

DESIGN AND DEVELOPMENT OF ONLINE EDUCATIONAL GAMES BASED ON QUESTIONS

M. Espinilla, I. Palomares

Computer Sciences Department, University of Jaén, Jaén, Spain
mestevez@ujaen.es and ivanp@ujaen.es

H. Bustince

Automatics and Computing Department, Public University of Navarra, Pamplona, Spain
bustince@unavarra.es

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Abstract: Thousands and thousands of electronic contents have been developed in e-learning models and platforms to support the student's learning process. Generally, e-contents are complete, well designed and correct, but sometimes they can result boring for students. One example is the self-evaluation and self-training process that is generally conducted by the student through the resolution of test questions presented in a multiple-choice exam. However, a simple multiple-choice test is boring for students and they will need content that is motivating and enjoyable. In this contribution, we propose the use of educational games as a tool for students to carry out the process self-training and self-evaluation. The set of games are included in a SCORM learning module, so its use is extended to any e-learning platform.

1 INTRODUCTION

The end of the 20th century and the beginning of the 21st century have been witness of the deep change produced by the huge development of the *Information and Communication Technologies* (ICT) due to the growth and development of Internet and its services (Carballar, 1999). This growth has caused that all the areas and topics related to our lives such as economics, commerce, employment, learning, leisure, etc., have been affected by these technologies in order to improve their already existing services (Mjoset, 2000; Piccoli et al., 2001; Trochim et al., 2003).

One area deeply affected, modified and improved by the web based technologies has been the *Learning*, because the use of networking has allowed overcoming both time and placing limitations, which were an obstacle in classical classroom-based learning. *E-learning* is the result of integrating learning and Internet services. In this contribution, e-learning is defined as all those planned teaching/learning experiences that employ a wide variety of technologies, mainly computer-based or Internet-based (Ho and Ko, 2010), to disseminate knowledge.

Educational contents online can be shown in multiple formats, for example text, images, sounds, video, games etc. and the idea of using platforms to store all these contents is becoming important and usual in many educational institutions. In fact, the interest on virtual learning environments (VLE) has grown in the last decade. A VLE is a structure populated with digital and interactive resources that favor the student's self-learning (González-Videgaray et al., 2009). VLEs are used in multiple forms: in on-site, distant or blended education; with static or dynamic contents; with or without interactivity, organizationally or personally.

There are different learning content as learning modules, long test, glossary of terms, file download, etc. Each content pursues a purpose, our purpose is focused on e-learning content that support self-evaluation and self-training process. Generally, this process is carried out across contents that present multiple-choice test. The repeated use of the different questions is a good method to acquire the knowledge students need in order to achieve success with their subject/course. Furthermore, students can measure their level of aptitude thanks to the application's interface, informing them about correct answer, mistakes, etc.

However, a simple multiple-choice test may finally result boring to students, who wish a more entertaining way of learning (Sánchez et al., 2009). For this reason, it seems appropriate to develop an entertaining tool to conduct test. In this contribution, we present a SCORM module than contains a set of educational games developed at the University of Jaén as an online support material that provides to students an effective self-training and self-evaluation tool in an entertaining way (Marínez et al., 2007a; Marínez et al., 2007b), because the questions are presented to students through educational games.

To do so, the contribution is structured as follows: Section 2 reviews some concepts of e-learning needed to understand our proposal. Section 3 shows our e-learning proposal consisting of educational games based on questions in a Scorm. Finally, Section 4 presents some conclusions and future work related to our proposal.

2 E-LEARNING BACKGROUND

The use of e-learning has been used since several years ago to support the learning. Different contents exist in the e-learning platforms, each content has a few characteristics and each one chases an aims inside the learning process of the student. In this section, we briefly review the learning process (Sabry and Baldwin, 2003; Atman et al., 2009), the platforms that support it and the kinds of content that contains the e-learning platforms

2.1 e-Learning

The incorporation of ICT in the Internet has meant the new educational methodology of the 21st century: the e-Learning. Next, we give some definitions for e-Learning (Rosenberg, 2001): *e-Learning is the convergence of the internet and education* (Howard Block (Block, 1999)); *All possible ways of learning by means of the Internet.* (Cisco Systems); *e-Learning consists of the use of "The Web" to design, communicate, select, expand and manage knowledge* (Elliot Masie, The Masie Center).

