Serious Games in the Life Long Learning environment.
Games and Learning Alliance Network of Excellence

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Abstract
This paper will describe in a short way the one of very interesting FP7 project, GALA which start on 1st of October this year, coordinated by the University of Genoa, Department of Biophysical and Electronic Engineering. The project involved 31 institutions around the EU including the Romanian Advanced Distributed Learning Department. The main objective of the GaLA NoE is to shape a scientific community and build a European Virtual Research Centre (VRC) aimed at gathering, integrating, harmonising and coordinating research on Serious Games (SGs), and disseminating knowledge, best practices and tools as a reference point at international level. The VRC will act as a real, live competence centre, where virtuality is intended as a way to effectively integrate skills, knowledge and tools coming from multiple disciplines and physical locations, in order to favour scalability, flexibility and exchange efficiency.

1 Short introduction to Serious Games

The “serious game” term as we intend today was firstly used in 2002, with the start of the Serious Game Initiative lead by David Rejeski and Ben Sawyer in the US, and taken up in Europe by the formation of the Serious Games movement including the Serious Games Institute in the UK. The SG Initiative focuses “on uses for games in exploring management and leadership challenges facing the public sector. Part of its overall charter is to help forge productive links between the electronic game industry and projects involving the use of games in education, training, health, and public policy”.

SGs were initially conceived to train people for tasks in particular jobs, such as training army personnel, or training insurance salesmen. These tasks were characterized by their specificity and applicability for particular work-related purposes and are typically targeted at a captive audience.

More recently, a number of games have been developed specifically for non-entertainment purposes. In 2005, the World Food Programme developed “Food Force”, which seeks to take advantage of the popularity of computer games to educate children about hunger and the work of the aid agency. The “Hazmat: Hotzone” game designed with the help of the New York Fire Department aims at training fire fighters on how to deal with conventional, environmental, biological and terror-based incidents while functioning as a team where the players play the game through networked computers communicating through headsets to complete cooperative tasks (Entertainment Technology Centre and Carnegie Mellon University, 2005). In this same line, in 2006 Delft University of Technology (partner of GaLA) developed, the SG “Levee Patroller”, aimed at training levee inspectors, adding a practical component to the theoretical education of professional and voluntary levee inspectors of Dutch Water Boards. The game is designed to make levee inspectors learn about the ways dikes can fail or breach, and how failures can be recognised in the field at an early stage.
Serious Games Interactive has developed “Global Conflicts: Palestine”, an immersive fully 3D role-playing simulation that gives the player the chance to explore the Israeli-Palestinian conflict first-hand. Through the diverse stories students engage within the game they learn about issues related to the conflict like terrorism, human rights and media’s role. The University of the West of Scotland has worked with schools that had historic religious conflicts between them located within an area that had serious alcohol problems to collaboratively develop a computer game, called “ThinknDrinkn?”, that teaches about the problems associated with underage alcohol abuse. The Elios Lab has developed for the Liguria Region Government a SG for road safety and a multiplayer online serious game for the safety at the sea. Moreover the Elios Lab has leaded a Culture Programme EU project for the development of a Serious Virtual World (“Travel in Europe”) for the promotion Cultural Heritage in Europe.

The MIT Education Arcade latest document discusses a number of examples of learning games, such as Zoo Scene Investigators, Palmagotchi, Racing Academy, Ayiti, Gamestar Mechanic, The Calm and the Storm, Mind Rover, Lure of the Labyrinth, the Federation of the American Scientists’ Immune Attack. The document shows that uses of SGs now “span everything from advancing social causes to promoting better health to marketing. The class of games known as Games for Change (www.games4change.org) are being designed with a social or political agenda to get people to consider particular issues. Members of Games for Health (www.gamesforhealth.org) design games for both patients and practitioners with a medical purpose in mind. Advergaming is a popular form of advertisement that delivers commercial messages through games”.

