New learning innovations with Web 4.0

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Abstract
The report analyzes the evolution of Web technology and the role of innovation in education. These technologies are applicable both in distance learning, e-learning and m-learning. It has been created a summary of the various stages in the development of technologies of web 1.0 to web 4.0. Emphasis is made on the following basic characteristics of Web 4.0 - Intelligent agents, Mobile technologies and Cloud computing and services.

Key words: Web-based learning, e-learning, m-learning, intelligent agent, mobile technologies, cloud computing and services

1. Introduction
The educational process supported by information and communication technology (ICT) changed the traditional education. With the utilization of new teaching and learning methods new forms of learning emerged, varying from computer based learning, online learning, web-based learning, e-learning etc.

Web-based education means the most extreme form of online education that uses streaming videos and the more advanced functionalities available in educational software and where there is no actual face to face contact between the teacher and the student (Lynch at al., 2009). There are seven important functionalities in web-based education before Web 4.0: real time announcements, posting of text, html, spreadsheets, videos, PowerPoint, audio files, real time grade book, external links, discussion board and chat rooms, automated quizzes, and emails to individuals and list serves (Lynch at al., 2009).

2. Web-based learning
The World Wide Web was developed in 1989 by English computer scientist Timothy Berners-Lee as a program called "WorldWideWeb", with the main goal to enable information to be shared among internationally dispersed teams of researchers at the European Laboratory for Particle Physics (CERN) near Geneva, Switzerland (Berners-Lee T., 1998). As he wrote: “The dream behind the Web is of a common information space in which we communicate by sharing information…. a second part of the dream ….the ways in which we work and play and socialize…. make sense of what we are doing, where we individually fit in, and how we can better work together “ (Berners-Lee T., 1998). From the time when he wrote the first web client and server in 1990 to now the number of Web pages exceeds 9 Billion and Internet specialists defined four periods (http://www.ideafinder.com/history/inventions/worldweb.htm), listed below:

2.1. Web 1.0 (from 1997 to 2003)
That period is defined as the read only web. That is Geocities & Hotmail era with all about read-only content and static HTML websites (Amit, 2009). Content creation by the few; web
participation is a luxury; software on the local machine; product pages and limited e-commerce; desktop computers (Larson, 2012).

2.2. Web 2.0 (from 2004 to 2006)

Web 2.0 is interactive (asynchronous) communities that communicate. Whether we are talking about Facebook or MySpace Web 2.0 is about communication and community membership (Liles & Liles, 2008). It is known as the Read/Write/Execute Web and is commonly characterized with the content creation by the many; web participation is a privilege; advent of social; software local and web-based; everything commodity can be purchased online; desktop computers and mobile phones (Larson, 2012). The availability of Web 2.0 technologies has meant that individual learners are able to create learning and social spaces that they control in terms of dissemination, collaboration and content creation (Ng, 2012).

2.3. Web 3.0 (from 2007 to 2011)

Definitions of Web 3.0 vary greatly. Some believe its most important features are the Semantic Web and personalization (Amit, 2009). With the content creation by the majority; web participation is a right; social layers horizontally available; software in the cloud; e-commerce overtakes offline retail; desktop computer, mobile phones and tablets (Larson, 2012). According to some Internet experts, Web 3.0 will allow the user to sit back and let the Internet do all of the work for them. Internet experts think Web 3.0 is going to be like having a personal assistant who knows practically everything about you and can access all the information on the Internet to answer any question (Strickland, 2012).

2.4. Web 4.0 (from 2012)

Meaning creation by the majority; web participation is a necessity; customer engagement enablement; operating system (OS) in the cloud; ‘considered purchase’ products and services (once thought only saleable offline) join the Internet party; desktop computer, mobile phone, tablets and iTV; augmented data layers.

Figure 29 Defined periods of Web 1.0 – Web 4.0 (Source: Uskov, 2010)
2.5. Teaching Tools of the Future
The wide range of technologies involving in the education methodology significantly improved the quality of teaching and learning in higher education. The ten incredibly powerful tools defined by Heick (2012) for the future education are shown on fig.2.

