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Computer games and interactive technologies in education: enhancing motivation and engagement for the 'iLearner' generation

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Abstract

This paper describes the work carried out by the ICT in Education research group at the University of the West of Scotland in using games-based learning and interactive technologies as a means of enriching and stimulating the learning experiences of students. This paper examines the contribution of games-based learning to education, highlighting how it enhances motivation and engagement for learners, as well as providing specific examples of games-based learning platforms and applications some of which have been developed and implemented by researchers from the ICT in Education research group led by Professor Thomas M Connolly. The paper will highlight some of the main advantages and problems associated with games-based learning, as well as highlighting a new project, the Web 2.0 European Resource Centre which is aimed at enabling the mass of educators who find ICT confusing and frightening to have a simple and secure environment to use ICT within their class.

Keywords: games-based learning, alternate reality game, Web 2.0

Introduction

In recent years the area of games-based learning has evolved to provide a stimulating and engaging learning experience for younger learners who have been brought up in a technologically rich environment. Such learners can be termed digital natives (Prensky, 2001) or *'iLearners'* who have been heavily influenced by the latest highly interactive and individual technologies such as iPods, iPhones, iPads, Wii games consoles, as well as Wi-Fi Internet access and graphic rich multiplayer Internet gaming. In contrast many of today's educators and teachers were largely brought up in a less technologically advanced world. Connolly et al. (2007) observed younger generation learners exhibited a cognitive preference to certain media, for example they liked portability and are more frustrated with by technology that ties them to a specific location.

According to Connolly and Stansfield (2007) games-based learning can be defined as the use of a computer games-based approach to deliver, support, and enhance teaching, learning, assessment and evaluation. Games-based learning has been applied to a variety of different fields such as medicine, science and mathematics, military training, language learning, computer science, and business and knowledge management. Connolly et al., (2004) suggest that computer games are well suited to use within an educational environment because they build on theories of motivation, constructivism, situated learning, cognitive apprenticeship, problem-based learning and learning by doing. In addition, it can be argued that the younger generation of 'iLearners' prefer video, audio and interactive media and do not read as many traditional books as previous generations, and due to shorter attention spans require learning in smaller size chunks. As result of the Internet,

learners today learn much more collaboratively than in previous generations, thus there is an important need for educators to embrace and adopt approaches to teaching and learning that are better suited to the learning styles that the younger generation of learners now adopt and provide a more stimulating and engaging learning environment. It is as a result of this need that the next section will explore some examples of how games-based learning and interactive technologies have been used in education.

Examples of Games-Based Learning in Education

Over the past decade numerous games-based learning applications have been developed for use in the classroom, in further and higher education, as well as for training. This section will focus on examples most notably within business, the classroom environment and within the context of further and higher education, highlighting how they have enhanced learning and engagement among learners.

Games-based learning in business

An example of a games used for teaching business and leadership skills is SimuLearn's Virtual Leader (http://www.simulearn.net) which provides a 3D-simlation game aimed at trainers in providing accelerated learning in a wide range of business related skills such as effective leadership, communication, team building and group dynamics, how to foster creativity, and project management. A screen shot showing some of the game's features and characters is shown in Figure 1.
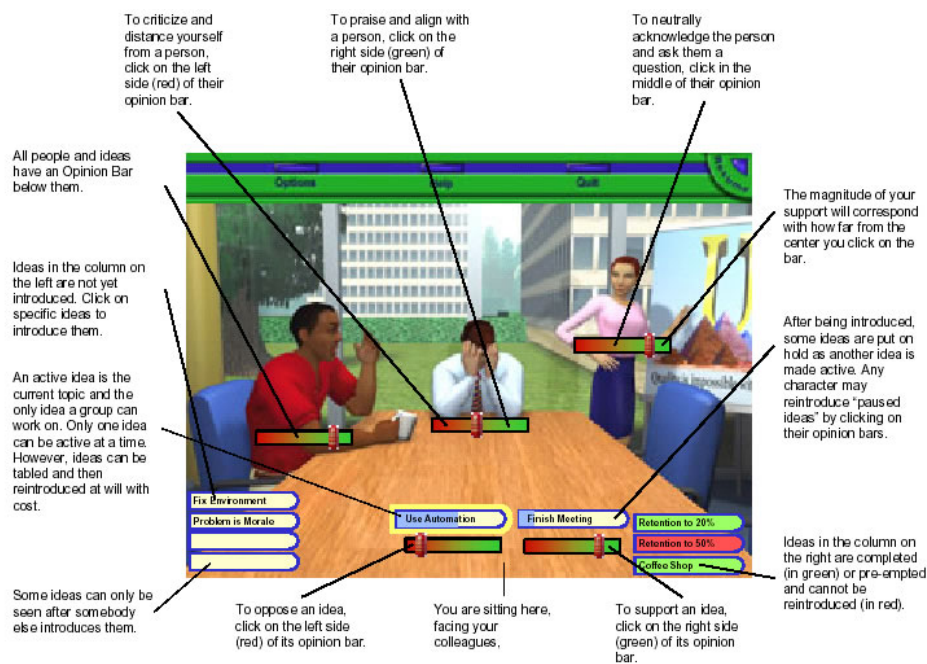

