained nor lost, only transformed from kinetic energy to potential energy and vice versa.

Initially, students noticed the real device, described and explained the movements involved. But to develop the problem solving competence, we needed to use computer simulations. Consequently, the students could configure the trajectory of the moving car, modify motion parameters and check their calculations as in Figure 2.

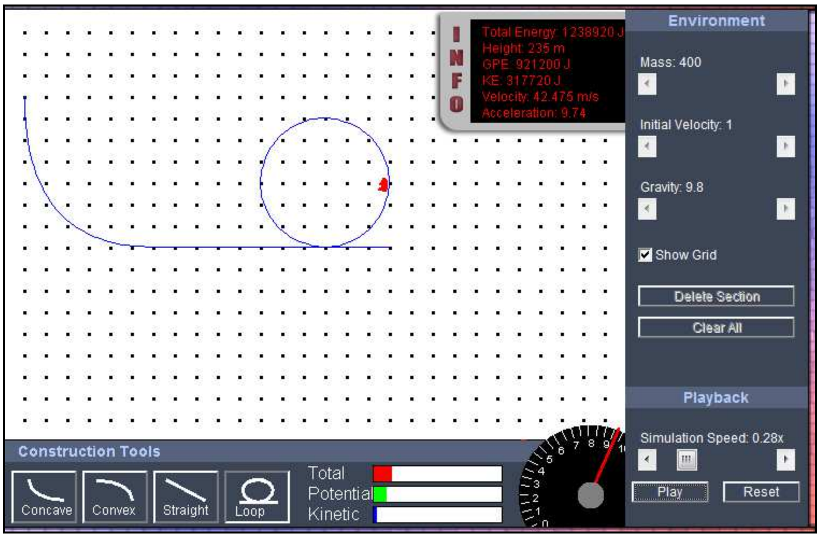

Figure 2. Modeling a roller-coaster problems by students

At the request of composing a problem situation to describe the situation created by them, most of the problems proposed by students referred to the initial mechanical energy, the speed at ground level and, in some cases, to the height at which the car can stop its circle trajectory.

Although this activity does take time, it is useful because students become familiar with the basic steps of creating problems. In this way, all students can progress, even if not all reach maximum performance.

Considering that the PISA 2015 will assess competence to solve problems, we designed the collaborative educational situation described below.

Students were organized into groups of three. Collaborative problem solving was performed using collaborative platform https://realtimeboard.com. Each group received the same text problem, but the situation was different in each problem (Figure 3).

The advantage of collaborative solving is that each student can contribute with what he knows best, ask for the support of team colleagues and the tasks can be distributed in accordance with the skills and knowledge of each team member.

The platform, which has the interface of an endless board, allows drawing and sticking post-its on the whiteboard, type in text, add shapes, create links and leave tagged comments. In addition, the board allows the student to add pictures, Vimeo and YouTube videos, PDFs and documents from Google Drive.

The benefits of visual collaboration are: sharing concepts and ideas, prototype, leaving comments and gathering feedback from colleagues, seeing all the updates and changes in real time. Another advantage is that it is possible to export the boards as PDFs and images, embed them to your website, blog or even post them to your Facebook timeline just like a YouTube video.

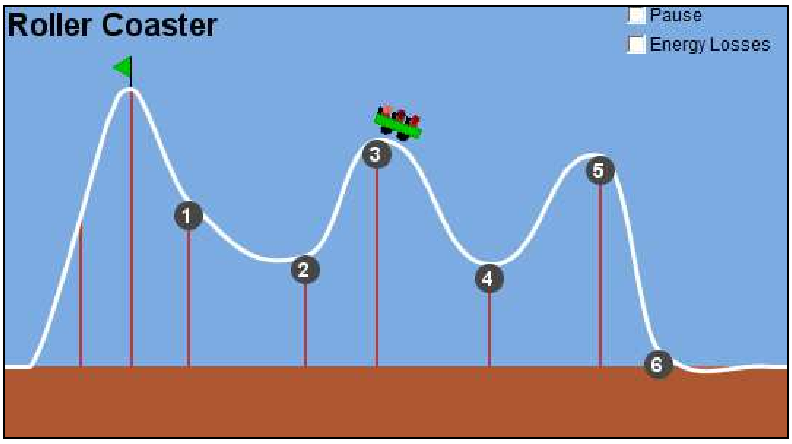

Figure 3. Modeling problem situation

Communication while working on this platform is facilitated by a chat service so that teams can work either in the same space, not being disturbed in their work, or at a distance, in either situations, thier learning not being limited to the formal Physics classes (Figure 4).

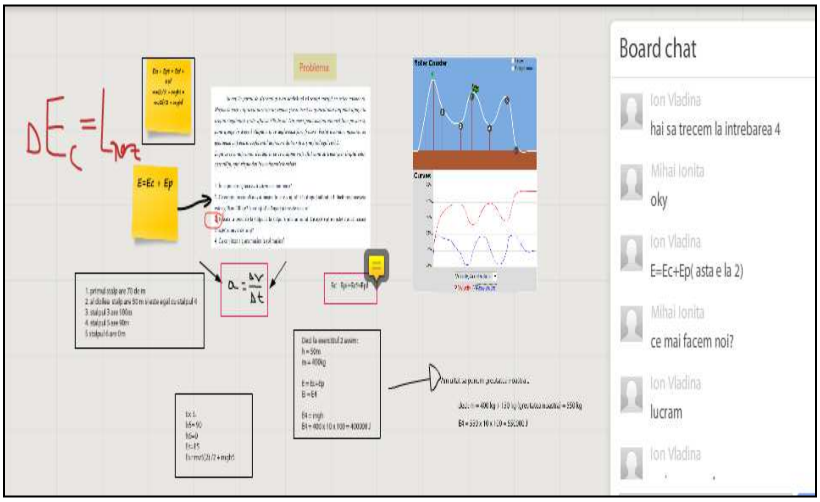

Figure 4. Collaborative problem solving

However, the difficulty of editing problems reduces the effectiveness of this method, so an assessment based on multiple choice items is much more appropriate.

Conclusions

The strategies that favor the emergence and development of creativity are the stimulation of students' interrogative attitude and problem solving. It is equally important that teaching technology should focus on the creative process and not on its product. The choice of educational means must consider both their effectiveness and efficiency in transmitting new information and the formation of skills and intellectual skills.

Following the educational approach presented, we noticed a slow progress of students who have already achieved a high level of problem-solving competence. Basically, in this situation, these students serve as tutors for those who have not achieved that competence yet.

For students capable of outstanding performance in the study of Physics, these methods can maintain or even increase their motivation to study, but superior results require a combination of traditional and modern strategies specific to gifted students. In addition to this, not all problems benefit of computer simulations.

On the other hand, for those students who did not have the competence or whose competence was not sufficiently developed, collaborative approach has proven to be a very effective method.

Students bravely tackle the issue, with the comfort of their support teammates. In this way they assimilate new information and clarify the most misunderstood concepts in an attractive way. Consequently, learning is no longer an objective of teaching, but a consequence of it.

The problem solving provides a basis for future learning, personal and management activities for effective participation in the society. Collaborative problem solving is an essential skill for education and employment.

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Transdisciplinary application in ”THE STONE’S SPEECH’’ Project

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Abstract

Our paper aims to illustrate a complex project under construction, based on the trans-disciplinary paradigm, which is addressed to youth involvement in nurturing and promoting the authentic values of the Country of Oas, through the creation of maps based on multi-touch technology and the corresponding software applications made through data bases from the places included in the study area and their efficacy both in the educational environment, by creating and participating at innovative trans-disciplinary activities and workshops, as well as at the surrounding community, through an essential contribution to a sustainable development of the society in which we live.document provides you with detailed guidelines for producing and submitting your print ready proof for the proceedings. The document is written in accordance with the instructions, which should be followed carefully.

Keywords: Multi- touch, interactive maps, Tradition, New Man

1 Introduction In the study *Society of conscience*, academician Mihai Drăgănescu, approaching the issue of *Information Era*, distinguishes three steps: *the society of information, the society of knowledge* and a third, about to be born, *the society of consciousness* (M. Drăgănescu, 2007), while academician Basarab Nicolescu speaks about the *Trans-disciplinary Era*, which “will be the era of translators – those who translate into our macro-physical language that which occurs at another level of Reality” (B. Nicolescu, 2007) , and Stephen Hawking says, equally inspired: “I believe that the next century will be the *century of complexity*" (http://complexity.ro/html/complexitate.htm). Complexity derives from the explosion of disciplinary investigation, the field of each becoming increasingly smaller and the dialogue between them less and less possible. Reductionist simplicity is canceled by multidisciplinary complexity. "The ideal of the simplicity of a just society, founded on a scientific ideology and the creation of the *new man*, collapsed under the burden of a multidimensional complexity. What remains, based on the logic of effectiveness in the service of effectiveness, can no longer propose anything but the end of History.” (B. Nicolescu, 2007).

Without overstating it or granting it exclusivity, we believe that the solution to leaving the Matrix of the twenty first century could come from Trans-disciplinary, associated to the study of Complexity grafted on constructivist paradigm. The trans-disciplinary mirror unites Subject and Object under the sign of the Included Third, which is the Sacred, the Tradition, transfigures Nature, and involves a transgressing knowledge. Aggressed by the informational “boom”, modern man seeks solutions through a return to Tradition. In the modern world it is increasingly difficult to distinguish the authentic values of a specific traditional culture to what was taken over by sterile imitations, mediated by external loans from Western cultures crossing an era of fragmentation, globalization and the loss of those landmarks meant to shape a unique and authentic national identity.

Young people today need a re-construction of their own subjectivity by re-discovering the specificity of the culture they belong to, which is a source of values that can inspire them in making future decisions aimed to build a sustainable society based on knowledge and cross-cultural dialogue. We also note that not only the tourists who want to discover the historical Maramures or Country of Oas find themselves lacking the landmarks to guide them in an area rich in traditional cultural values clouded by the explosion of materialistic opulence expressed in consumerist temptation, but even us, the inhabitants of this cradle of ancestral civilization, the young and the mature alike, we do not know the defining elements which build us inside, at the level of the individual conscience and of the intuition of our universality in cross-cultural dialogue. The birth of the *new man* will bring a cultural and spiritual revival of civilization in our community, sanctifying the place where we live and granting a lasting effect to the actions, attitudes and behaviors that define our uniqueness, creating a deep and true self-knowledge.

1.1 Experimental Trans-disciplinarity

For these reasons, we, the Multitouchcnme Team of the National College "Mihai Eminescu", in a partnership with a group of students from the Theoretical High School Negreşti-Oas, devised a generous, creative and inspiring project, "THE STONE'S SPEECH", which falls in the experimental trans-disciplinary approach, primarily aimed at involving young people in the cultivation and promotion of authentic traditional values from the Country of Oas and Maramures.

The overall objective of the project is to increase the capacity of active and innovative involvement of students in trans-disciplinary activities and their creative contribution to the development of a community based on living values, discovering those veritable human treasures which can become inexhaustible sources of fertile and sustainable dialogue between different generations. Its final purpose involves setting up an integrating web platform, with multi-touch support, which would include:

- Interactive maps illustrating cultural - anthropological routes;
- Multimedia lessons;
- Links to the Wiki page – "virtual laboratory";
- Links to themed blogs;
- Educational Software: Romanian Sky;
- Educational games;
- Media: field recordings; films made by students;
- Connections to page promoting FB;
- Prezi: applications submitted in national competitions;
- Pro Didactica: didactical annexes - teaching projects, PISA tests, etc.

The whole project is based on data collected from localities situated in the geographical area of the anthropological investigation. The project team contains experts from diverse fields of culture and science, both undergraduate and postgraduate, academic and museums in the field (Romanian Peasant Museum) by conducting research partnerships. In the actual work of research in ethnography, folklore and anthropology, we have created teams consisting of high school students and mentor-students from the universities included in the project (Babes-Bolyai Cluj-Napoca, Faculty of Letters of the University of North Baia Mare). The Multitouchcnme Team of the National College "Mihai Eminescu" will be the nucleus of the software product development, while the High School Negreşti-Oas will be the center of information and documentation. The area of investigation is aimed at the localities in the Country of Oas: Negrești-Oaș, Racșa, Vama, Certeze, Huta Certeze, Bixad, Boinești, Trip, Tarșolț, Aliceni, Moișeni, Cămârzana, Prilog, Lechința and from historical Maramureșul.

2 Specific Objectives

2.1. At the level of personal development and of self-awareness:

- To understand the need and the vital importance of discovering the inner evolution as a process of coagulation of individual uniqueness, enabling students to engage in a complex manner, both subjectively and objectively, in the educational training;
- To capitalize on the multiple forms of intelligence that any student interested in the complexity of the interaction of the levels of knowledge can activate in all learning and training activities;
- To find ways to unify the levels of being - body, heart, mind, and thus to build an abiding inner fortress through a personal effort to allow full involvement in any type of activity, pragmatic, artistic, or team work.

2.2. With educational and practical purpose in school:

- To develop software products on multi-touch support;
- To develop aesthetic taste for photography by attending photography workshops held in the field, in the villages of the Country of Oas and the historical Maramures;
- To make synesthetic documentaries / anthropological and cultural reports by cultivating an artistic sense of cinematography as film directors, capitalizing in a fertile manner the database and the inter-human relationships developed during research trips;
- To discover the importance and significance of reading monographs by seeking data on specific traditions and customs of the Country of Oas and historical Maramures, which they would then use creatively in the development of cultural routes
- To understand the need for the applicability of the information collected from various research sources, in the life of the school and the local community through the dissemination of project activities in the school magazine, the media, school competitions and festivals.
- To record on a blog and a published journal - impressions, pictures and photographs taken by students, the way they articulate the personal experience of the adventure of trans-disciplinary knowledge with the signs and symbols of the spiritual geography of Oas.
- To know the cultural figures who contributed and still contribute to the building of the spiritual dowry of the Country of Oas and of Maramures.