A number of Commercial off the Shelf (COTS) games are also being used for education. Richard Van Eck argues that integrating COTS in the learning process is promising for education, since it is more cost-effective than developing SGs ad-hoc designed to support specific curricular activities. The paper provides many examples of COTS games already being used in the classroom, including Civilization (history), Age of Empires II (history), CSI (forensics and criminal justice), The Sims 2 (making complex social relationships), Rollercoaster Tycoon (Engineering and Business Management), and SimCity 4 (Civil Engineering and Government). For some of them there is a clear match between their explicit content and the classroom content. For others, the match is between a course aims and skills and the underlying strategies and the game play. In any case it is important to be able to “easily augment the game 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)”. Prensky has put together a list of five hundred “serious” games that can be used to teach different content, and his new book and accompanying Web site provide even more guidance on using games for learning. Given the many different and varied applications of SGs there is little or no report on SGs as knowledge bases for engineering design and product manufacture. Yet SGs can play an important role in these highly iterative and precise product development environments. The management of knowledge, i.e. how it is captured, used and maintained is crucial for ensuring maintenance and future development programmes can be executed when personnel change and when training is required. All these aspects and modalities of use need to be discussed at the light of more detailed tests and analyses, also in Europe. And it is important to provide scientists, practitioners, stakeholders and users with tools that support a systematic exchange of high-quality data and information and presentation/dissemination of results/achievements/theories.

New types of gaming/leisure environments also include Virtual Worlds (VWs). “The success, and wide reporting, of Second Life has helped to highlight the wider use of immersive worlds for supporting a range of human activities and interactions, presenting a wealth of new opportunities for enriching how we learn, how we work and how we play”. Sara de Freitas, of the Serious Game
Institute, prepared for the JISC e-Learning Programme a scoping study on the use of Serious Virtual Worlds (SVWs) to support learning and training.

The report includes a review of the field, case study examples (Active Worlds Educational Universe, SciLands, Croquet Community, Project Wonderland, Forterra OLIVE’s Platform) and a typology classification. The study stresses the opportunities given by the participation of learners in constructing spaces, content and activities and the blending between virtual and real spaces and experiences. Related challenges for improvement are identified in particular a need for common standards for interoperability (e.g. of user profiles, player avatars, 3D objects) and the validation of assessment and evaluation techniques. A debate between developers, educators and designers is considered as necessary to ensure that these challenges are met positively, and to ensure quality in all areas of academic and educational practice. The paper concludes that “although virtual worlds have been around for over 20 years, it is only really in the last five years that the real potential for virtual worlds has been recognized, and the next 20 years could bring about a virtual world revolution that has the capability to radical shift how we learn. To ensure that this revolution is successful at engaging students and supporting the development of higher order thinking skills it is vital that we work together as a community and integrate our plans so that the learners of the future have an educational system that gives them an enriched learning experience, does not suppress creativity and helps to create a cohesive community that works together for the greater good”.

An important innovation enriching gaming/leisure environments is the use of Brain Computer interfaces (BCI). A brain-computer interface (BCI) is a system that connects the brain directly with the computer and vice versa. The BCI translates electrophysiological signals into an output that reflects the user’s intent. Thus, it can provide people with severe motor disabilities, such as amyotrophic lateral sclerosis (ALS), spinal cord injury or brainstem stroke, with a new non-muscular channel for basic communication and control. It is already possible, to control basic games with the sole use of brain activity. Furthermore, BCI can also serve to monitor the player’s emotive state as well as general arousal during playing, which can then be used to adapt the behavior of the game to the needs of the player. Arousal is reflected in the rhythmic activity of the brain. In general, faster frequency bands, such as beta, represent activated states, whereas the slower frequency bands, such as theta, represent a low activated state in a person.

The use of a BCI also involves learning, as the user has to learn to modulate his/her brain activity by means of feedback of performance. The success of a BCI depends on how correctly and efficiently these two adaptive controllers - the user and the system – interact. The learning involved in BCI is closely related to operant conditioning. Operant conditioning is widely used in behavior modification procedures described a treatment for children with attention deficit hyperactivity disorder (ADHD). These children were trained to enhance the mu rhythms in order to suppress motor activity but still to stay attentive.

Furthermore they should also enhance the low beta rhythms in order to enhance the cortical excitation of the under-aroused children with ADHD. With the aid of clever designed serious games, the training of enhancement or suppression of specific frequency bands could further be used to help induce, during playing, a mental state that facilitates learning.

2 Concept and objectives

The GaLA motivation stems from the acknowledgment of the potentiality of Serious Games (SGs) for education and training and the need to address the challenges of the main stakeholders of the SGs European landscape (users, researchers, developers/industry, educators). A foundational fault issue in this context is the fragmentation that affects the SG landscape.

GaLA aims to shape the scientific community and build a European Virtual Research Centre (VRC) aimed at gathering, integrating, harmonizing and coordinating research on SGs and
disseminating knowledge, best practices and tools as a reference point at an international level. The other two key focuses of the project are (1) the support to deployment in the actual educational and training settings and (2) the fostering of innovation and knowledge transfer through research-business dialogue.