Figure 1. Virtual Leader's interface

The participants in the training exercise join a group of animated artificial intelligence characters as a leader who is then provided with the task of getting the team work together in achieving a common business goal. The tasks are made more challenging as a result of the virtual team members having particular personalities, viewpoints, allies and agendas. As result the leader must apply certain principles relating to effective leadership in order to get the group to focus on the task in hand. Leaders are judged on how individuals in the group respond to the tasks and the actions they take. Virtual Leader has been used within the context of training with several large organisations such as Coca-Cola and Johnson & Johnson.

Games-based learning in teaching software development requirements collection and analysis

An example of a games-based learning application in this area is provided by Connolly et al. (2007) who developed a game aimed at helping further and higher education students learn key skills and knowledge associated with software development requirements collection and analysis. Connolly et al. (2007) state that software development requirements collection and analysis can be considered to be a 'wicked problem' as a result of what can often be viewed as incomplete, contradictory and changing requirements and solutions that are often difficult to recognise due to complex interdependencies. As a result students often find considerable difficulty in understanding implementation-independent issues and analysing problems where there is often no single, simple or correct decision. In order to address these important issues a simulation game 'SDSim' was developed in which an example of the interface is shown on Figure 2.
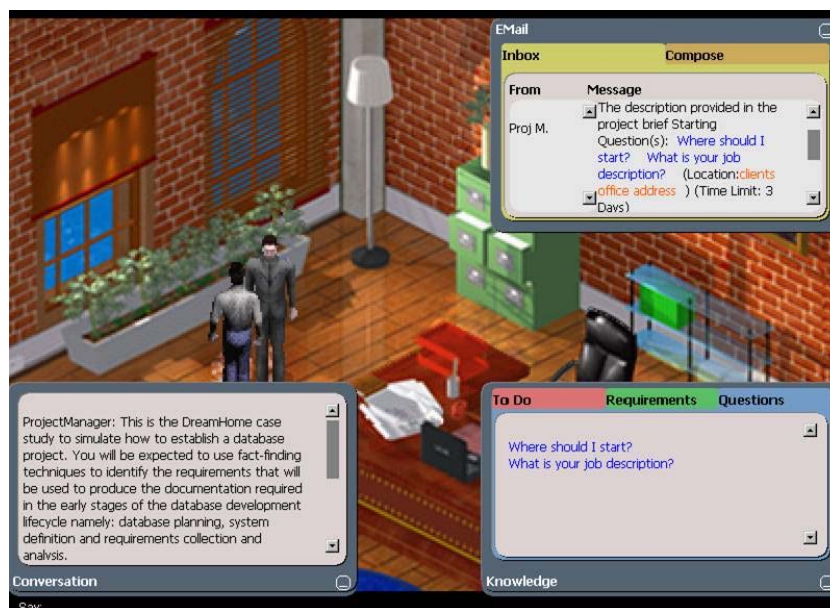

Figure 2. SDSim game learning environment

In the game, a team comprising one or more players are tasked with managing and delivering a software development project in which each player has a specific role (e.g. project manager, systems designer, team leader) and must communicate with non player characters in the game in order to find the relevant information in order to successfully produce a high-level design that addresses the client's requirements. A detailed evaluation of further and higher education level students using the SDSim game (Hainey, 2010) found that it did have a significant impact in motivating students and providing a stimulating environment within which to learn key skills and knowledge associated with software development requirements collection and analysis as compared to more traditional text book and classroom based teaching and learning.

Games-based learning and interactive technologies in teaching languages

In relation to using a games-based approach to teaching languages Rankin et al., (2006) in a preliminary study used EverQuest II to support the teaching of English language as a second language. A screenshot from EverQuest II is shown in Figure 3. EverQuest II is an example of a Massive Multiplayer Online Role Playing Game (MMORPG) that was found to be useful in generally reinforcing language acquisition. MMORPGs generally create a persistent universe in which hundreds of thousands of players can simultaneously interact in graphically rendered immersive worlds. By completing the quests, Rankin et al., (2006) found that the small number of players used for the purposes of their study who comprised Korean, Chinese and Castilian speakers were able to gain an appreciation for colloquial meanings, verbs and adverbs.