![Incredibly Powerful Teaching Tools of the Future (Heick T., 2012)](image)

They are: Visual Learning; Evolved Currencies; Personalization; Gamification; Social Media; Game-Based Learning; Connectedness; Crowdsourcing – by definition, it is a distributed problem-solving and production model. In the classic use of the term, problems are broadcast to an unknown group of solvers in the form of an open call for solutions (http://en.wikipedia.org/wiki/Crowdsourcing); Project-Based Learning; Digital and Physical Merge

3. Main characteristics of web 4.0 important for e-learning: development intelligent agents, mobile technologies and cloud computing and services

3.1. Intelligent agents
Personal agents have been developed to help manage the increasing volume of electronic information available (Maes, 1994). Such development has produced digital assistants for managing electronic information, proactively engaging in tasks on behalf of the user to find, filter, assess and present information to the user in the most appropriate manner (Maes, P. 1994). Personal agents have been developed for a number of applications, including email and news filtering (Lashkari, et al. 1994) meeting scheduling (Dent, et al. 1992); and information retrieval (Rhodes&Starner, 1996). Personal agents require a user model, or personal profile, which they employ when undertaking their task. Profiles allow personal agents to perform tasks according to the needs and preferences of the user, turning the computer into an intelligent personal assistant. With knowledge of the user, personal agents can specifically tailor how they interact with the user. Furthermore, the profile constructed by the agent must adequately and accurately reflect the true requirements and needs of the user (Soltysiak &Crabtree, 1998).

For optimal use, personal agents must be able to learn a user’s preferences and habits over time, and adapt to the changing needs of the user. In order to generate an accurate user profile,
information from as many different sources must be used (Soltysiak & Crabtree, 1998). Therefore, personal agents require access to many different systems that the user interacts with to be able to build up this profile. The framework allows agents to deposit information for later use by itself or by other agents. In this way, information sharing between agents is possible, but it is also controlled in such a manner as to allow modular inclusion of agents within the framework. It is likely that a user’s personal agents will find it beneficial to share information with each other rather than simply work in a stand-alone manner.

**Personal agents may need to collaborate with each other to perform tasks for their users.**

A personal agent that is new to doing a certain task may want to ask other personal agents (with similar owners) how they might perform that task. The ability to do this would allow personal agents to be “bootstrapped” in order to be useful from an early stage.

An intelligent agent is a set of independent software tools linked with other applications and databases running within one or several computer environments. The primary function of an intelligent agent is to help a user ‘client’ better use, manage, and interact with a computer application such as a course management system (CRM) or campus portal system (Jafari, 2012).

Through intelligent agents among management courses can overcome some limitations of these environments. Once the instructor is included in the system he can follow through agent for assistance to the duties of the student for the job, participation in collective projects, whether online tests are made. In general intelligent agent can be summarized and categorized the information according to the preferences of the instructor. If you have prepared relevant features intelligent agent can send email messages to students for those with above average results for the group and those who have the worst results of the recent assignments.

In the implementation of e-learning intelligent agents may have different tasks for which the authors classify them differently. Intelligent agents that perform teaching and learning tasks can divide into three main groups: Digital teaching assistant, Digital tutor and Digital secretary. These agents may communicate with their human clients using a combination of text, graphics, speech, factual expression and voice recognition. Besides using the web browsers on a PC, agents may use other types of communication environments including personal digital assistant, telephones, instant messenger systems and others.

### 3.2. Mobile technologies

M-learning makes the most of being on location, providing immediate access, being connected, and acknowledges learning that occurs beyond (and in conjunction with) formal learning settings, in places such as the workplace, home, and outdoors. The integration of mobile technologies into training has made learning more accessible and portable. Mobile technologies make it possible for a learner to have access to a computer and subsequently learning material and activities; at any time and in any place. Applying the m-learning, learners can use mobile devices including: mobile phones, personal digital assistants (PDAs), personal digital media players (eg iPods, MP3 players), portable digital media players, portable digital multimedia players, portable gaming consoles, Ultra-mobile Personal Computers (light and small portable computers that run Windows Operating Software as well as standard packages such as Word, Excel, PowerPoint and Access), tablet PCs (like laptop computers except they come with a special pen to select, drag, and open files as well as enter handwritten notes), smart phones.