2.3. At the level of durable development culturally and spiritually of the local and regional community

- To learn local history, legends, myths, traditions and customs specific to the Country of Oas and Maramures, by participating in exhibitions of photographs taken by students locally or in neighboring villages or by the effective use and exploitation of the cultural benefits offered by multi-touch maps
- To help the inhabitants of the Country of Oas and Maramures to decant traditional authentic values from those borrowed sterilely and automatically, without grafting them to the local spirituality and culture.
- To allow potential tourists to orient themselves in the Country of Oas and Maramures in an original, creative and genuine manner, by discovering in their personal experience the cultural opportunities offered and marked on interactive

maps that mark the living treasures, priceless treasures of local and universal tradition;

- To contribute to the development and promotion of anthropological and cultural tourism in the Country of Oas and Maramures, at a national and international level.

2.4. At an axiological generally-human level

- To help create a trans-disciplinary attitude of tolerance, dialogue, openness and rigor, both at the level of human relationships and the exchange of culture and civilization to which we are constantly exposed in the context of globalization, standardization and consumerist contemporary nomadism.
- To develop the students' reflective spirit in the sense of activation of the interrogative dimension of the being destined to the vocation of preserving and creating culture, in the horizon of spirituality as a sign of awareness of the sacred in the world.

In the following you will find detailed *guidelines for formatting your paper*. These guidelines include complete descriptions of the fonts, spacing, and related information for producing your proceedings manuscripts. Please follow them and if you have any questions, direct them to **vlada[at]fmi.unibuc.ro**.

3. Cultural – Anthropological Routes 1 Basic Formatting

The project, complex and generous by its very area of investigation, focuses on achieving those interactive maps, applicable both in the educational environment, scenarios of trans-disciplinary lessons and also at the level of the regional community, in promoting cultural values.

The information will be written in three languages: Romanian, English, and French, to provide the opening for a good reception. The cultural-anthropological routes covered are structured around the following areas:

Art:

- In Search of Poetry - This route aims at learning poetic creations of writers born in the Country of Oas and Maramures. The interactive maps will indicate: information about the artists; memorial house (where available); their work with examples; audio/ video recordings.
- Caught in the Dance of Colours – the maps will be a virtual museum of academic art and folk art. They will also provide information on pictorial / graphic technics, about *Baia Mare School of Painting* etc.
- Photography from Oas/ Maramures - the master of photography, Ionita G. Andron, complex personality of the Country of Oas and the group of contemporary photographers in the studied area.
- Traditional Folk Music and Violins - this route aims to identify complex musical work by Dr. Ing. Ioan Chiorean-Oas, a native of Prilog, and also meeting with local traditional violin players, singers, trumpeters, whistlers, flute players, simple local people and also the consecrated ones, etc

Traditional Crafts:

- Weaving the bride’s hair
- Washing clothes at the whirlpools
- Stringing beads and ornaments of Oas
- Pottery (Vama)

- The water mill from Cămârzana - for corn flour
- Farriers in Cămârzana
- The traditional stills - the water of life of Oas
- The sewing workshops for the traditional costumes of Oas: gown, apron, crown etc.
- Spinning and weaving
- Leather clothiers, etc.

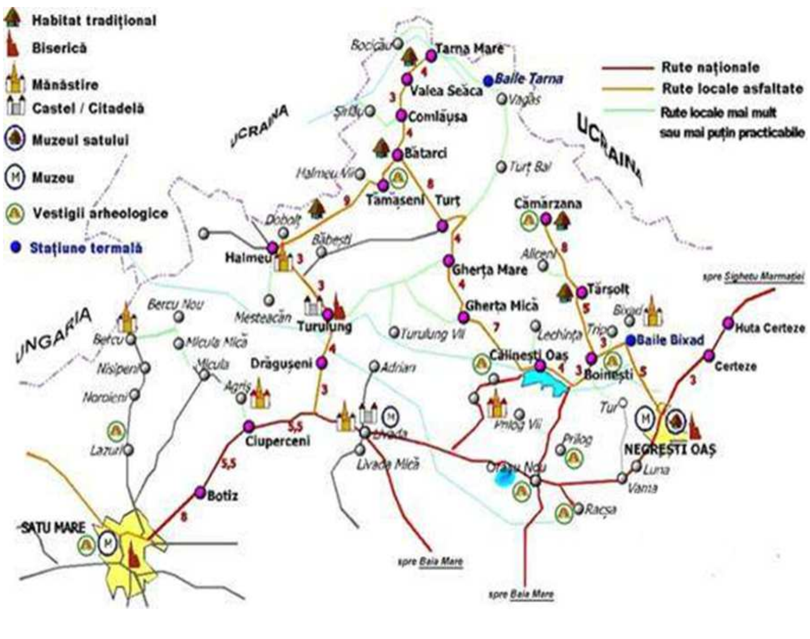
Myths, Legends, Local History:

- **The Route of Pintea the Brave** who takes refuge for a while, coming across the mountains from Maramures and hides in the Devil's House in Racşa (a paleolithic cave from Cremene), moving then to Bixad where there is a rock with the traces of Pintea's ax.

Romanian sky:

Partnering with the Astronomical Complex Baia Mare allows us to include our project in the large project they are developing, *Romanian Constellations*. If the Planetarium project is based only on information taken from the consecrated studies, signed by Ion Otescu, Tudor Pamfilie, Romulus Vulpescu, Dimitrie Gusti, we intend to complete the astral picture with information taken from areas of research, concerning stellar mythology in the Country of Oas and Maramures.

Figure 1 Interactive map sample – the Country of Oaș



5. Conclusions

The project involves the creation of transferable skills: developing initiative and creativity; investigation; processing; generalization; application; teamwork; integration of personal experience in team experience; developing skills to use new technologies. The tool is the computer and the internet is the friendly environment for information and communication. In the constructivist trans-disciplinary paradigm, the teacher provides only the tools for acquiring knowledge: individual and group investigative activities, problem solving, certification of analogies or phenomena through intuition, role play, making bridges between science and art, etc. Guided by teachers and mentors, students build their active and dynamic knowledge without mechanical accumulation of information.

In the trans-disciplinary vision there is also a “trans-relationship” that connects the four pillars of education – learning to know; learning to do; learn to exist; learning to live with others – which is the inner being, the state in which the mind is reconciled with the feelings and the body. The human being lives simultaneously at the level of individual, social and cosmic reality, united under the sign of the Hidden Third. Therefore, the multi-touch technology dovetails the trans-disciplinary vision.

Because of the multidimensional and multi-referential character of Reality, the trans-disciplinary research method might be the solution to the existential crisis of the 21st century: “trans-disciplinarity produces quantum transformations: religion into trans-religion, history into trans-history, ethics into trans-ethics. Thus, by successive quantum transformation, our world will reach a true era of peace” (B. Nicolescu, 2007) substantiating a new humanism, the trans-humanism, which provides a being the path of maximum cultural and spiritual development, the path of access to the Being of Beings.

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Idem

Nicolescu, B. (2007): Teoreme poetice, Iaşi, Publishing House Junimea.

http://complexity.ro/html/complexitate.htm

Teachers’ Interest in Developing Papers on ICT Topics

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Abstract

This study focuses on the results of an analysis of the topics researched in 2757 papers submitted for the postgraduate didactic certification level I (PDC LI). The aim of our investigation was twofold: 1) to find in the list of papers submitted by candidates the ones approaching such topics as ICT and online learning and 2) to analyse the content and references of a sample of 26 PDC LI papers in order to examine whether: a) candidate-teachers draw on electronic resources to write and document their papers b) what types of resources are used (books, articles, reports, etc.) and what category they are included (primary, secondary, tertiary respectively, gray literature) c) the percentage of electronic resources in the total of references used. Our findings show a low interest of teachers in ICT topics. Moreover, it was revealed that online resources are poorly represented in the bibliographies of papers submitted for the postgraduate didactic certification level I, teachers’ preferences for documenting their works going for tertiary resources and gray literature.

Keywords: Postgraduate Didactic Certification Level I, ICT literacy, Online resources, Continuous training

1 Introduction

In Romania, teachers’ continuous training provides for both career advancement and professional development. Teachers’ career advancement is effected by postgraduate didactic certification levels II and I. To earn a postgraduate didactic certification level I (”first didactic degree”) teachers write a paper in their academic specialisation; the topic to be approached in this work is agreed upon by candidate teacher and university specialist coordinator. Public presentation of the paper submitted, which is the last step in fulfilling the requirements for didactic certification level I, is preceded by formal classroom observations by school inspector or specialist counsellor.

Professional development is accomplished through teacher training programmes or courses whose aim is to improve the competences:

- teaching competences – competences in the field of specialization (eg. Physics and Didactics of Physics);
- psycho-pedagogical competencies: teaching and evaluation methodologies etc.
- managerial and guidance competences: classroom management, leadership etc.
- other complementary competences (including transversal competences): Information and Communications Technologies/ICT, e-learning, project management etc.

One of the competences considered necessary for the teaching job is ICT literacy (Pimm and Johnstone-Wilder, 2005; Adăscăliței, 2007; Goktas et al. 2009, Grindei et al, 2012). The reasons are suggested by Jimoyiannis (2012):

> ”ICT applications and e-learning environments are becoming common elements of contemporary educational institutions, allowing both teachers and students to build strong learning communities around a common subject or field of interest. ICT and the new

generation of Web technologies (blogs, wikis, social media etc.) offer enhanced learning resources and virtual learning spaces that are expected to exert a significant impact on education, since they change the boundaries between school and home; formal, non-formal and informal learning; teachers and learners; education and entertainment.″

ICT literacy is defined by Bawden (2001, cited by Neicu, 2011) as ″a set of attitudes and necessary skills to use and communicate information and knowledge effectively in a variety of environments and formats”. ETS (2002) explains that ICT literacy involves “using digital technology, communications tools, and/or networks to access, manage, integrate, evaluate and create information in order to function efficiently in a knowledge society”. In other words, ICT literacy involves functional competencies to process information:

“- acces information: knowing about & knowing how to collect and/or retrieve information;
- anage information: applying an existing organizational or classification scheme;
- integrate information: interpreting and representing information by summarizing, comparing and contrasting;
- evaluate information: making judgments about the quality, relevance, usefulness, or efficiency;
- reate information: generating information by adapting, applying, designing, inventing, or authoring information.″ (ETS, 2002).

Most definitions of ICT literacy divide the ICT knowledge and competences in two clusters: basic and advanced competences (Poulter and McMenemy, 2004; Goktas, et al. 2009). Basic competences reffer to basic computer operation and use of software (Goktas, et al. 2009). In Romania basic competences are acquired during pre-university and university education studies. Possessing advanced competences means to be able to use them to professional activities. Students future teachers acquire advanced competences through a Computer assisted instruction (CAI) course in which they learn how to use their ICT knowledge and skills in classroom contexts.

For teachers already in the system, development of ICT skills is facilitated through continuous professional development programmes. The main providers of in-service training ICT courses are the higher education institutions, County School Inspectorates, Teachers’ Houses and NGOs. Here are some examples of projects funded under the Sectoral Operational Programme Human Resources Development (POS DRU) or delivred by Teachers’ Houses:

- “ICT Key Competencies in the School Curriculum” - POSDRU/1/1.1/S/5;
- “Competence, Professionalism and European Dimension through ITC integration in education” - POSDRU/87/1.3/S/57406
- “The IT&S (ICT and Didactic Strategy) integrative and innovative training programme for continuous professional development for teaching staff in the București-Ilfov and South-Muntenia Regions” - POSDRU/87/1.3/S/61515
- “School – an active member in the information society” - POSDRU: ID 62979.
- “Technical and vocational education in the domain of ICT”- POSDRUM/1/1/S/4 Project code: 994.
- ”In service teachers’ training of mathematics teachers in the knowledge society”- POSDRU: ID 63671.
- ”Integration of ICT in educational process” - a training course delivered by Teacher House ”Grigore Tăbăcaru” Bacău.
- ”Advanced used of ICT instruments” - a training course delivered by Teacher House Arges (OMETCS/3284)

To help teachers integrate new ICT technologies in the instructional process most of the schools have ICT laboratories equipped with functional computer system units and supplied with software packages necessary for the teaching-learning activities for every subject in the curriculum.

Under the circumstances, ICT competences and interest in developing competences for integration of ICT in the instructional process should naturally be reflected by the topics approached in the papers submitted by cantidates for the postgraduate didactic certification level I.

As a result, our research was aimed to find out if teachers capitalize their ICT competences in preparing their papers for postgraduate didactic certification level I. To this end we studied the titles and contents of the papers submitted (with their chapters and sub-chapters) and, respectively, the bibliography lists included. The last-mentioned can include a large variety of sources which can be grouped into the following categories (according to Florida Gulf Coast University Library Services):

- primary sources: autobiography, dissertations/theses (original text), case studies, personal papers, films, historical documents, laboratory data, original manuscripts /original documents, original research, images (photographs, schemes, maps), religious documents, technical reports etc. published in scholarly journals, refereed/peer-reviewed journals, books
- secondary sources: work that relies on primary sources: analysis, biographies, dissertations/theses (literature review chapters/materials), editorials, film documentaries, reviews of the literature etc. published in books, encyclopedias, atlas, newspapers, scholarly and refereed/peer reviewed journals, web.
- tertiary sources: work that is based entirely on secondary sources and published in books and textbooks, popularisation/vulgarisation works, magazines & newspapers, web.
- gray literature. This concept is still a bone of contention among specialists. Schöpfel (2011) analyzes and clarifies the concept:

> "Grey literature stands for manifold document types produced on all levels of government, academics, business and industry in print and electronic formats that are protected by intellectual property rights, of sufficient quality to be collected and preserved by library holdings or institutional repositories, but not controlled by commercial publishers i.e., where publishing is not the primary activity of the producing body."

Therefore, establishing a typology of information resources teachers use in writing their paper for postgraduate didactic certification level I was another aim of our study.

2 Method

The observational study was developed over two stages.