The NoE organizations aim to integrate their activities and resources in a long-term view structuring the activities along 3 major axes:

- **Research integration and harmonization.**
  - Strong integration among leading researchers, users and business;
  - Strong concern on the current standards of education, in order to favour a real uptake and scaling of the educational games initiatives.
  - Address sustainability.

- **Joint research activities.**
  - Identify key issues and address them through multidisciplinary teams (putting always the users – learners and teachers – and stakeholders in the centre of the focus) that will be iteratively explored;
  - Promote Research and Development team forces – organized in thematic areas – that will do focused research (e.g. joint PhD and MSc projects on hot SG research projects, joint project proposals) and continuously inform the project about the latest developments in technology and education;

- **Spreading of excellence.**
  - Dissemination of the NoE achievements as a flagship EU initiative in the TEL area
  - Strong coordination with EU TEL activities, offering a specialized focus and expertise on SGs.

The potential of SGs is huge, because a large and growing population is familiar with playing games, that can present users with realistic and compelling challenges, highly stimulating their information processing capabilities and capturing their concentration span for long duration. SGs provide appealing experiences (also involving multiple players) and are highly cognitive demanding. Exploiting the latest simulation and visualization technologies, SGs & SVWs are able to contextualize the player’s experience in a stimulating and realistic environment. “Games embody well-established principles and models of learning. For instance, games are effective partly because the learning takes place within a meaningful (to the game) context. What you must learn is directly related to the environment in which you learn and demonstrate it; thus, the learning is not only relevant but applied and practiced within that context. Learning that occurs in meaningful and relevant contexts is more effective than learning that occurs outside of those contexts, as is the case with most formal instruction. Researchers refer to this principle as situated cognition and have demonstrated its effectiveness in many studies over the last fifteen years. Researchers have also pointed out that play is a primary socialization and learning mechanism common to all human cultures and many animal species”. Don Menn claims that students can only remember 10 percent of what they read, but almost 90 percent, if they engage in the job themselves, even if only as a simulation, and this assertion has been supported by evidence from recent studies on the effectiveness of game-based learning.

Good SGs & SVWs challenge players sense immersive situations, providing concrete, compelling contexts where the player gets concretely involved. This is important also to show the concrete relevance to everyone’s life of subjects (eg. maths and physics) that are frequently considered as cold and abstract, but whose applications to improve our understanding (and prediction) of the world and its processes are surprising and give satisfaction to students. Moreover, SGs can provide an excellent context not only to acquire and test knowledge and skills, but also to closely examine an environment without the barriers of time and space (and any other type of costs), thus can be gyms where new knowledge, practices and solutions can be developed.
Play, in fact, supports players in exercising five kinds of freedom (freedom to fail, experiment, fashion identities, of effort and interpretation), that are rarely possible in traditional schooling and can complement it by encouraging learners “to come up with new and varied solutions rather than regurgitating the "right answer." The freedom to fail eliminates the penalty for making mistakes that most schools impose. The fear of failure shuts down the brain's ability to think creatively”.

Finally, SGs can be multiplayer online, favouring team-building and cooperation in facing issues, shaping real communities of learners. In order to achieve these results, SGs require the study and implementation of a complex mix of advanced technologies that are, in a broader sense, key in the global competition. These include but are not restricted to: Artificial Intelligence, Human-Computer Interaction, networking, computer graphics and architecture, signal processing, web-distributed computing, neurosciences. These technologies are to be developed and exploited in a target-oriented multidisciplinary approach that puts the user benefits at the centre of the process.

For quality control and to enhance effectiveness, the development of SGs and SVWs should be firmly grounded in educational theory, as well as in cognitive psychology and neuroscience. It should employ methods and insights from cognitive neuroscientists and educators to scrutinize and monitor the specific type of learning involved in playing SGs.

Learning is phylogenetically old and ubiquitous, but also a very diverse ability. Different types of learning range from implicit learning (conditioning and motor learning) to declarative learning (verbal facts or figurative contents). Different types of learning are subserved by very different neural structures, follow different trajectories and require different learning environments to be optimally efficient. Different neuroscientific methods can be used to track learning related changes in the brain. First, BCI can be used to monitor learning during playing and to evaluate the learners’ mental state. Second, recently developed brain imaging techniques such as functional magnetic resonance imaging (fMRI) allow locating the areas within the human brain that change their level of activation due to learning.