Through mobile technology, they can: provide anytime, anywhere access to content (depending on the mobile device), provide just-in-time training or review of content, enhance learner-centred approaches, and facilitate collaboration through synchronous and asynchronous communication.

Mobile technologies can be used to deliver a range of formats for different learning strategies: audio resources (podcasts, sound files), video and photographic/graphic resources, communication (SMS and MMS messaging), web content, portable documents (e books, word, excel, pdf etc),
activities (games, quizzes), interactive content (navigable pages of topic information), cross–
platform activities and content (reuseable learning objects creating using SCORM also useable on
Learner Management and other course delivery systems), Bluetooth (system for mobile devices to
connect and share information, files and applications), Wi-Fi/WLAN – learning activities where
secure access to a campus based network of information is required.

Mobile technologies can be integrated into training deliveries to make learning more accessible
and portable. An m-learning approach should be deployed only to enhance the training strategy or
authentic context for delivery so that learners are provided with opportunities to work from
location or work.

Deploying m-learning materials can support equal access to learning by providing materials in
a range of formats. For example, a learner who is unable to access a mobile learning resource
using a mobile phone, media player or PDA should still be able to access a version of the learning
activity using a web browser or via downloadable or print based resources.

An m-learning approach should respond to and address the diversity of the learner group,
learning needs and styles.

M-learning should be deployed to provide situated, relevant and flexible learning activities that
enhance contextual learning and communication and learning opportunities between and amongst
learners and trainers.

3.3. Cloud computing and services

In recent years, Cloud Computing-and draws attention of industrial companies and academic
establishments (Creeger, 2009; Vouk, 2008). As a complex structure, Cloud Computing-provides a
single computing resource for everyone within the network connection using third party services
(Web service). Its advantage lies in the fact that there is accessibility to data and applications
anywhere, anytime from any device connected to the Internet. This feature of the cloud eliminates
the cost and complexity associated with integration and maintenance of an information
infrastructure. Cloud Computing-proposed flexible computing resources that are available in a
shared resource that can be physical or virtual. Because of these characteristics Cloud Computing-
and was developed as a successful business model.

According to Khai (2011) the main attributes of cloud computing are:

1. **Service Based:** consumer needs not to know about complexity of underlying infrastructure.
   This can be accomplished by using management interface to facilitate consumer’s need for
each service. Interfaces hide the implementation details and focus more on how technology
solve consumer’s problem rather its capabilities.

2. **Scalable:** the service’s capacity can scale up or down as the consumer demands.

3. **Elastic:** ability of the service to add or remove resources to any instance with minimum effort.

4. **Shared:** the underlying infrastructure, software or platforms are shared among the consumers
   of the service (usually unknown to the consumers). This enables unused resources to serve
   multiple needs for multiple consumers, all working at the same time.

5. **Metered by Use:** services are tracked with usage metrics to offer multiple payment models.
   These may vary from on-demand plans, subscriptions, fixed plans and even free plans. These
   plans are charged base on usage measured by hours, data transfers, storage capacity or
   availability.

6. **Delivered through Internet Technologies:** service can be delivered using Internet formats and
   protocols such as URLs, HTTP, TCP/IP and Web technologies.

In addition, cloud solutions can be used to support cooperative learning and socially oriented
theories of learning, using computer technologies to support collaborative methods of instruction
(Thorsteinsson et al., 2010). Cloud computing offers many benefits to e-learning solutions by
providing the infrastructure, platform and educational services directly through cloud providers
and by using virtualization, centralized data storage and facilities for data access monitoring (Pocatilu et al., 2009). In order to ensure success in e-learning, universities use metrics systems adapted to measure the effectiveness of e-learning solutions based on the cloud (Mircea M. at al., 2011).

4. Conclusion
Education based on Web 4.0 is more student centered rather than professor centered education of traditional education. While many research papers and media publications report substantial success with Web-based education, a careful analysis of the situation and informal discussions with "on-line teachers"show that Web-based education is quite far from achieving its main goal-reaching a wide distance audience in a cost effective and educationally sound manner, and in particular accommodating the requirements of students from underrepresented groups (Brusilovsky, 1998).

With new technological innovations for applying intelligent agents, mobile technology and cloud computing and services it is enabling to develop and enhanced education for the creative universities and professors.

5. References