In the first stage we read through a list of 2754 titles of papers submitted for postgraduate didactic certification level I exam at the Babeş-Bolyai University of Cluj-Napoca to identify topics related to ICT issues. Part of these works were already completed and presented (857 papers), others (856 papers) have been completed in written form and are to be presented during the academic year 2014-2015, while 1041 titles have been undertaken by candidate teachers as their research topics to be developed and, subsequently, presented in the academic year 2015-2016.

The second stage of the study involved an analysis of the contents and bibliography lists of a sample of 26 papers in the domain of Natural Sciences which are to be defended in public during the academic year 2014-2015. One of the purposes of this investigation was to establish whether aspects related to the integration of ICT in instruction were discussed in the content of these papers through theoretical (of chapters or sub-chapters extension) or practical approaches (lesson plans, design of class activities). The second purpose was to find out whether teachers used, in preparation of their papers, online or web sources of information. Finally, establishing a typology of web references used in producing the papers was aimed.

3 Findings

The analysis of the titles for the 2754 papers revealed a low interest of teachers in approaching ICT topics in their research. Thus, except the papers written with reference to the use of software in the instructional process, submitted by teachers of computer science, only 36 papers (1,31%) discussed ICT issues.

Table 1. Percentage of titles of papers approaching ICT issues by series of candidates

Series	Number of papers	Number of titles of papers covering ICT topics	Percentage of titles of papers covering ICT topics
2012-2014	857	11	1.28%
2013-2015	856	11	1.19%
2014-2016	1041	14	1.34%

However, the results does not show a growth of teachers' interest in the topic over time (see Table 1 and Table 2).

Table 2. Percentage of titles approaching ICT topics by categories of candidates

Series	Preschool teachers	Primary school teachers	Middle school and high school teachers
2012-2014	0	0	2,41%
2013-2015	0.51%	0.98%	1,76%
2014-2016	0.43%	0.42%	2,1%

As shown in Tabel 2, middle school and highschool teachers are more interested in ICT topics than their peers in primary school and kindergarten education. Consequently, the percentages of ICT topics by teaching staff categories are as follows:

-preschool teachers: 0.31%
-primary school teachers: 0,47%
-middle and high school teachers: 2.09%

As regards the range of ICT topics approached we noted that it is not of a large variety: most of the papers focus on the integration of software applications in class activities. Topics related to e-learning and virtual learning environments (such as virtual classrooms, e-learning platforms, media learning, etc.) are missing.

To exemplify what has been stated above, some titles of postgraduate didactic certification level I papers approaching ICT topics are listed below:

-"The role of CAI in studying the topic «Redox processes» in high school" (Chemistry teacher, series 2012-2014);
-"New Information and Communications Technologies in Teaching and Learning Biology in High School" (Biology teacher, series 2013-2015);
-"CAI for Mathematics Classes in Middle School" (Mathematics teacher, series 2013-2015);
-"Improving Receptive Skills through ICT" (English teacher, series 2014-2016);
-"CAI applied in marketing studies" (Economics science teacher, series 2014-2016);
-"The Use of Software Applications in Teaching Sciences in Foundation Classes" (Primary teacher, series 2014-2016);
-"The Contribution of Educational Software in Developing Transversal Competences in Preschoolers" (Preschool teacher, series 2014-2016).

In the second stage of our study 26 papers written by Science teachers (Romanian language studies) were analyzed to identify ICT topic-related approaches and the typology of bibliography lists of information resources used in researching the themes.

The investigation of the content of these 26 papers written by Science teachers provided us with the following evidence for our theme of study:

- 3 of the 26 papers included theoretical chapters/ sub-chapters on ICT issues;
- 5 papers described practical applications of ICT in their specialist domain.

The typology of information resources in the bibliography lists related to the ICT domain indicated by the authors of PCD LI papers is illustrated in Table 3.

Table 3. Types of references on ICT topics in the sample of 26 papers

Type of sources	**Bibliography sources and number of postgraduate didactic certification level I papers in which these sources are specified**
Primary sources	- articles published in Romanian or foreign languages in scholarly journals: 7 papers; - books (printed on paper or in digital format, e.g. Google books): 3 papers;
Secondary sources	- doctoral theses, bachelor's degree theses, master's degree dissertations – theoretical chapters: 2 papers; - reviews of some theses – 1 paper; - atlases, encyclopedias: 5 papers;
Tertiary sources	- summaries of some doctoral theses: 2 papers; - extended abstracts of scientific articles: 2 papers; - Power Point presentations: 7 papers; - articles published in Conference proceedings volumes: 2 papers;
Grey literature	- scholarly articles available online on various websites: 17 papers; - papers or materials produced by other teachers available online (for example on Didactic.ro): 9 papers; - popularisation works available on various websites: 4 papers; - popularisation articles or books in print: 9 papers; - documents issued by the Ministry of Education (curricula, syllaby, methodological guides, other types of documents): 17 papers; - support materials developed in various projects: 8 papers; - European documents: 2 papers.

The total number of bibliographic entries in the lists included in the 26 papers studied is 1173, which means an average value of 45 entries per paper. Out of the total number of entries, 348 represents the number of web resources (29,67%).

4 Discussion and Research Limitations

The findings of our study show that a very small number of teachers choose to apply their ICT knowledge and competences in developing a research paper for postgraduate certification level I in their specialist domain, or in the ICT domain (or to write full chapters or sub-chapters on ICT topics at least in their research paper). A potential cause might be represented by the time constraints: it is easier for teachers to develop or extend the research initiated in their bachelor's degree theses or master's degree dissertation rather than approach completely new themes. A second reason might be the lack of practice for the ICT knowledge acquired or competences developed through various continuous training courses (by systematic use in their class activities).

Teachers use their ICT knowledge and competences to gather information on topics of interest available from web sources. We may ascribe the use of mainly tertiary and gray literature types of sources of information in most of the bibliography lists of the papers analyzed to financial constraints, since e-books or whole scholarly articles published online in high impact journals can be costly to access. That is why only 10 papers include entries of books and articles available on the web.

In as far as the limitations of our study are concerned we should mention the following:

- the candidate teacher agrees on the topic of his or her research paper with the coordinating academic staff member In most cases the scientific coordinator (supervisor) does not change the domain of the theme or topic proposed by the candidate; however, such situations may occur.
- some authors of PDC L1 indicate books available on the web (Google Books) but they do not provide the appropriate links, which led to errors/omissions in collecting the necessary data for our research.
- the sample of 26 papers included only the copies submitted to the Registration service of the Teacher Training Department up to 28th of August. Since the deadline for submission was 31st August, some of the papers submitted for the domain of Natural Sciences of the candidates in the series 2014-2015 may not have been included in the sample.

5. Conclusions

Tuckett (1989, cited by Bawden, 2001, p.8) states that: ″while you can be computer literate without being information literate, you cannot possibly be information literate ... without also being computer literate″. Developing Tuckett' opinion to the teachers' training in ICT is important to underline two aspects:

- teachers' training in developing ICT knowledge and competences should be focused on using ICT to enhance teaching and learning rather than basic ICT applications (Katz and Macklin, 2007; Pritchard, 2007; Goktas et al. 2009).
- technology changes rapidly and for this reason teachers need support to develop both new technical and new pedagogical skills (Higgins, 2014).

Providing teachers with opportunities to practice their ICT competences in real professional contexts, relevant to their specialist domains support teachers to become competent to design and implement effective learning activities for pupils who are, as a matter of fact, familiar with and interested in the domain of ICT.

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Language-related Factors Leading to the Improvement of the Didactic Communication

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Abstract

Modern perspectives on didactic communication emphasize the idea that the teacher should get acquainted with the factors which can lead to its improvement. The issue of improvement of the didactic communication arises from the necessity of sustaining the development of the student's communication competence with direct and indirect repercussions on the quality of the learning process. This type of communication involves factors of various natures: psychological, psychosocial, pedagogical, linguistic, contextual etc. Our study focuses upon the linguistic-related factors which, in our opinion, lead to the optimization of the didactic communication. Thus, the objectives of the research are to identify the linguistic-related factors at three school levels (primary, gymnasium and high school) and to determine the practical relevance for each item in the process of improvement of the didactic communication in order to achieve an adequate diagnosis that allows teachers to make the best decisions in their work.

Keywords: Didactic communication, Language-related factors, Efficient communication

1. Introduction

The efficient didactic communication is, in fact, the result of a combination of various factors (psychological, psychosocial, pedagogical, linguistic, contextual etc.) working together. Without minimizing the importance of any of the influnces, our work dwells on a series of linguitic-related factors present in the process of didactic communication and perceived as of great importance for its improvement.

The issue of efficiency of didactic communication has been approached from different angles. Thus, I. Cerghit (2008) states that the act of didactic communication must be based, essentially, on a common linguictic experience of the teacher's and student's repertoires. As such, the emitter of the didactic message, in this case the teacher, should display flexibility adjusted to the real linguistic possibilities of the communication partener, the student. Another factor which leads to the improvement of the didactic communication is the clarity of the message. V. Tran and I. Stănciugelu (2001) insist upon this feature transposed into a series of general qualities: concision, grammatical correctness, the use of the most appropriate words to successfully convey the intentions of the speaker, focus on the topic of discussion without further digressions etc.

D. Sălăvăstru (2004) underlines that students must be familiarised with the dialogue and everything it implies: alternating points of view, arguments developed from the ideas under the lens, critical perspectives supported by evidences. As a consequence, the students understand that the dialogue in the didactic process is a display of arguments and counterarguments and thus s/he acquires a series of strategies meant to support this culture of the dialogue.

In order to meet the qualities of an efficient communication, the teacher must make use of all resources of persuassion, flexibility, ability of explanation etc. All these requirements are based on a series of principles (Chartier, 1986) any teacher’s message must obey: the principle of simplicity, the principle of logical structuring, the principle of repetition, the principle of support elements. In our research we have insisted upon the last principle in the enumeration which we identified as explanations, examples, arguments, observations, interpretations etc.

In order to improve the didactic communication, various authors (Şerbănescu, 2002; Ognev and Russev, 2008) draw attention on the fact the teacher must use diverse types of questions (factual, empirical, productive, evaluative). They should be organised as a crescendo, in a progressive order so that the students should acquire knowledge gradually in any field of study. Along the same lines, I. Ognev and V. Russev (2008) come up with a classification of questions that can be used in the educational process to sustain students’ focus and communicational disponibility, which we grouped under the syntagm ”stimulating questions”: informational questions (give the possibility of transmitting and receiving the necessary information), focalizing questions (determine the interlocutor to think of the consequences of actions or decisions), directing questions (either cover a moment of silence during the dialogue or orientate it into a new direction) etc. Additionally, G. Leroy (1974) speaks as well of stimulating questions that not only stimulate the student to look for the answer, but they also urge him to speak more amply, more precisely and correctly without imposing a certain direction to his thinking.

Another important issue in the problem of optimization of the didactic communication is the feedback. J. G. Longenecker (1969), T. K. Gamble and M. Gamble (1993), J. Cosnier (2010) state that feedback has a significant contribution to the optimization of the didact communication because it has positive, correcting and adjusting role to the initial message. D. Sălăvăstru (2004) considers that the questions the teacher asks during the class are another way by means of which the feedback on the reception of the transmitted message can be obtained. Along the same lines, A. Şerbănescu (2002) considers that the main categories of questions are the ones for clarification and for confirmation.

The same author (Şerbănescu, 2002) also tackles the issue of teacher’s expressiveness. In order to be expressive the teacher has to choose the most appropriate words to convey the ideas and the emotions intended. At the same time, the way a word is pronounced can ensure several meanings and affective reverberations. The tone of voice, the accent, the speed, the rhythm, the pauses, the diction have an extremely large impact on the students, determining the correct reception of the educational message.

The analysis of the references previously mentioned shows that the issue of linguistic-related factors necessary to the improvement of the didactic communication has been approached fragmentarily in various studies on the verbal communication. Assembling all this information, we have tried to offer a unitary interdisciplinary perspective of the linguistic-related improvement factors in the context of didactic communication.

2. Presentation of research

The objectives of our study are: a) to identify the linguistic-related factors which lead to the improvement of the didactic communication at primary, gymnasium and high school levels, according to the theoretical background sketched above; b) to determine the practical relevance for each item in the process of improvement of the didactic communication in order to achieve an adequate diagnosis that allows teachers to make the best decisions in their work.

The instrument used for the research was a questionnaire analysing the opinions of the teachers in primary school, gymnasium and high school regarding the linguistic-related factors that contribute to the improvement of the didactic communication. The starting point of the questionnaire was the study of specialized literature corroborated with discussions in focus-groups with the teachers from each of the three school levels. This led to the identification of a series of linguistic-related factors in the didactic communication transposed into the following items:

- compatibility of teacher's and student's repertoires (mutual adjustement to the partener in terms of cognitive and linguistic experience);
- clarity of the mesasge (systematized, concise, easy to grasp exposure);
- (strategies of) argumentation of the message;
- use of support elements for a better understanding of the didactic message (explanations, examples, arguments, observations, interpretations etc.);
- use of stimulating questions (e.g. *Can you dwell on the idea?* etc.);
- use of clarifying questions (e.g. *Why?*);
- use of questions to obtain feedback (e.g. *Have you understood?*);
- teacher's expressiveness in oral communication (tone of voice, rhythm of speech etc.).

Mention must be made that we consider the factors identified above language related as their use is connected to various fields of linguistics such as semantics, grammar, pragmatics, stylistics, phonetics.

The items identified were structured into a questionnaire. The respondents were asked to choose one of the following variants of a five-step scale: (1) to a very low extent, (2) to a low extent, (3) to an average extent, (4) to a large extent, (5) to a very large extent, thus showing how often they came across the situations described by the items. The data collected demonstrated the relevance of each linguistic-related factor in the process of improvement of the didactic communication.

The sample used to apply the questionnaire was formed of 150 teachers (50 for each school level: primary, gymnasium, high school) from Vrancea County, Romania. The participants were 52 teachers with 10 to 20 years of experience in the educational system, 67 teachers with 20 to 30 years of experience and 31 teachers with 30 to 35 years of experience. Of all respondents 72 were men, whereas 28 were women.