Figure 3. Screenshot of the EverQuest II game

An example of a more detailed study into the use of games for language learning is provided by the ARGuing project (Connolly et al., 2009; Hainey et al., 2009; Tsvetkova et al., 2009). Alternate Reality Games (ARGs) are a form of interactive narrative and puzzle solving which often involve multiple media and gaming elements to tell a story that might be affected by the ideas and/or actions of the players as they take place in 'real-time'. The multiple media which is used to reveal the narrative to the players can involve web sites, instant messaging, text messages, emails, as well as TV and newspaper adverts. As well as being a form of computer game, ARGs are heavily built around social networking in which players interact with one another and can form alliances. In the past ARGS have been used to promote new films and TV series, as well as music CDs in which players are directed to various media in order undertake various challenges and quests in which 'puppetmasters' steer players in different directions as the game's story unfolds.

The ARGuing project was part of a two year European Commission co-funded Comenius project entitled 'ARGuing for Multilingual Motivation in Web 2.0' led by Professor Thomas M Connolly from the ICT in Education research group at the University of the West of Scotland. Web 2.0 refers to web applications that facilitate social interaction, participation, collaboration, information sharing, with tools and services including blogs, wikis, e-portfolios, video sharing, podcasting, tagging and social book marking, RSS and syndication.

The ARGuing project involved developing an alternate reality game that was based on a set of characters who through their collective effort build a contemporary 'Tower of Babel' which refers to notions and values well established in European civilisation. The ARGuing project was a cutting edge project that addressed two important needs in European education – (i) how to bridge the widening technological gap between educators and their students, (ii) how to motivate students to understand the benefits of language learning at a level that impacts on their existing personal lives.

The ARGuing project targeted secondary school children in which the game characters and the game participants discover how to build the foundations of the tower which are based on the principles and values of Europe – namely democracy, tolerance and respect, freedom and the rule of law, and access to education. The storyline of the 'Tower of Babel' is based on taking students to a future world in order to save languages that are under threat and can only be saved if students collaborate with each other and the ARG characters in bringing the different parts of Europe together and learning about each others cultures and languages.

The ARGuing project involved 328 secondary school pupils and 95 secondary school teachers from 17 European countries. Most of the quests in the ARG involved students working collaboratively with other students who were speakers of different languages in order to find information relating to a particular quest. The 'building blocks' for the tower where puzzles, assignments and quests in multiple languages and in different subjects. The quests often involved a variety of tasks such as translating languages, uploading files, searching on the Internet and were delivered through forums, blogs, websites, short video clips and emails. Games were scored using two systems – building blocks awarded for the completion of a quest and an empathy score which related player's collaboration as voted by other players. An example of the 'Tower of Babel' interface is shown in Figure 4.

In total 328 students from 28 schools across 17 European countries participated in the ARGuing project. Overall, the students' reaction to the ARG was very positive showing that the ARG was able to deliver the motivational experience expected by the students. Students believed the skills that they obtained and developed from using the ARG included problem-

solving skills (48.8%), reflection skills (37.7%), analysing and classifying skills (44%), collaborative and teamwork skills (55%), leading and motivating skills (41%), critical thinking skills (32%), and creativity skills (54%). 92% of the students who completed the evaluation questionnaire indicated that they felt there should be more use of ICT in language learning. Of nineteen language teachers who completed a post-test evaluation questionnaire 42% considered that using the ARG to be a very valuable professional experience. Some of the issues raised by the teachers included some technical problems in using the ARG, as well as some teachers (5%) considering that it might be too difficult to monitor students' actions throughout the game. In addition, for teachers participating in the ARG, it did put immense pressure on markers to ensure that students received scores and feedback in a timely manner once they had conducted a quest so that they could continue onto the next quest.

Figure 4. Example of the 'Tower of Babel' interface

Advantages of Games-Based Learning in Education

There are a number of advantages of using games-based learning within the context of education. Connolly and Stansfield (2007) suggest that that games-based learning can provide for learners increased motivation and engagement, as well as an enhanced learning experience, improved student achievement and student retention. In addition, games-based learning can provide risk free training in a mistake friendly learning environment that allows trial and error and immediate feedback (Kriz, 2003). These types of environments can be considered to invite exploration and experimentation, stimulating curiosity, discovery learning and perseverance (Connolly & Stansfield, 2007).

In relation to motivation, Malone and Lepper (1987) presented a framework of intrinsic motivation in relation to computer games in that on a individual level they provide challenge (an appropriate level of difficulty and challenge, multiple goals for winning and

constant feedback), fantasy (an appropriate level of immersion by assuming a particular role), curiosity (providing sensory stimulation to ensure prolonged participation), control (the ability to select choices and observe consequences of these choices. On an interpersonal level computer games can provide cooperation (assist others to achieve common goals), competition (comparing performance with that of other players), recognition (a sense of satisfaction when accomplishments are recognised). Other advantages of using games-based learning within an educational context include:

- access to knowledge where human expertise may be scare or very expensive.
- they may encourage learners who lack interest or confidence and enhance their self-esteem (Klawe, 1994; Dempsey et al., 1994).
- the versatility of using computer games was highlighted by Griffiths (2002) in which children can have access to technology that may help them overcome fears in using technology as well as assisting in the development of transferrable IT skills.
- complex games have the potential to support cognitive processing and the development of strategic skills that can encourage greater academic performance as well as the development of social skills (Natale, 2002; Connolly & Stansfield, 2007).