According to these definitions, we can assume e-Learning is attached to the use of the Internet as a knowledge diffusion resource (Browning and Williams, 1997). Now, students are not strictly required to be present in a certain place and a certain hour, and teachers aren't expressly devoted to give master classes, thus removing some geographical, economical, age or expert availability gaps. Thanks

to e-Learning systems, teaching essentials can be attended more in a more flexible and economical way (The American Journal of Distance Education, 1989). The main e-Learning issues in comparison to traditional learning models are the following (Rosenberg and Marc, 2001):

- **Dynamic.** Contents shown in the e-Learning system are regularly updated to attend those educational essentials consider important anytime, in order to respond to constant technological evolution. Traditional systems require plenty of time and resources to update any necessary documentation.
- **Real time operating:** We can find what we need instantly. This is not possible in traditional systems, where a time interval in needed to gather such information.
- **Individual:** An e-learning satisfies individual student's particular knowledge essentials (Dewey, 1916-1966). However, a traditional system is based on master classes, given to a group of students simultaneously.
- **Different ways to obtain knowledge:** Thanks to the use of ICT, e-Learning systems incorporate different technologies to show knowledge in the most appropriate way according to the student's requirements. Traditional systems also allow methods to show knowledge through ICT, but a major investment is needed.

As we can see, e-Learning advantages against traditional teaching methods are causing that both public and private organizations (Ho et al., 2010) are taking measures to attend all educational essentials required in the 21st century's society.

2.2 E-Learning Contents

The Internet's high multimedia capacities allow teachers to use different kinds of learning material (Ritchie and Hoffman, 1997). The most usual e-learning contents available for students are usually the following:

- **Documents and other files:** The simplest way to provide students an e-learning material is making available a set of documents, images, etc. with the content of interest for the subject or course they are studying.
- **Forums:** A forum is a medium for open discussion or voicing of ideas related to a particular subject. Learners can use a forum to exchange questions and ideas about a course or subject with other learners or teachers,

posting messages available to be read by other users in the same group.

- Chat: A chat is another way to exchange ideas between two or more users, similar to forums. The difference is: messages are transferred in a real-time communications with chat, as an instant messenger application, and they can't be read by other users who haven't taken part in the communication.
- Learning Modules: A learning module consists of a file, with a particular format, containing learning material. This material can be varied, from documents and images to tests and applications. The main advantage of learning modules is their capacity to be managed in multiple platforms and environments, because they often obey to a standardized format.
- Tests: A very typical e-learning resource. Learners can perform an online test anywhere with a computer connected to the Internet.

Most of these types of material are commonly used in devoted learning environments known as learning platforms.

2.3 e-Learning Platforms

Most e-learning processes are made through e-learning platforms or environment. A learning platform or environment (Casamayor et al., 2009) provides a set of educational tools for students to learn through a computer connected to the Internet. Generally, in these platforms, lectures upload different type of contents so that they are available online to all interested learners. Representative examples of learning platforms are *Moodle* and *ILIAS*. Most of these platforms are ready to store educational content in several formats: text, images, media, tests, specific learning module formats, etc.

Another important issue offered by e-Learning Platforms is an integrated environment for the creating and enforcing tests and assessments, in order to monitor student's learning progress as well as the tutors and examiners, supporting different kinds of questions, i.e. multiple choice, single choice, cloze questions, ordering, matching, etc. But the most flexible issue is the possibility of uploading learning content in SCORM module format. Learning modules are a flexible resource, usually compatible with most of the current Operating Systems and Web Browsers. A SCORM module may contain a great variety of content and interactive applications in several programming languages, for example Java.

3 EDUCATIONAL GAMES BASED ON QUESTIONS

Our proposal in this contribution consists of the design and development of online educational games based on questions, aimed to students of different modules. These games provide students a useful, easy and entertaining resource to self-train and self-evaluate their learning skills. The student's self-training is possible because the repeated use of the different games is a good method to acquire the knowledge students need in order to achieve success with their subject/course, and we have a student's self-evaluation because they can measure their level of aptitude thanks to the game's interface, informing them about correct answer, mistakes, etc. In the following, we present the design and development of educational games, then we present the description of each game and finally, we propose the SCORM structure that includes all games.

3.1 Design and Development of Educational Games

The educational games have designed in the Java object-oriented language, as *Java Applets*. An Applet is a Java application designed to run on the Web, under a Client/Server Architecture, so that the server system sends it to client systems to be run on each of them.

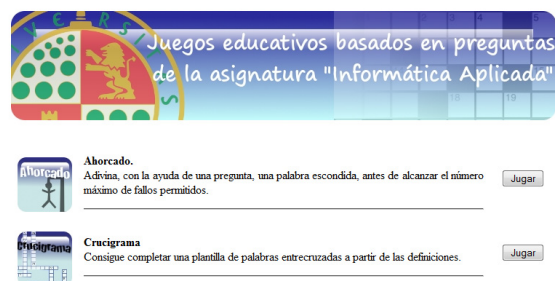


Figure 1: Example of Main Page for our Gaming Web Application.