For the analysis of the data we have used the SPSS program, the t-test for the independent samples and Levene test. Descriptive statistics of the scores obtained are presented in Table 1.

Table 1. Means and Standard Deviation of Linguistic-related Factors Scores

Items of linguistic-related factors	Primary school Mean (std. dev.)	Gymnasium Mean (std. dev.)	High school Mean (std. dev.)
compatibility of teacher's and student's repertoires	4.22 (0,936)	4.18 (0,839)	4.16 (0,896)
clarity of the message	4.78 (0,418)	4.82 (0,438)	4.52 (0,789)
argumentation of the message	4.10 (0,931)	4.64 (0,563)	4.58 (0,538)
use of support elements for a better understanding of the didactic message	3.94 (0,867)	4.04 (0,856)	4.00 (0,969)
use of stimulating questions	4.16 (0,575)	4.68 (0,614)	4.62 (0,733)
use of clarifying questions	4.02 (0,820)	4.14 (0,729)	4.10 (0,863)
questions to obtain feedback	3.90 (0,953)	4.24 (0,981)	3.68 (0,862)
teacher's expressiveness in oral communication	2.98 (0,724)	2.90 (0,890)	2.88 (0,925)

Analysing the means from table 1 we have realised a classification of the linguistic factors in the three school levels as presented in table 2. Thus, the first rank is considered of highest relevance to the process of improvement of the didactic communication whereas the eighth rank shows what is considered to be the lowest relevance for the same purpose.

Table 2. Descriptive of Classification of the Linguistic-related Factors for the Three School Levels

Rank	Primary school	Gymnasium	High school
1.	clarity of the mesasge	clarity of the mesasge	use of stimulating questions
2.	compatibility of the teacher's and student's repertoires	use of stimulating questions	argumentation of the message
3.	use of stimulating questions	argumentation of the message	clarity of the mesasge
4.	argumentation of the message	questions to obtain feedback	compatibility of teacher's and student's repertoires
5.	use of clarifying questions	compatibility of teacher's and student's repertoires	use of clarifying questions
6.	use of support elements for a better understanding of the didactic message	use of clarifying questions	use of support elements for a better understanding of the didactic message
7.	questions to obtain feedback	use of support elements for a better understanding of the didactic message	questions to obtain feedback
8.	teacher's expressiveness in oral communication	teacher's expressiveness in oral communication	teacher's expressiveness in oral communication

As table 1 shows, in a comparative analysis of the means of the indicators of the linguistic-related factors, the highest means for primary school (m=4.78) and gymnasium (m=4.82) are for clarity of the message, whereas for high school the highest mean (m=4.62) is for use of stimulating questions. The lowest mean, existing in all three school levels, is for teacher's expressiveness in oral communication (primary (m=2.98), gymnasium (m=2.90), high school (m=2.88)). With the other items, the hierarchic order varies as shown in table 2.

We applied the T test for the independent groups in order to determine the differences at the level of the linguistic-related factors leading to the improvement of the didactic communication between the teachers' groups. The analyses are performed between primary school and gymnasium, primary school and high school, gymnasium and high school. We set the significance level to 0.05. Starting from the significant differences from a statistical point of view among the appreciations of the teachers from primary, gymnasium and high school we can state the relevance of the factors which determine the efficiency of didactic communication for every school level.

Thus we can observe that the teachers in gymnasium estimated, by comparison with the teachers in primary school, that a greater relevance in the didactic communication is registered by two items for which the mean obtained is higher for gymnasium in comparison with primary school (argumentation of the message, use of stimulating questions, $p<0.05$).

Analysing the appreciations of the teachers from primary and high school we notice significant differences for three items (clarity of the mesasge, argumentation of the message, use of the stimulating questions, $p<0.05$). For the first item the means are higher for primary school than for high school, which shows that the teachers in primary school appreciate clarity of the message as having a greater relevance for their educational goal. For the other two items the means are higher for high school than for primary school as argumentation of the message and use of the stimulating questions were considered of greater relevance for the the former school level.

Among the appreciations of the teachers of gymnasium and high school there are significant differences for two items (clarity of the mesasge, questions to obtain feedback). For each of the items, the mean obtained is higher for gymnasium in comparison with high school. The results show that the teachers in gymnasium estimate that the two items have a greater significance for the improvement of the didactic communication.

Generally speaking, there are not statistically significant differences in scores which demonstrates convergence of appreciations between the investigated groups for the majority of the items. However, there is divergence of opinions for two items between primary and gymnasium levels, for two items between gymnasium and high school, for three items between primary level and high school.

3. Conclusions

Our research led to a pertinent identification of a series of linguistic-related factors which contribute to the improvement of the didactic communication at three school levels: primary, gymnasium and high school. Our analysis allows prompt differentiated interventions which could optimize the communicative interactions. Additionally, the active participation of the students at the exchange of information, ideas, impressions and opinions in school activitites is a good opportunity of argumentation, analysis, providing alternatives to solve a situation, involving thus the volunteer implication of cognitive-theoretical and practical structures which form the basis of the communication competence. Thus, the strategies of optimization of intercommunication in school activities must aim at developing each aspect specified in the indicators in the research and at including them in a strategy based on the idea of total communication, that is a coherent, integrating strategy, with elements in a relationship of explicit and implicit interaction, of mutual influence and support.

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A Study on the Effects of Dysfunctions of the Didactic Communication

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Abstract

The paper focuses on the effects of dysfunctions in the didactic communication. The objectives of the study are to identify the effects of dysfunctions in the didactic communication, which were grouped, according to specialized literature, on three levels: cognitive, affective, behavioural, and to realize descriptive analyses in order to determine their impact on the individual at primary school, gymnasium and high school. The results of the research led to the localization of the problematic aspects which affect the efficient accomplishment of communication in the didactic activity for each school level and as such they may be used by teachers to make the correct decisions to optimize the process of didactic communication.

Keywords: Didactic communication, Dysfunctions of the didactic communication, Effects of dysfunctions of the didactic communication

1. Introduction

The issue of the effects of dysfunctions in the didactic communication has been repeatedly approached by several researchers (Ionescu, 2001; Cucoş, 2002; Jude, 2002; Albulescu, 2003; Dinu, 2004; Voiculescu, 2004), in the larger context of the effects of communication as compulsory presences in the structure of the interpersonal communication since there is no message which does not leave “traces” on the receiver. Thus, Jude (2002), analysing R. Bales' configurational model of communication, points out that the dysfunctions in communication can lead to negative reactions such as rejection, disapproval, tension (fear), lack of involvement, antagonism.

C. Cucoș (2002) makes some relevant suggestions on possible effects of dysfunctions in communication related to the temporal context which may involve didactic errors, stress, physical weakness, and tension. Along the same lines, F. Voiculescu (2004) mentions as negative effects of dysfunctions in the didactic communication in the temporal context: fatigue, stress, decrease in the capacity of focalising attention and, consequently, diminution of school efficiency and low motivation for learning.

M. Ionescu (2001) underlines that a flawed communication, irrespective of the causes, determines a chain of lacunae in the system of knowledge and diminution of school efficiency. Ion Albulescu (2003) states that the effects of dysfunctons in communication may lead to intense affective emotions such as frustration and stress. He also highlights that the effects of dysfunctions in communication are not the direct results of messages, but they acquire the semnifications the receiver detaches from them.

M. Dinu (2004) points out the interrelation between the effects of communication and feedback as the latter constitutes the base upon which improvements can be made. He classifies the effects of communication into three categories: cognitive, affective and behavioural.

2. Methodology of Research

The objectives of the study are:

a) to identify the effects of the dysfunctions in the didactic communication based on the information and the classification from the specialized literature;

b) to realize descriptive analyses of the effects of the dysfunctions in the didactic communication in order to determine their impact on the individual at primary school, gymnasium and high school.

A questionnaire was applied to a sample of 150 teachers (50 for each school level: primary, gymnasium, high school) from Vrancea County, Romania. The teachers were selected from among experienced teachers with 10 to 30 years of experience in the educational system.

Starting from the specialized literature previously mentioned and from discussions in focus groups with teachers from the three school levels, we have made a selection of the effects of dysfunctions in the didactic communication. As a result, the selection in the questionnaire included the following items which we grouped according to M. Dinu's (2004) classification:

a) at cognitive level: demotivation, lacunae in the student's knowledge, low efficiency of the learning process;

b) at affective level: frustration, stress, fear of teacher;

c) at behavioural level: boredom, negative attitude towards school discipline, negative attitude towards teacher, aggression.

Each item of the questionnaire comprised a five-step scale. The respondents were asked to answer depending on how often they met the situations described by the indicators included in the questionnaire:

(1) to a very low extent;
(2) to a low extent;
(3) to an average extent;
(4) to a large extent;
(5) to a very large extent.

The procedure allowed the collection of specific data revealing the impact of the selected effects on the student.

3. Findings and Results

Table 1. Effects at Cognitive Level

Items	Scale	Percentage (%) Primary	Gymnasium	High school
Lacunae in the student's knowledge	1	0	0	0
	2	4	0	0
	3	20	12	10
	4	76	84	22
	5	0	4	68
Demotivation	1	4	0	0
	2	52	0	12
	3	24	12	28
	4	20	86	54
	5	0	2	6
Low efficiency of the learning process	1	8	0	0
	2	14	0	2
	3	72	92	10
	4	6	4	38
	5	0	4	50

At cognitive level, the results of the research indicated the following percentages for lacunae in the student's knowledge: 76 at primary school and 84 at gymnasium on scale 4, 68 at high school on level 5 of the scale. For demotivation the highest percentage registered for primary school was 52 on level 2 of the scale, whereas for gymnasium and high school the highest percentages, 86 and 54, were registered on level 4 of the scale. For the next cognitive effect, low efficiency of the learning process, the highest percentages were registered at primary school and gymnasium, 72 and 92, on the level 3 of the scale, and at high school, 50 on level 5 of the scale.

The descriptive analyses showed that the highest percentage in the primary school belonged to lacunae in the system of knowledge (76), in gymnasium it belonged to demotivation (86), and in high school to low efficiency of the learning process (50). Mention must be made that in primary school and gymnasium the reference was made to level 4 of the scale, whereas in high school the results obtained were in reference to level 4 of the scale.

Table 2. Effects at affective level

Items	Scale	Percentage (%) Primary	Gymnasium	High school
Frustration	1	30	0	38
	2	64	0	62
	3	6	2	0
	4	0	86	0
	5	0	12	0
Stress	1	24	6	0
	2	56	28	0
	3	20	66	0
	4	0	0	98
	5	0	0	2
Fear of teacher	1	42	0	47
	2	34	0	23
	3	24	4	30
	4	0	96	0
	5	0	0	0

At affective level, the results revealed the following percentages for frustration: 64 at primary school, 62 at high school in reference to level 2 of the scale, 86 in gymnasium in reference to level 4 of the scale. As regards stress, the highest percentages were registered on different levels of the scale: 56 on level 2 for primary school, 66 on level 3 for gymnasium, 98 on level 4 for high school. For the next affective effect of dysfunctions in the didactic communication, fear of teacher, the highest percentages registered 42 for primary school and 47 for high school on level 1 of the scale, and 96 for gymnasium on level 4 of the scale.

The descriptive analyses indicated the highest percentages in the primary school belonged to frustration (64) on level 2 of the scale, in gymnasium it belonged to fear of teacher (96), and in high school to stress (98) both on level 4 of the scale. This demonstrates that the impact of the effects of dysfunctions in the didactic communication is different for each school level.

Table 3. Effects at behavioural level

Items	Scale	Percentage (%) Primary	Gymnasium	High school
Boredom	1	0	0	0
	2	0	0	0
	3	0	5	4
	4	92	90	76

	5	8	5	20
Negative attitude towards school disicipline	1	0	0	0
	2	36	0	0
	3	62	80	2
	4	2	20	74
	5	0	0	24
Negative attitude towards the teacher	1	6	0	0
	2	92	0	0
	3	0	96	0
	4	2	4	84
	5	0	0	16
Aggression	1	0	0	0
	2	0	0	0
	3	72	22	8
	4	26	76	92
	5	2	2	0

At behavioural level, the results indicated the following percentages for boredom: 92 at primary school and 90 at gymnasium, 76 at high school, all of them on level 3 of the scale. For negative attitude towards school discipline the highest percentage registered for primary school was 62, for gymnasium was 80, both on level 3 of the scale, and for high school 74 on level 4 of the scale. As regards the negative attitude towards the teacher, the highest percentages were registered on different levels of the scale: 92 on level 2 for primary school, 96 on level 3 for gymnasium, 84 on level 4 for high school. For aggression the highest percentages were 72 on level 3 of the scale at primary school, 76 for gymnasium and 92 for high school, both on level 4 of the scale.

The descriptive analyses indicated the highest percentages in the primary school belonged to boredom (92) on level 4 of the scale, in gymnasium it belonged to negative attitude towards the teacher (96) on level 3 of the scale, and in high school to aggression (92) on level 4 of the scale.

4. Conclusions

The descriptive analyses draw attention on the increasing weight of the effects of dysfunctions in the didactic communication and implicitly on the greater impact on the students as the school level advances. This may constitute an alarm signal for the teachers interested in the efficiency of the learning process. Thus, at primary school the low presence of the effects indicate that, although the dysfunctions are present in the didactic communication, they are easier to identify and remove as their impact on students is insignificant. The teacher has an ampler perspective upon the instructional-educational process, on the process of communication and on the factors that might affect them, and, therefore they can be more easily kept under supervision. In gymnasium the effects of dysfunctions in the didactic communication are comprised in all plans of analysis at individual level (cognitive, affective, behavioural). In high school all cognitive indicators have registered a significant impact, and this is reflected directly into the quality of the learning process. The lacunae in the system of knowledge, demotivation, low learning efficiency are interrelated, and their association with the effects at affective and behavioural levels, with significant impacts as well, indicate the depreciation of the learning process, of the psycho-social climate, leading to reduced efficiency of the instructional-educational process in general.