Issues and Problems with Games-Based Learning in Education

One of the main concerns associated with the area of games-based learning that is cited is the dearth of empirical evidence supporting the validity of the approach (e.g. deFreitas, 2006; Connolly et al., 2007). Games are often developed with little evaluation and concrete empirical evidence. As a result this hinders the further development and acceptance of the area of games-based learning since the area can be dismissed as lacking real evidence to substantiate claims (Hainey, 2010).

Connolly and Stansfield (2007) point out that there are concerns about the negative impact on learning that games may have due to students concentrating on scoring and winning rather than the learning objectives. As well as the considerable cost that might be involved in developing games-based applications in terms of money, time and access to suitable expertise, there are also concerns that the use of some games may have a high learning curve and take significant amounts of time to work through making them unsuited to short or small-scale use within the classroom environment.

Preparing Teachers for the 'iLearner' Generation

As has been shown by the examples in this paper, games-based learning and Web 2.0 technologies can play a key role in teaching and learning across a wide range of different learner profiles from school age learners to mature learners within a training context. However, one of the key issues in attempting to engage and motivate learners is how educators can become skilled and knowledgeable in the use of such technologies within the classroom and with learners, particularly in the case of school age students who have become used to using the latest communication technologies, social networking and games-based technologies over many years. Many educators might not be as confident and knowledgeable in the use of such technologies since they were brought up in a less technologically advanced environment.

It is with these type of issues in mind that the Web 2.0 European Research Centre (Web 2.0 ERC) project has been set up and coordinated by Professor Thomas M Connolly at the University of the West of Scotland. The Web 2.0 ERC is a two year European Commission

multilateral co-financed project that started in early 2010 aimed at enabling the mass of educators who find ICT confusing and frightening to have a simple and secure environment to use ICT within their class.

Many ICT tools exist and teachers do not have time nor expertise to identify the best solution for their needs. With many students using and communicating easily and openly using Web 2.0 tools (blogs, wikis, social networking, etc), the technology gap between educators and students continues to grow despite best efforts of national and European agencies. The tools such as those described in the previous section have pedagogic value arising from sharing, communication and knowledge discovery that teachers could use to provide a more motivating, engaging, relevant and collaborative environment for students.

As a result there is a clear need for understanding how Web 2.0 tools can be used effectively within education. Thus, the Web 2.0 ERC project will:

- establish a European Resource Centre for simplified and targeted Web 2.0 tools, for schools, HE and adult education.
- provide clear examples of how to use them in class with accompanying pedagogy, guides and videos.
- produce a customisable integrated Web 2.0 platform with single sign-on for educators to use.
- foster and build collaborative communities to exchange best practice and for experienced Web 2.0 educators to mentor new users.

The project will be aiming to significantly increase in number of educators who can use Web 2.0 tools in a pedagogically sound way. Underpinning Web 2.0 tools and applications is an ethos of socialisation, collaboration and participation. Having a set of tools, pedagogy and guides that demonstrate how Web 2.0 can be used effectively in the classroom will provide educators and students with the means to collaborate on a European dimension and share and experience different languages and cultures.

The project will also attempt to develop an innovative pedagogical framework for the use of Web 2.0 and illustrate the use of this framework with a set of pedagogical guides for the secondary, HE and adult education sectors. The project will be running teacher training courses and piloting the integrated Web 2.0 educational platform during 2010 and 2011 across the secondary, HE and adult education sectors. The projects included the setting up of a Community of Practice where educators from any level of education can share their experience and advice. More information in relation to the Web 2.0 ERC project and how to become involved can be found at: http://www.web20erc.eu/ and http://www.facebook.com/pages/Web-20-ERC/317534459957?v=info

Conclusions

This paper has highlighted some of the key issues that educators face if they are to continue to motivate and engage today's learners. Whilst using games-based learning and interactive Web 2.0 technologies might pose significant hurdles for many educators from a personal, organisational and professional perspective, this paper has provided some examples of how these technologies can be used in a positive and engaging way with a range of different learners from secondary school age through to adult learners. New projects such as the Web 2.0 European Resource Centre provide a key resource that educators from across Europe will soon be able to access and engage with other educators, learners, technologists and decision-makers in learning more about adopting such technologies and tools for their own teaching, as well as seeing examples of best practice.

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