3 The role of the Romanian Advanced Distributed Learning Department

The Ro ADL Department was invited to take part in this project consortium based on its experience in the ADL field and SCORM development, as well as. Since the Ro ADL Department is recognized as a ADL partnership Lab by the USA ADL Initiative it is represent a pole of experience and capabilities in the eLearning field oriented to the adult learning area and especially to the military domain. The Ro ADL Department started couple years ago to use different SG in the training curricula oriented to the military contingents which are deployable into different war theaters such as : Afghanistan, Iraq , Kosovo and so on. For example, the course “Cultural Awareness - Afghanistan – pre deployment course” opens with a look at the definition of culture and introduces Afghanistan (including history, climate and geography). The majority of the course centres around six visually appealing, interactive scenarios in which the learner must make decisions in a variety of culturally tense situations. Like real life, there are no absolutely right or wrong answers. Learners receive feedback through a cultural risk meter that indicates if their choice has increased or decreased cultural tensions. To support them in making the best choice, learners have access to content specific material that provides easily understood information about key cultural areas, such as the treatment of women or the importance of honour and shame in Afghan culture.

The mains role of our department in this projects are around two objectives:

- **SG metrics**
  This task will concern the development of a taxonomy and metrics for SG, in order to allow an effective assessment and priority definition, which are perceived as an urgent need by the research
community. Metrics will concern: educational effectiveness of games (segmented in terms of user
typologies, educational domains, degree of student cooperation, etc.), usability, appropriateness of
technologies for specific targets, entertainment, ability to appeal to users (segmented in terms of
user types), ability to capture user attention and keep their concentration, types of solicited skills,
ability to shape users cognitive abilities, etc. Curricular and 21st Century skills will be considered
and assessed. The work will consider different types of games and users.

- **Interoperability and semantics**
  
  One of the more important negative aspects of using the games in the formal education and
training is given by the impossibility to track user activity within 3D games environments. While
the linear content is standardized and most of the well known LMSs are compatible with
standards, 3D games are not based on standardization. Our principal task will be focused to find a
SCORM solution (Shareable Content Object Reference Model) conformant 3D serious game for
Learning Management Systems. This aim will be fulfill by research methods for enabling
interoperability, accessibility, and reusability of SCORM compliant learning content in 3-D virtual
worlds.

  Around this subject are some essential questions which need an answer: Can games be broken
down into reusable objects? What components of games should be considered an object (e.g.,
multimedia assets; subroutines for interactions, animations and simulations)?

  Developing those objectives y deeply research we will have in attention 4 major things.

  First – Standards. In the government and defense, configuration management and architecture
compliancy spell life and death for software and hardware. The gaming industry has no uniform
standards, but more importantly, the government has not published a standard for the importation
of serious game applications into its network infrastructure – either classified or unclassified. For
the market to continue to grow, government and industry must agree on a policy and standard. As
in the case of an innovation market, there are different engines, interfaces, and operating systems
vying for market space etc. – eventually it will come to a head.

  Second -- Price. The costs of quality games are prohibitive. Until costs go down – without
sacrificing quality -- I think the market will always have limitations. Costs of $1M or more for a
“game” are hard to sustain, although not unprecedented. We all know there are some applications
being produced much more cheaply, but from what I have seen they may work in the early
markets, but won’t be sustainable because of their overall limitations in network deployability,
upgrades, and sheer lack of behavioral sophistication.

  Third – Procurement. Most serious games have been developed through Research,
Development, Test and Evaluation (RDT&E) funds sponsored by research organizations (i.e.
DARPA, ONR, etc.) to promote the exploration of gaming applications. It’s been a tremendous
investment. However, once the gaming “mystique” or “novelty” has been quenched, the bulwark
of funding will move towards the Other Procurement (Navy, Air Force etc.) (OP) which eliminates
developmental or prototype designs – it is this money that buys games and does the acceptance,
test and evaluations from industry.

  Fourth- Classifications: Serious (military) games are just analogous enough to escape the
issues of classification. They are often restricted in access and distribution (Like Ambush!), but
eventually, copies of a serious game will make it onto the internet be found on a terrorist's laptop
and then the party is seriously over. Additionally, games, in my mind, can be divided into two
areas: functional or cognitive (training).

4 Conclusions

GaLA aims at integrating the participants’ activities and capacities. The NoE tool allows reaching
an operational and collaborative critical mass of research that will provide benefits to the overall
SG and TEL domains. In particular, GaLA will operate to systemize the research and education activities and indicate a roadmap based on the working experience of an integrated body of excellences that cover all the competence fields involved in design, development and deployment of SGs. Such a systemization will promote typically European specificities (creativity, collaboration, team-building and human-centered culture and sensitivity) and pedagogical approaches (deductive and strongly theoretically-founded learning) in a field, such as that of the SG, that is currently biased by the American inductive approach.

References

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