Consequently, a better knowledge of the impact of the effects on the students is necessary as this leads to the localization of the problematic aspects which affect the efficient accomplishment of communication in the didactic process. In order to optimize the instructional-educational activity and the intercommunication in school there must be concern for the analysis of the conditions which make possible a communication with little loss of information and with satisfaction for all parteners involved. By knowing the impact of the effects, and the specific of the dysfunctions for each school level, teachers have the possibility to choose and apply custom contextualized strategies to prevent or diminish the appearance of such negative aspects.

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Offering Individualized Feedback in English for Medical Purposes through Asynchronous Writing

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Abstract

Objectives*: Although needs analysis may indicate that asynchronous blog writing can be perceived as challenging long-held traditions of university teaching/learning, it was employed in an English for Medical Purposes (EMP) context in Higher Education (HE) with second year students of Dental Medicine in order to offer individualized feedback with the intention of improving students' writing.* Methodology*: The current paper reflects on the content, outcomes and qualitative results of a short-term writing project for Dental Medicine English. The benefits and challenges of content development and student writing in such an enterprise is analyzed for both the designer and users.* Results*: Although autonomous and peer learning occurs in most EMP contexts, students are likely to require further practice in order to be able to produce grammatically-correct, accurate and effective professional writing. As a comparison between paper-and-pencil class writing and blog writing demonstrates, individualized feedback offered in asynchronous public writing is a transparent, continuous process that is more likely to improve the students' communicative competence and foster their awareness about the importance of refinement and revisions for the production of articulated, short SE writing varieties.*

Keywords: English for Medical Purposes, asynchronous writing, blogs

1 Background

Medical professionals need to pay special attention to language and appropriate oral and written communication since words their mouths may have significant effects and consequences, sometimes equal to those of drugs (Handler, 2011). On the other hand, advancement in the medical field is based on grant proposals and winning scholarship, international visibility and publication of research with over 95% of SCI-indexed papers being written in English (Hyland, 2009). Likewise, knowledge of best practices, state-of-the-art development and techniques, as well as access to literature in the field presuppose solid English communication skills. Medical educators and ESP/EMP trainers should both consider these facts in order to deliver relevant medical instruction that can face the challenges of international medical communication, not least with the written English communication in their curriculum (Dudley-Evans, 2001; Cianflone, 2011).

2 Project Presentation – Medical English Writing and Communication

English for stomatology can be defined within the Medical English field as a type of Occupational English, i.e. the language and communication skills needed by future professionals in order to practise their profession in an English-speaking environment (OET http://www.occupationalenglishtest.org/). This also, of course, entails the language and communication skills necessary for future dentists to access information, communicate and share successfully with other international professionals and develop their practices.

English taught to higher education medical students is essentially an *English-through* (Day, 2012) type, meant to consolidate their English communication via materials from the field of medicine, in this case stomatology. EMP courses in Romanian higher education primarily aim to develop and improve speaking and reading skills while activating and expanding the specific medical vocabulary. Due to the limited amounts of time (often less than hours per semester), writing is reserved for group projects and examinations rather than taught and trained in class.

Results in the first term from ESP tests of Dentistry students of the University of Medicine and Pharmacy of Tirgu Mures revealed a stringent need for EMP writing optimisation. Since improving writing can require long hours of extensive practice, it was decided that development of writing skills would be transferred to asynchronous public writing through the Medical English project: http://www.medicalenglishumf.blogspot.com. Blogger was chosen as a springboard for the writing activities for reasons of user-friendliness and the embedding facilities that would allow for skills integration.

*Target group***:** 2 groups (N= 62) of second year students in Stomatology at the University of Medicine and Pharmacy of Tirgu Mures, of which 40.3% were already engaged in non-compulsory asynchronous EMP writing.

Period: October 2013 – June 2014

Hypothesis: Offering asynchronous individualized feedback in a continuum through frequent blog writing is likely to improve the students' English writing competence.

One of the initial challenges of this project was that students saw learning English as another academic subject, although they were aware of the need for communicative competence in their field in order to be successful on the local and international job market. Specifically, the top challenge was to experience Stomatology English as a communicative tool rather than a receptive skill.

Moreover, according to the needs analysis survey conducted at the beginning of the course, students expected traditional teaching methods and activities in ME and they had not been previously involved in other types of collaborative, online or public learning projects.

2.1 Content Development for Stomatology English

This section will reflect on both the obstacles and eventual insights gained from developing SE materials with the purpose of helping stomatology students to become more accurate writers. Tailoring content to the field stemmed from both the students' expressed need for career-specific English language competency, but also from the lack of specialized course-books for Dentistry English.

The context of the lessons was conceived with the idea of making it relevant to the students' particular field and future careers. Although doctors' writing may often be formulaic, doctors may need to write more than many other professions. Clear and coherent writing, which is vital for avoiding unpardonable errors, is essential. *The objective* of our Writing for Medical Purposes project was, therefore, generating writing that could be comprehended as clearly as possible.

Another guideline for the materials design considered the target group/s for the doctors' writing. According to their audiences, MDs may write informatively for patients and the general public, reflectively for themselves, and in ways more related to their research for other specialists.

Finding thought-provoking SE topics that would encourage debate and involve formal and less formal writing contributions was a challenge in itself, as was the adaptation of extensive technical information to an optimum level for a mixed-ability ESP class.

The blog (http://medicalenglishumf.blogspot.ro) is an online portfolio of student comments, contributions and debates on stomatology-related topics. The following writing skills and sub-skills were envisaged:

A. **Writing skills**
   - **Reflective writing** – comparing and contrasting (Being a student in stomatology, truth vs myth about dental procedures)

- Detailed account, **giving instructions** (Prevention is better than cure: tooth-brushing techniques)
- **Abstract writing** (Parental stress and early childhood caries)
- **Argument** (Effect of local sugar consumption for oral health; case study interpretation; tooth jewellery)
- **Offering advice** (indirectness, politeness, empathizing, offering bad news)
- **Note-taking** – integrated videos
- **Dialogue-writing** (informal writing)
- **Interviewing** for writing patient records.

B. **Sub-writing skills**: gathering information (reading), research (webquests), observation, ability to adapt writing so as to be appropriate for the patient, attention to detail; planning, drafting and revising.

Each post included additional tools/activities: i.e. reading, listening. Asynchronous group discussions rather than responses to the teacher's original post were encouraged.

2.2 Offering Individualized Writing Feed-back

Paper-and-pencil class writing versus blog writing. Individualized feed-back is offered both in class writing and in asynchrony. If paper-and-pencil individualized feed-back remains an isolated, one-sequence, one-way experience (T-S), with certain contributions even uncorrected in large groups of students, in asynchronous online writing, feed-back is more frequent, visible for the whole class, and definitely more interactive. The following types of feed-back co-existed in the asynchronous writing: Student – Student feed-back (S-S Fig.1), Student comment - Teacher feedback – Student feedback – Teacher feedback, etc. (S-T-S-T-...n interaction in Fig. 2).

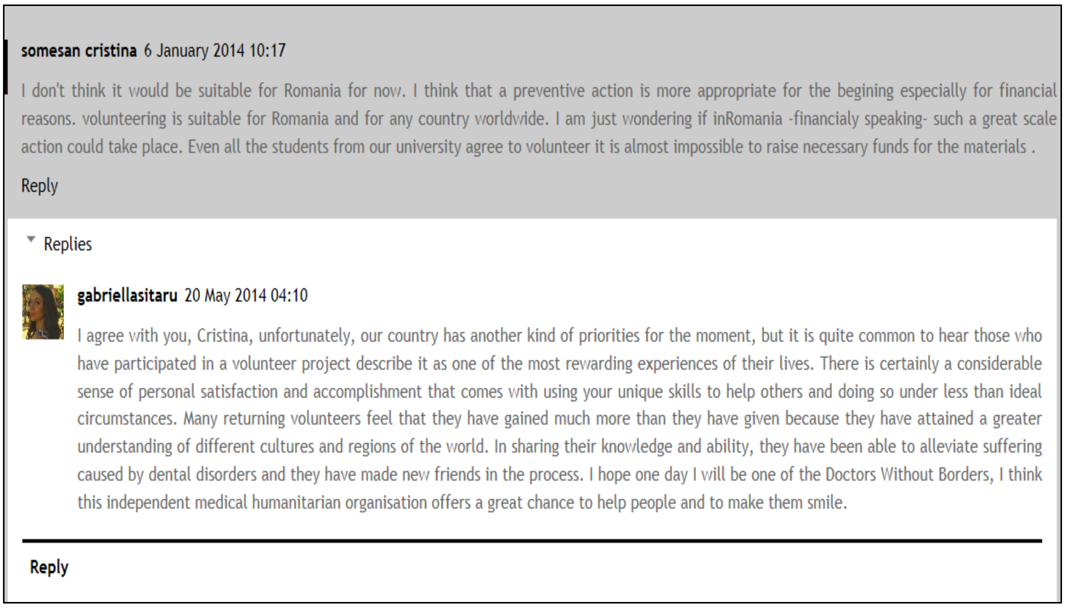


Fig. 1. Student-student asynchronous feed-back

In decreasing order of frequency, asynchronous writing involved one of the following methods of offering personalized feed-back:

1. *Self-correction*: Students were challenged to find their own mistakes (Fig.3) – unlikely to happen in traditional writing, where the teacher corrects mistakes and/or suggests variants.

Fig. 3 Feed-back personalization: encouraging self correction

2. *Indirectly*: drawing students' attention to reiterated mistakes and suggesting revision of grammar such as: if-clauses, question formation.
3. *Directly*: asking students to develop on content, refine style.

Content analysis of student contributions revealed that most frequent mistakes were linked with:

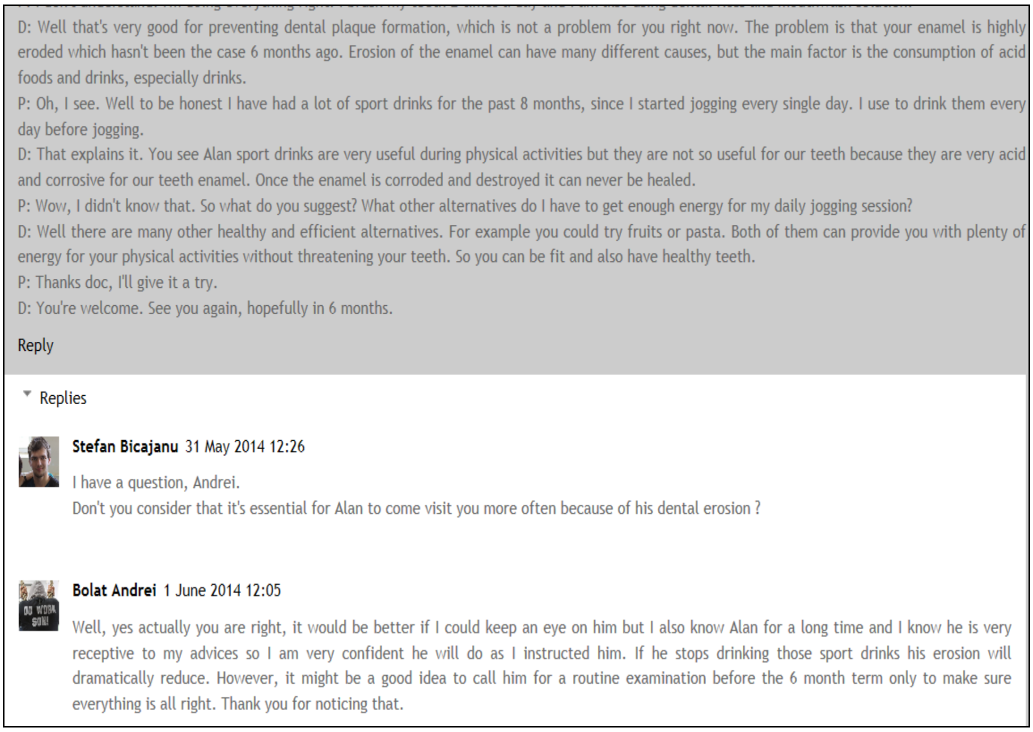
- translation and negative transfer from Romanian/Hungarian: lack of initial sentence subject: e.g. *In My opinion [...] is very very important* (Balint L.) or pluralizing uncountable nouns: e.g. *advices*;
- spelling of homophones: your (pronoun) vs you're (short form of to be); carries (verb) vs caries (pluralia tantum, noun);
- word order: *a child drinks daily soda/cola*; *if you brushed well your teeth* (Nora C.); if-clauses: *If I will become parent I will consciously raise my children* (Nora C.).

3 Discussion

A. As designer of asynchronous EMP writing tasks, the teacher is confronted with the need to find captivating dentistry topics which students can argue and express original ideas about and that will involve their writing skills. For students, the earlier they place a comment on the blog, the easier it is for them to generate original content, as later commentators need to spend more time browsing through previously accepted contributions. Furthermore, unlike in real time communication, writing in asynchrony implies that there will always be a gap between student comments and feedback due to comment moderation.

B. Students make typos and mistakes, and their mistakes may be inconsistent due to a variety of reasons including the time pressure in busy pre-session periods and their lack of consistent writing practice, rather than just ignorance – e.g.: *There is very useful information in this article, specially for common people who are bad informed* (Bostan C.). The fact that students make mistakes is also viable evidence for teachers who are reticent to engage their students in E-writing for fear of the copy/pasting.

C. S-S feed-back is another point of departure of asynchronous writing from classical writing (Fig. 4).


D: Well that's very good for preventing dental plaque formation, which is not a problem for you right now. The problem is that your enamel is highly eroded which hasn't been the case 6 months ago. Erosion of the enamel can have many different causes, but the main factor is the consumption of acid foods and drinks, especially drinks.
P: Oh, I see. Well to be honest I have had a lot of sport drinks for the past 8 months, since I started jogging every single day. I use to drink them every day before jogging.
D: That explains it. You see Alan sport drinks are very useful during physical activities but they are not so useful for our teeth because they are very acid and corrosive for our teeth enamel. Once the enamel is corroded and destroyed it can never be healed.
P: Wow, I didn't know that. So what do you suggest? What other alternatives do I have to get enough energy for my daily jogging session?
D: Well there are many other healthy and efficient alternatives. For example you could try fruits or pasta. Both of them can provide you with plenty of energy for your physical activities without threatening your teeth. So you can be fit and also have healthy teeth.
P: Thanks doc, I'll give it a try.
D: You're welcome. See you again, hopefully in 6 months.

Reply

Replies

Stefan Bicajanu 31 May 2014 12:26

I have a question, Andrei.
Don't you consider that it's essential for Alan to come visit you more often because of his dental erosion ?

Bolat Andrei 1 June 2014 12:05

Well, yes actually you are right, it would be better if I could keep an eye on him but I also know Alan for a long time and I know he is very receptive to my advices so I am very confident he will do as I instructed him. If he stops drinking those sport drinks his erosion will dramatically reduce. However, it might be a good idea to call him for a routine examination before the 6 month term only to make sure everything is all right. Thank you for noticing that.

Fig. 4 Student-student written feed-back

D. Quality writing takes time: although the posts extended over a period of seven months between October and April, students contributed only sparingly before the examination period, either due to their tight academic programme or because of the lack of previous experience with technology-based learning, exam-oriented learning and only occasional class writing. While this may explain the frequent typos and need for teachers to draw attention to detail, it also demonstrates that students depend on teacher intervention and feed-back in order to produce quality writing.

4 Conclusion

Although the principal objective of the asynchronous writing was to activate and extend writing communication while enhancing language accuracy, the Medical English Writing and Communication Project also consolidated receptive skills (listening, reading) in an English-*through* Stomatology context, developed learning autonomy and contributed to the consolidation of students' digital literacy.

Content analysis of the writing project showed that:

- overall, students were able to articulate original points of view and write logically, succintly and appropriately on the debates and topics submitted for their consideration.
- if carefully designed, asynchronous blog writing will not necessarily produce copy-pasted samples, possibly due to the real-time visibility of all the contributions.
- if students are offered more relevant and interesting subjects that allow for the expression of originality, they demonstrate the ability to be rich content creators. Quantitatively, the 25 students produced 772 comments, an average of about 31 comments per student and received multiple, more frequent, two-way, T-S-T-S and peer feed-back.
- students were also involved in their own learning and took greater responsibility for it: when their attention was drawn to explicit grammar, agreement, vocabulary elements, students were able to correct most of their own errors. Although the inconsistent nature of grammar errors suggests that more writing training and careful draft refinement is necessary for the production of competent SE writing specimens, the asynchronous writing project made students feel more comfortable and confident about their own writing abilities whenever they could amend their errors.

It is therefore the role of such projects to improve the students' EMP communicative competence and boost their awareness about the importance of refinement and revisions for the production of articulated, short SE writing varieties.

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Developing the Informational Activities of Public Service Employees

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Abstract

The impact of information and communication technologies (ICT) to social, educational, management and economical spheres is growing. ICT skills are becoming very important for conducting administrative and office tasks. The author analyzes professional activities of public sector employees and according to them systemizes informational activities and software which help to solve management tasks. The paper presents system of computer exercises which were implemented in advanced training course for public service employees.

Keywords: ICT, Informational Activities, Professional Activities, Public Service Employees.

1 Introduction

The concept of Russian Federation long-term socio-economic development for the period up to 2020 indicates that the education system modernization is necessary for the formation of an innovative economy and social development. One of the national education policy strategic objectives is to increase availability of high quality education that meets the needs of modern society and each citizen. Also there is the need to create a modern system of continuous education, training and retraining of professionals

The Russian Government' regulation under advanced training understood updating knowledge and skills of public sector employees. The training should be in connection with increasing demands for their qualifications, develop and improve ways of solving professional problems.

2 Informational Activities of Public Sector Employees

The main way to improve public sector employees' professional knowledge, skills and competencies is the introduction of ICT in their educational and professional activities. It would effectively, consciously and adequately implement their duties. Based on the regulations, eligibility requirements, professiogram for public service employees we identified main professional activities:

- **analytical** – activities for the collection, processing and analysis of information about the complex (self-organizing and self-developing) systems that are under management of the agency;
- **organizational** – prepare the team for the design and construction of the main management activities, stimulate creativity, choose the technologies, form the needs and motivations of management process participants;
- **coordination** - establish the optimal balance between different types of management activities in order to improve the efficiency and quality of the tasks and functions performance;
- **planning** – allocate the possible optimal resources to achieve goals;
- **control** – check readiness of government, separate divisions and employees to conduct a given activity (correct management decisions, the availability and qualifications of employees, etc.);

- **advisory –** explanation or making expertise of various material at the requests of law enforcement, legal entities or individuals (certificates, advisory opinions, reviews, etc..) on private or general issues of government;
- **representative –** act on behalf of the government and (or) in its interest to any person (a division of the authority, other authority, a person, etc.);
- **regulatory** - organize the collective activity, cooperate with legal entities and individuals;
- **managerial** – carry out assigned subordinated action and certain tasks;
- **innovative** - find and implement innovation and improve the quality of services provided by the government, improve the technology and the organization of relations between the management processes participants;
- **expertise** - the expert, advisory, project activities within the professional competence of the public sector employees.

The set of informational activities are performed for each of the professional activity areas of a public service employee. They are the following: search, creation, collection, processing, transmission, storage, representation and protection of information. We can characterize informational activities as:

- **search** – retrieval of stored information;
- **creation** – creative or any other activities that result in the establishment of information products and information resources;
- **collection –** activity of the subject, during which he receives information about the objects of interest;
- **processing** – ordered process of transforming information in accordance with the algorithm for solving the problem;
- **transmission** – actions aimed at obtaining information for unspecified persons or transfer of information to the public;
- **storage** – the process of maintaining the original information in the form ensuring production output of data at the request of the end users on time.
- **representation –** reproduction (presentation) of information in any form.
- **protection –** a set of measures aimed at ensuring information security

For every area we justify the set of informational activities, so we can allocate software for each type. The result of our analysis are given at table 1.

Table 1. Connections Between Professional, Informational Activities And Software.

Professional Activities	**Informational Activities**	**Software for maintaining activities**
Analytical	Search - Storage - Collection - Processing	Word processors, spreadsheets, databases, e-mail, etc.
Organizational	Search - Processing - Transmission - Creation	Word processors, e-mail, the Internet, reference systems, etc.
Coordination	Collection - Processing - Transmission - Representation	Document automation systems, e-mail, etc.
Planning	Processing - Representation - Creation	Electronic organizers, cloud resources, project management systems, etc.
Control	Collection - Processing - Storage - Representation - Protection	Databases, informational systems, statistic packages, etc.
Advisory	Search - Collection - Creation - Representation - Transmission - Processing	Computer-assisted legal research systems, informational systems, document automation systems, etc.
Representative	Storage - Representation	Internet, browsers, e-mail, applications for creating presentations, etc.

Regulatory	Collection - Processing - Transmission	Document automation systems, e-mail, etc.
Managerial	Storage - Protection - Processing - Creation	Project management system, decision support systems, etc.
Innovative	Search - Creation - Transmission - Representation	Informational systems, document automation systems, etc.
Expertise	Creation - Search - Collection - Processing - Storage	Business intelligence systems, computer-assisted legal research systems, etc.

3 Computer Excersises for Public Service Employees

Under the advanced training we mean the improvement and development of employee’s professional, methodological and social competencies for the effective implementation of duties in accordance with professional activities. Forming of advanced training courses is based on a modular principle that allows taking into consideration specificity of public sector employees' professional and informational activities, to change the structure of program in accordance to training aim.

The system of computer excersises comtain 4 parts: Office Software, Project Management, Local and Global Networks, Statistics. These parts cover mainly all informational activities of Public Service Employees.

Module “Office Software” is designed to study such software as: word processors, spreadsheets, databases, applications for presentation different material. We offer to use Microsoft Word (or LibreOffice Writer), Microsoft Excel (or LibreOffice Calc), Microsoft Access (or LibreOffice Base) and Microsoft PowerPoint (or LibreOffice Impress). The computer excersises can be the following:

1. *Formatting in word processor*. Purpose: learn to format documents in a word processor, to create different types of lists and customize tabs on the example of the Russian Federation Federal Law.

2. *Creating and editing tables in a word processor*. Purpose: learn to create, format, and edit tables in the Russian Federation Federal Law.

3. *Creating a resume, adding automated list of contents and hyperlinks in the document*. Purpose: become familiar with the principles of creating a resume, learn to create a master document, add automated list of contents and hyperlinks to documents created in previous exercises.

4. *Merging*. Purpose: learn to create documents using the merger, by the example of sending letters to state and local government agencies.

5. *Formatting and filtering in the spreadsheet*. Purpose: learn to format the data by means of spreadsheet; acquainted with the concepts of filtering, auto filter, sorting; learn to use the formula in the spreadsheet.

6. *Creating PivotTables*. Purpose: learn to create pivot tables, for example, a database of state and local institutions.

7. *Visual representation of the data in the spreadsheet*. Purpose: get acquainted with the possibilities of spreadsheet for visualizing data; learn to create graphics in spreadsheet; learn to create graph, chart, pie chart, histograms in the spreadsheet for solution the applied problems.

8. *Data analysis in the spreadsheet*. Purpose: learn to analyze data by means of spreadsheets to solve professional problems.

9. *Creating tables and queries in the database*. Purpose: learn to create a database for state or local government agency, to make various types of queries to the tables.

10. *A visual representation of data*. Forms and reports. Purpose: learn to create forms and reports, display information graphically from the state or local government agency’s databases.

11. *Creating a presentation*. Purpose: learn to create, edit and format presentation materials on the structure, history, etc. of state or local government agency.

At the module “Project Management” we offer to use Microsoft Project or Zoho Projects. It is possible to perform these tasks using the project-based approach. Students are divided into groups, in which they select leader, executors of different phases, etc. The computer excersises can be the following:

1. *Introduction to project management systems*. Create a new project. Purpose: to get acquainted with the project management system; learn to create a new project; learn to identify the time frame, choose the resources, to enter the basic information; to get acquainted with the concepts of the task, subtask.

2. *Determination of tasks*. Purpose: to get acquainted with the possibilities of the project management system within the definition of objectives; learn to define and edit the task; become familiar with Gantt charts.

3. *Create resources and assignment costs*. Purpose: learn to plan the work with resources; to get acquainted with the possibilities to change resource information; consolidate skills objectives.

At the module “Local and global networks” public service employees learn to work with Internet resourses, e-mail, etc. The computer excersises can be the following:

1. *Finding information and analysis of Internet resources*. Purpose: learn to analyze Internet resources (information portals of government, the State Duma, newspapers, etc.); to get acquainted with the types of Internet resources, with the possibilities of searching systems (Google.com, Yandex.ru, Rambler.ru, etc.).

2. *Working with the mail*. Purpose: learn to create a mailbox on a free mail server, to send and receive e-mails.

At the module “Statistics” public service emploees work with SPSS or STATISTICA. The computer excersises can be the following:

1. *Simple statistics*. Purpose: learn to use mathematical and statistical functions; to get acquainted with the concepts of a random variable, the distribution of the random variable, expectation, standard deviation; learn to create a histogram; learn to create complex functions.

2. *Working with statistical functions in specialized facilities*. Purpose: learn to calculate indicators and the coefficients of demographic statistics, socioeconomic potential; calculate the gross domestic product for separate sectors of the economy; to create a graphical representation of indicators and coefficients; be able to analyze the results.

The public service employees will have following ICT competencies as a result of studying the advanced training course:

- the ability to generalize, analyze, perceive information, set the goal and choose ways of reaching it;
- readiness to apply the methods of mathematical processing, theoretical and experimental studies;
- readiness to use the basic methods, ways and means of receiving and processing information, to use a computer as a tool for information management;
- the ability to work with information in local and global computer networks;
- the ability to use the knowledge in the field of ICT in solving professional problems;
- readiness to use modern ICT to ensure the quality of professional activities;
- an ability to receive and to use new knowledge and skills which aren't connected with a profession, with the help of ICT;
- willingness to explore, design, organize and evaluate the implementation of the management process, using innovative technologies;
- willingness to use individual and group decision-making technologies in the management.

4 Conclusion

The set of computer exercises were implemented at advance training of public service employees. Application of the proposed exercises to public service employees' training in the field of information and communication technologies will form their competence which will be necessary for orientation in huge amounts of information, data analysis in short periods of time, preparation of analytical information for management decisions. They will be ready to bear responsibility for the decisions.

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Computer Graphics in the Training of State Employees

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Abstract

Modern society is in need of constant modernization and qualitative development of educational process. Wide-scale introduction and practical implementation of information and communication technologies (ICT) to the usual functions of state employees is a really integral part of government organs improvement. The usage of business graphics programs will be able to increase the efficiency and quality of different document preparation by state employees. This article considers review of widespread programs of business graphics and choice of prior products which is possible to include to the training process. Authors give brief summary and priorities of usage for each program. In this article we try to explain all advantages of acquiring of knowledge and self-development which is necessary to have for effective professional performance of state employees. All this knowledge and self-development qualities are developed in operating with business graphics programs.

Keywords: State employees, Business graphic, The programs of business graphic, Word processors, Civil service.

1 Introduction

The introduction of computer graphics in training process of state employees is relevant because there are a lot of changes in the all spheres of education. The society is changing because of modernization of political, economic, social life and different reforms: administrative, public and educational. Due to the fact of such modernization new requirements to the professional standards of state employers occur.

The civil service reforming in Russia and increase of its efficiency is impossible without the professional retraining and advanced training of manager staff. The international society has entered a new information stage of development. Complication and intellectualization of information products and services, updating the management information, the formation of a new educational environment are the main attributes of the information society their efficient production. The largest and most widely used different programs for working with documents are word processors. About 80% of Russian state employees use the computer as a specialized "typewriter" till now. Working process depends on different competences which help to prepare and use various documents

One of the spheres of computer graphics which is used by state employees is business graphics. Business graphics is the sphere of vector graphics which is used in work of different institutions including. The difference between civil service and other types of work: production of material wealth, entrepreneurship, creation of spiritual values, homemaking and many others tells us that the activity scope of state employees is connected with information. State employees do not create, directly, material assets, but provide the proper conditions for governmental establishments. The graphics appearance of documents, targets, reporting documentation, statistics, structural and systematic analysis, strategic management is all the objects which is need using in business graphics and illustrative materials. The efficiency of civil servants is possible with the implementation of specialization of information visualization systems. That's why it is necessary to pay attention to the development of practical knowledge and skills in the field of business graphic for employees who deal with information.

2 The review of professional requirements of state employees

The difference between state employees and others are not only in the fact that their activity is in the field of immaterial production, but also in the fact that the professional activities and training are strictly regulated by various decrees, regulations, mandates etc.

The main item of information technologies usage in the activities of the federal governments is to increase the efficiency of state management mechanisms through the creation of a common information technology infrastructure.

The information which operates in the public service is required for public officials to perform their official duties. Knowledge, abilities and skills which are necessary for state employees, are closely connected to management cycle of the main activities of administrative staff and reflected in the management process.

The cycle of management in the public service are given on Figure 1.

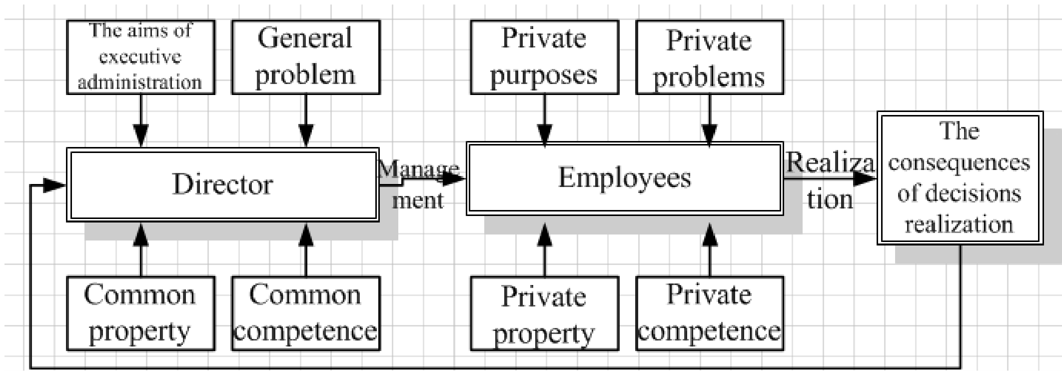

Figure 1. The cycle of management in the civil service

The management includes three aspects: institutional aspect, functional aspect and instrumental aspect. The success of the reforming and development process of the public service system depends on implementation of measures aimed at modernize the public service as a single system, as well as on the practical application of new information technologies and public administration.

The Russian Federation conceptions due to the Federal educational program are the following: "The Civil Service Reform in the Russian Federation" and "The Concept of Using Informational Technologies in the Activities of the State Employees " the main part is development of training for civil service employees and additional professional education of state employees.

There are three levels in civil service. They are: directors, officers and staffers. Staffers (functional employees) are civil servants who operate as professionals in this sphere.

Due to the management cycle we can make a conclusion that requirements of employees are different.

We pay attention to the ICT (information and communication technologies) training due to the following categories of operational employees (specialists). They are specialists of state structures with all competence of state functions, but do not have any rights to make official legally authoritative acts. The specific state employees' competences are determined by the structure and content of their professional activities. The main principle of organization of the civil service system should realize the final result, which will be the item to everything connected with the system's organization and functioning of the system. The requirements to the level of state employees training in ICT are contained in official documents, job descriptions and qualification requirements are generated on the base of it. The state employees qualification is defined in a number of governing documents, among them are the following: the state requirements for retraining, skills upgrading and professional training of civil servants; the concept of ICT using in the activities of the Federal structures of state management until 2015.

The basic requirements for knowledge and skills in ICT are the following. Knowledge: hardware and software; capabilities and features of modern information and communication technologies in government, including the use of document' capabilities; general issues in the field of information security. Different knowledge which is connected with internet work in the operating system, in a word processors, with spreadsheet, presentations; graphics in electronic documents and databases. Skills: work with internal and peripheral devices of the computer; work with data and telecommunications networks, including the network.

The analysis of training programs in the usage of graphical objects shows insufficient knowledge, abilities, skills in the use of business graphics programs. The usage of business graphics programs has the main goal to improve the perception of information by a person, to make it more vivid and expressive. The ability to present the results of civil service competently and effectively is a necessary practical skills for civil servant. The requirements for ICT skills should be the following: they should use word processors as professionals and have abilities to work with different documents and reports.

At all levels of the state employees professional training is required working with electronic documents, but they are mostly limited to work with text editors and spreadsheets. They don't pay enough attention to the graphic layout of the given document. That's why state employees should learn some business graphic programs. We will examine into details some of these programs and describe advantages and disadvantages of them.

3 Business graphics' training of state employees

One of the most popular and easier program to use is Microsoft Visio. The interface is not complicated for employees who usually work with word processors. It can help to safe time and to create new level for diagramming in general. (Earlier on the discipline of "Business graphics" as software programs usually have been used Excel and PowerPoint, as the most simple and affordable.)

Microsoft Visio is the business graphics vector program (2D), which can be used in the training of state employees, it has high functionality. The supported formats are the following: VSD, VSS, VST, BMP, JPEG, DWG, XML.

Visio is a full-fledged graphic multifunctional system with a large set of libraries. This program is created for making different diagrams, tables, graphs and charts for professional level. It is a popular editor for many reasons. At first the program help to create tables, diagrams and charts, and secure a simple user interface and a large set of graphics primitives. All the graphics primitives are divided into distinct groups according to current standards of design and on the subject of charts. The program has Russian interface since 2007.

Visio brings diagramming to a new level with dynamic tools and templates. In the program have been offered advanced features management processes and tools to share data via the Internet (multiplayer mode). The library of graphic elements is divided into classes and categories.

The proposed sets of laboratory exercises contain 4 parts for 4 teaching hour each:

1. The interface of Visio 2013. State employees deal with interface and create simple diagrams.

2. Simple illustrations. They create simple illustrations: add new figures; move, copy, scale, shapes and elements, format shapes, work with members; work in groups; work with text.

3. Creating diagrams and figures which have compound structure. They study the basic templates, organize charts and change the appearance of the organizational charts. They create graphical applications and work with groups of templates for directions.

4. Creating high-level graphics and adding the description.

For the course "Business graphics" we develop competencies of state employees in the field of documents' graphic designing and support the transition from primary activity.

As an example we give the algorithm of creating the business process structure. Any process can be described using text, graphics, diagrams, or models. When we speak about it in the civil service we mean the result of creating, maintaining, updating and delivery of various documents. Illustrative material and simulation of various processes in the management can improve the efficiency of civil servants.

There are fragments of tasks results development of skills for state employees in the implementation of the program of professional training. This is the first stage. The diagram of the business process of document management which have been made in the Visio program shown in Figure 2.

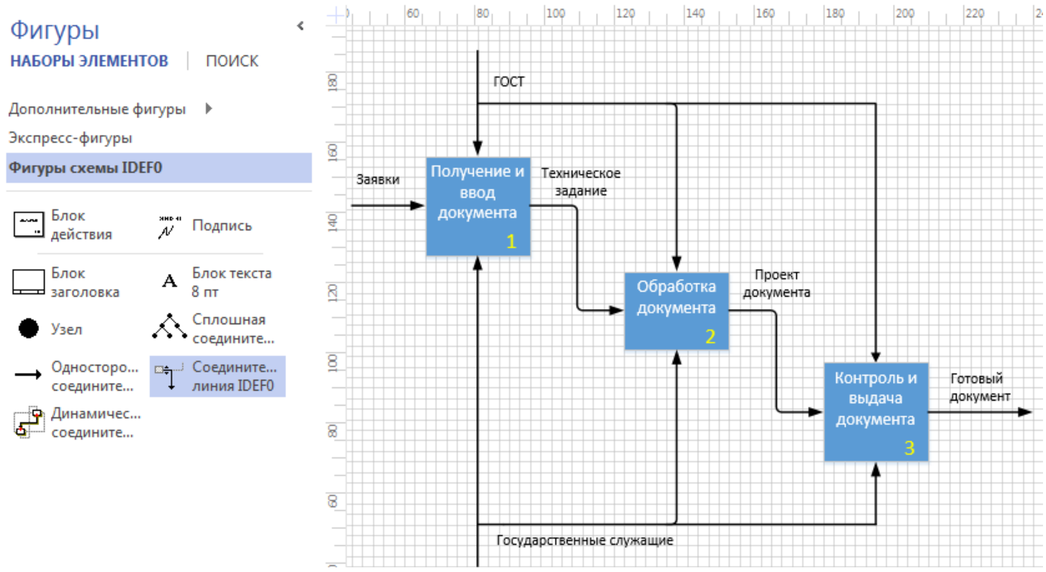

Figure 2. The structure of the realization of the final document

The second level – structural schemes and algorithms, the block diagram of the interaction of government services based on ICT (Figure 3).

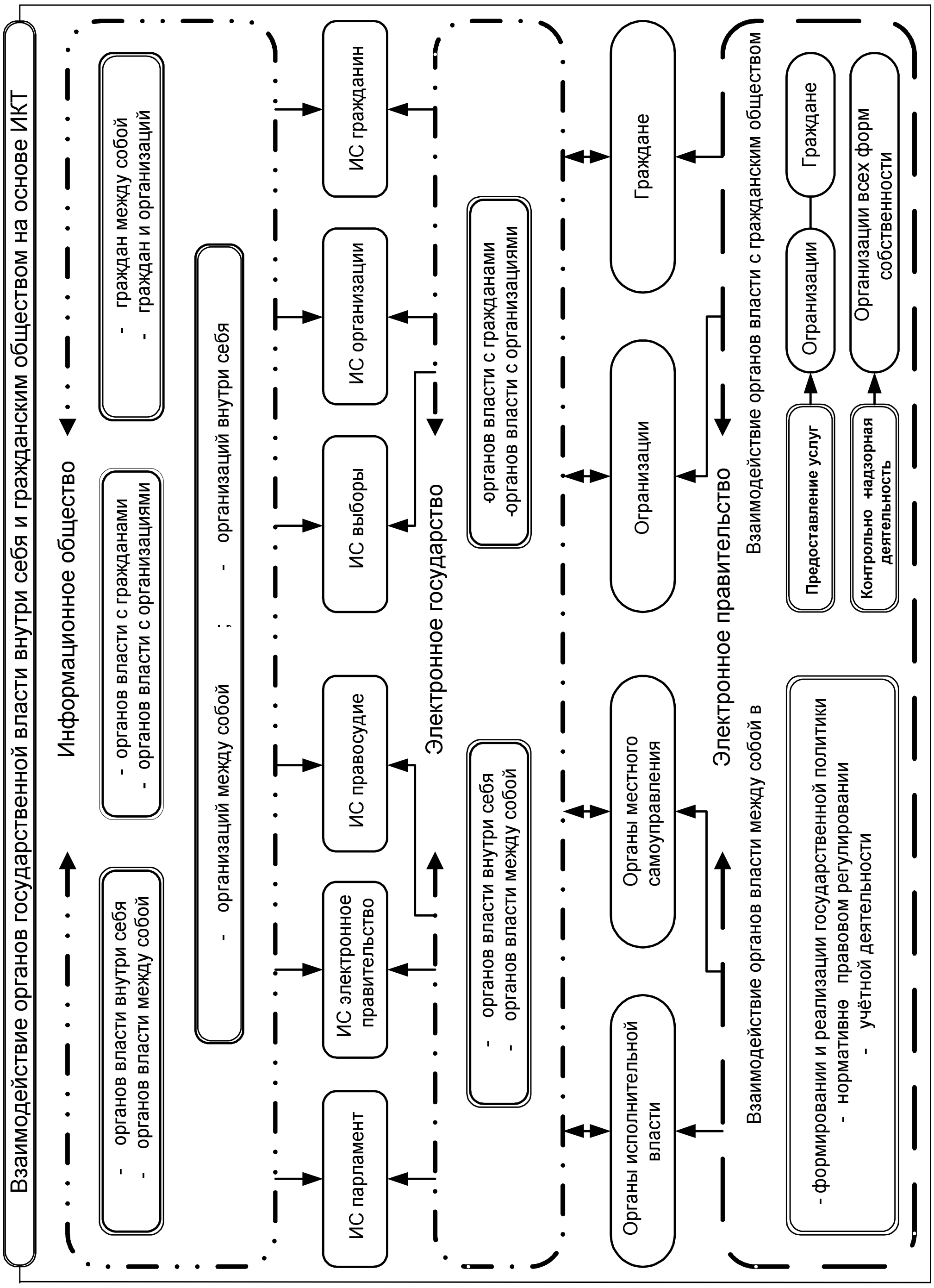

Figure 3. The communicational structure on the base of ICT system

This diagram is complex structure. The creation of such scheme can help state employees to improve knowledge, abilities, skills and to learn the communicational structure on the base of ICT system. The third level is the combined chart presented on the example of graph.

The diagram of state property has been shown in (Figure 4).

Figure 4. Providing of state property

One of the features of state employees working is creating various reports. To make it easier for understanding it should be visualized. This task can prepare state employees for the creation of visual objects which they need in their work.

4 Conclusion

Microsoft Office Visio 2013 is multi-function graphics program for creation of illustrations, diagrams, structures, graphics, models etc. The program can function as a system of assistance in the data analysis and visualization to support optimal decision-making. The study, obtaining competence in the use of this software, its proper application, all of this will help to improve the quality issue official documents and, consequently, will increase the efficiency of the state service system.

The studding of business graphics programs showed us that all the variety of products and their ICT capabilities are used insufficiently. Even when state employees render static information. They are not accustomed to use software in their activity. Business graphics program help to simplify, organize and visualize information. State employees need to improve their knowledge, abilities and skills in the ICT sphere.

The course of "Business graphics" helps to develop the necessary knowledge, abilities and skills of state employees. After the learning of this course has been improved efficiency and quality of state employees' activity.

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The Interdisciplinarity in the Training of Engineers - A Condition for Solving the Global Problems tf the Humanity

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Abstract

The trends in the global economy and the economy in the country change the needs and requirements to the preparation of engineers. Besides the traditional engineering practice that is associated with certain products, development, production, sales, management, etc. in the analysis of the development of engineering education (USA, UK and Bulgaria) are observed new trends in the holistic approach for achieving engineering solutions by integrating the elements of the general education with those of the liberal education, to enrich their scientific and technological training. According to: the National Statistical Institute, the research of the Bulgarian Industrial Association, details of joint seminars and meetings with employers of FTT are indicated major changes in the requirements to the engineering profession.

Keywords: interdisciplinary education, competensies, livelong learning

1 Introduction

One of the challenges of higher education is to modify its relationship with the rest of society (civic and corporate), so it can broaden its role to address the challenges of today's world. Universities have to being relevant to their communities, nation states and the world.

According to debates and decisions of Bologna are changing demands on higher education in the following areas:

- new courses for skills and approaches for employability within European society
- Europe universities need academic approaches which are interdisciplinary
- students need a conceptual tools to understand the modern world, while contributing to the social and economic development and the establishment of democratic society
- market-orientation directs universities towards practical, entrepreneurial objectives that will increasingly engage them in an interdisciplinary world.

2 Theoretical Background

Murray's opinion is (Murray, 2004) universities need to remove barriers to and create mechanisms for interdisciplinary undergraduate and postgraduate education.

- Many courses remain within traditional boundaries
- Academics seek to protect their own space to exclude others.
- New demands on education have resulted in activities that merge or combine fields, thus pushing the limits of academic activities into new territories.
- Interdisciplinary way of working is considered as extremely challenging and worthy of significant interest (Barnett, 2003).

In 2006 the European Council adopts a reform program of research in European universities to contribute to the economic growth and employment. Much of the Member States have developed a national program for modernization of their universities, but few see it as a national priority.

Universities need to redesign their training programs and research to exploit the possibilities of development of existing and emerging areas of research. This suggests that they focus less on scientific subject and more in research areas (renewable energy sources - "green" energy, nanotechnology), to cooperate more closely with these or other areas (including the humanities and social sciences, as well as management and business courses).

By transdisciplinary framework, interdisciplinary scientists would be better able to study more relevant social problems than if they remained constricted by narrow disciplinary boundaries and specializations.

Brown (Brown, 1993) portrayed transdisciplinary as an overall framework for the synthesis of knowledge that unites and then transcends the disciplines because it focuses on work in various fields as "the human problem". Scientists engaged in this transdisciplinary process would have to move beyond their narrow views of the world informed by their respective discipline or specialization.

To create a new, coherent picture of human relations with the world, specialists would have to weave three images of:

- the natural world,
- society,
- people as cultural, biological, adaptive, self-organizing beings (Brown, 1993). She believed that this unified picture of knowledge, when employed to solve the problems of humanity, would provide a common ground for dialogue as genuine inquiry.

University education shouldn't take place in “programs” with a specific focus and culminate in a “major” defined by a departmental silo holding the prescribed knowledge of a single discipline. Some scientists confuse education with training. From Latin, educare —to rear —stems from educere—to lead forth into the world and to grow.

Life is interdisciplinary. It doesn’t have departments. It doesn’t have majors with a pre-formatted program to follow. Life is messy, interesting, complex, exhilarating, excruciating, and surprising and definitely interdisciplinary.

The concept of transdisciplinarity originates from Daniels (Daniels, 1980) and Brown (Brown,1993). It was originally conceived at the OECD meeting (Apostle et al., 1972; Jantsch, 1972). In our opiniontransdisciplinarity has evolved, so that new distinctions are warranted, especially about transdisciplinarity.

During 2010-2011, Russ Volckmann and Sue McGregor (Russ Volckmann and McGregor Sue, 2011)published five papers in a series about making the Transdisciplinary University a reality. They have a view to a model to transitioning higher education from multi- and interdisciplinary approaches to a transdisciplinary university - "transversity".

At the raport, the autors scrutinize a variety of Approaches to Transdisciplinarity in Higher Education:

- redesigning entire universities to a transdisciplinary
- designing transdisciplinary master or doctoral degrees
- ensuring external funding for transdisciplinary research initiatives within universities
- university-coordinated transdisciplinary projects with industry and communities
- recognition of the need for inter-sectoral conversations about how higher education curricula policy can change to reflect 21st century problems.

Their opinion is that there is no one way to transdisciplinarity in higher education.

At the turn of the 20th century, the field was ahead of its time by recognizing the need to address broad-based problems through integrative and interdisciplinary approaches. As it moves into the 21st century, it can continue to be on the vanguard by embracing evolving notions of transdisciplinarity.

3 Researchand Discussion

Every year carries out surveys with students about the quality of education and their views on competences and acquire them support their successful realization.The education of students in the Faculty "Engineering and Technology" – Yambol includes certain key (complex character and transferability in different educational and life situations), base (reflect the specifics of the professional area), functional (specific activities inherent to the workplace) and ecological competencies.

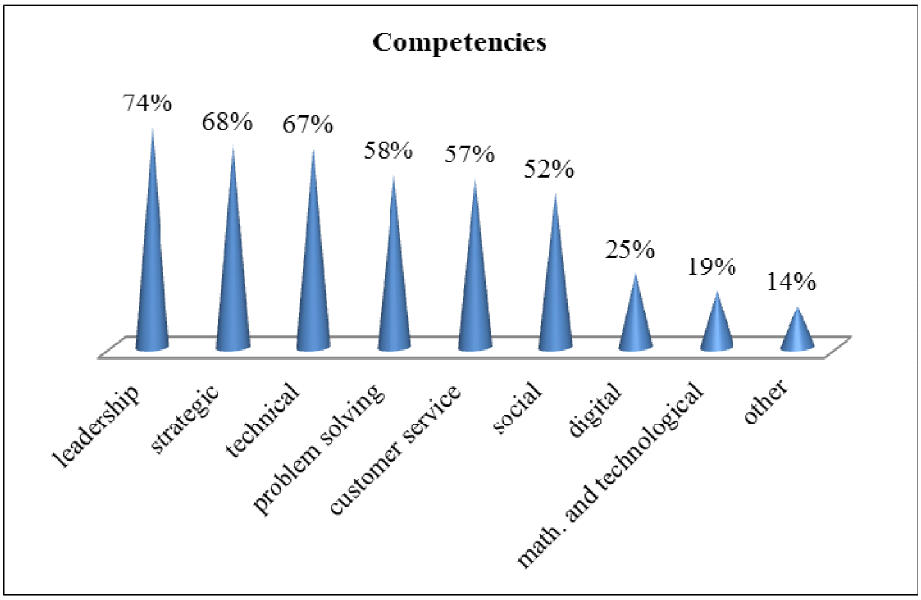

Figure 1. Competence of professionals of all position levels

One of the most important competencies of professionals mentioned by employers (according to data of the Bulgarian Industrial Association) are those that make the company successful, set direction and its leadership, strategic potential, and specialization, which is determined by the branch.

The next most important competencies are related to changes in the environment; the great uncertainty of the difficult economic conditions dictated by macroeconomic framework and they include:

- degree of ability to cope with difficult situations
- customer service
- social competences

From researching and other similar studies, competencies with the highest percentage can be considered as universal for the branches to be included in the key competencies, although the details of the demonstrated behaviors for each branch may have differences.

On one of the last places are ranked technically oriented competencies which might be a result of the need to increase efficiency through advances in technology, of logical competencies that are required for certain industries (such as IT or any related innovation), and specific technological positions.

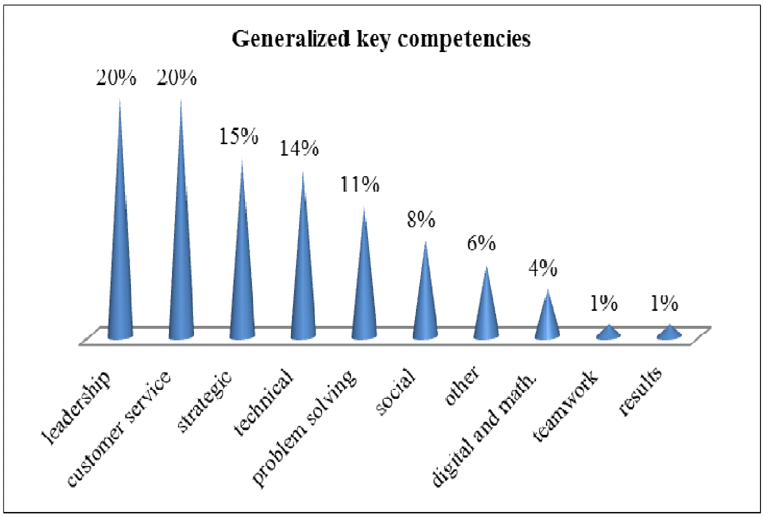

Figure 2. Generalized key competencies

In group (from 20% to 11%) reflects the macroeconomic situation. The summarized key competencies are related to increasing and retaining market share, strong leadership style that could be able to retain the efficiency of employees, despite heightened tensions of the current economic situation.It surprises the place of orientation to achieve results because the performance is more important than ever.

In surveys conducted with students concerning the quality of training they appreciate that in preparation of the faculty, develop their basic competencies as a willingness for mastering new tasks, technologies and procedures motivation for setting and achieving personal goals, interpersonal tolerance for critical thinking, searching, and analysis of information.

Highly are evaluated and acquired key competencies such as communication skills of native and foreign languages of new information and communication technologies, modern strategies for lifelong learning and more.

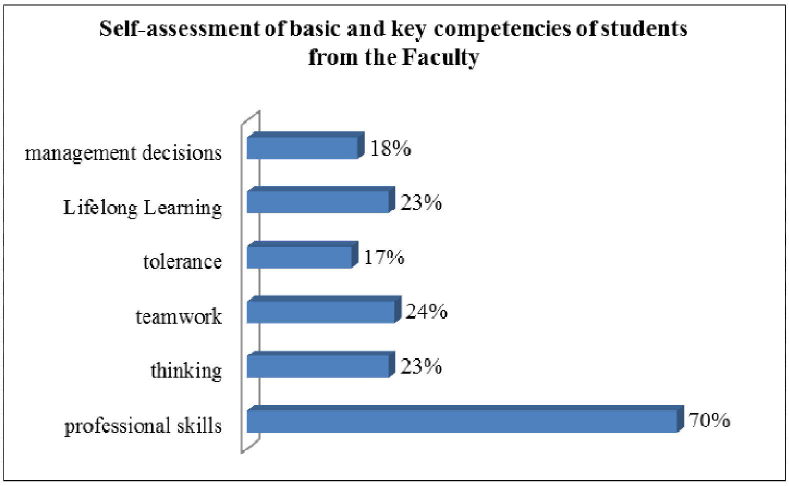

Figure 3. Self-assessment of basic and key competencies of students from the Faculty

On the regular meetings with the representatives of employers and branch organizations, led by the Faculty, are discussed problems in the preparation of future engineers and difficulties in professional adaptation. With a project funded by European programs for connection between business and the Faculty of successful realization of the students were conducted surveys with employers and were changed curriculum to reflect new needs and trends in the labor market.

Study of quality, performance and competence of engineers in the UK graduate engineers analyze the need to demonstrate: (Maddocks AP, Dickens JG, Crawford AR, 2002)

• ability to solve engineering problems through design systems through creative and innovative thinking

• ability to apply mathematical, scientific and technological tools

• ability to analyze and interpret information if necessary to design experiments to gain new data

In analyzing the quality of education in the Faculty and to meet the requirements of the labor market, we used the results of the study of the Working Group on ICT education associations.

Competencies that are still need to worked on are related to ensuring competitiveness are functional competencies such as creative skill in solving engineering problems by applying the expert thinking; readiness to solve problems and responsibility for decisions.

The efforts of the academic staff as a result of research findings, discussions and analysis are focused on the development of thinking and the quality of mental skills of the students.

Is recognized importance for the development of management the thinking through problem solving - defining and redefining the task, asking the right questions, concentration, consistent implementation of different views, reflexion, adjustability generalizations, conclusions, to learn not only from successes, but from mistakes.

The need to expand and integrate university education with experience in the workplace (training of terrain) is taken under account.

Under a project of Bulgarian Industrial Association - "Development and implementation of an information system to evaluate the competence of the workforce in sectors and regions," are analyzed state and the problems in the assessment of competence of the workforce at the national, sectoral and regional level to increase the adaptability and effectiveness of the staff and in accordance with the requirements of the labor market and the European Reference Framework (EQAVET, 18.06.2009), the national and industry standards.

In the preliminary preparation of the Ministerial Meeting (AEMM) education in Peru interviewed representatives recognize the need "to go beyond the approach of teaching / learning, which is based solely on the acquisition of knowledge." Identified four important general competencies for the 21st century which must be integrated into university education

- lifelong Learning
- problem solving
- self management
- teamwork

In a study commissioned by the Ministry of Labor and Social Policy, as well as studies of the Bulgarian Industrial Association has emerged the trend of growing demand for qualitative engineers who can solve problems in integrative multidisciplinary teams. The perspective until 2018 shows that will be found workplaces for specialists with higher education (21.2%), including engineers. Is predicted in the study that will increase demand for engineers in the field of information and communication technologies such as theFaculty prepares.

Conclusions

After a comprehensive theoretical overview, analysis of our and other studies and best practices, decisions of national and international employers' associations can conclude that interdisciplinary work in education and research contribute to the training of engineers who have a holistic approach that can solve complex issues that support the development of individuals and societies.

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Tiparul s-a executat sub c-da nr. 3555/2014
la Tipografia Editurii Universității din Bucureşti