We have integrated these Applets both in HTML pages with CSS styles and SCORM learning modules, as described in Section 2.3. The latter format has the great advantage of storing multiple games at once; in fact, a single SCORM module may host a tree-structured set of different games for a module. Figure 1 shows an example of main page for our Web application, designed for the course 'Computer Science applied to Business Management'.

An important novelty in the design and development of the application is the availability of a set of questions it reads to upload the game's questions shown to students, so that it is easy to change this file without affecting the application, thus giving lectures the possibility to create game copies based on different sets of questions (see Fig.2). The results have been delivered to corresponding lectures in multiple formats.

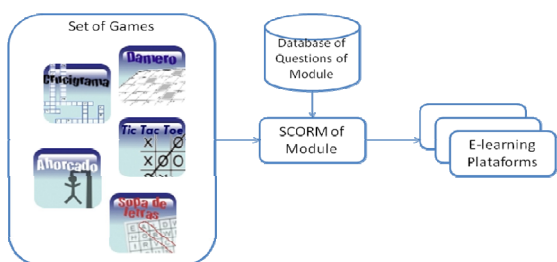


Figure 2: SCORM structure for educational games.

3.2 Description of the Educational Games

Our proposal contains five different educational games. The selected games are traditional games that generally everyone knows. Next, we describe each of these games, placing special emphasis on the learning and assessing processes:

- Hang-Man: The user must guess, with the help of a clue, a missing word, by inserting letters included on it. If wrong letters are introduced more than once, user may lose the game. The objective is assessing short questions and uncompleted sentences.
- Cross-Words: Given a set of definitions, the user must find the corresponding words to these definitions in a crossword. Thus, the aim of the game consists of assimilating a series of concepts and key ideas related to the subject.
- Word Find Puzzle: The aim is to find all definitions and concepts hidden in the puzzle before time expires. From the learning point of view, the objective is identical as mentioned in the Cross-Words game.
- Checkerboard: With the help of a few clues (short questions); user must unlock a hidden passage on the board. The game allows students to interrelate different concepts and ideas, in order to reach the final answer to a key question.
- Tic-Tac-Toe: A variant of the popular game, where users face the own game in a duel over a 7x7 board. Random multiple-choice

questions are shown. If the user chooses the right option, he can place a counter on the board; otherwise, the game places a counter.

The aim is getting as many lines as possible.

- Tic-Tac-Toe (Small version): A simpler variant of the latter, where the first who lines up three counters is the winner.
- Both Tic-Tac-Toe's versions lead students to the assessment of their amount of global knowledge acquired through the execution of a test type evaluation.

As we have just seen, different types of questions are used in the educational games, included short questions, definitions, completing the sentences, revealing passages and multiple-choice questions.

3.3 Structure of SCORM Modules

The SCORM modules we have set out in our proposal consist of a set of individual educational games (applets) for different contents in a course. We have considered a single SCORM module for each complete course, integrating both applets and HTML pages to contain each applet in a file compressed under a *zip* format. The resulting SCORM file is compatible with many learning platforms, for example *ILIAS*.

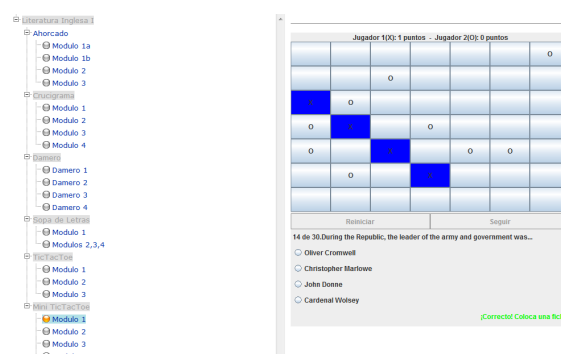


Figure 3: Tic-Tac-Toe integrated in a SCORM Module.

Figure 3 shows on the right side a Tic-Tac-Toe game for the course 'English Literature', and a complete tree structure for the corresponding SCORM module, running on an ILIAS learning platform, on the left side. The game tree includes all games created for 'English Literature' course, classified according to the type of game. For each game, besides, we divide educational games by themes or didactic units.

SCORM modules have been developed for various subjects who belong to different degrees at the University of Jaén.

4 CONCLUSIONS AND FUTURE WORKS

The virtual learning environments have been created and developed in many education institutions to improve different aspects of the learning processes. However, some contents are boring. In this contribution, we proposed the design and development of educational games as content for e-learning. The set of educational games will be used as a tool for students to carry out the process of self-evaluation and self-training and it is more pleasant than others content that have the same objectives. Furthermore, the set of educational games is included in a SCORM, so its use may extend to any e-learning platform. In the current year, we have successfully performed the implantation of these games in four subjects belonging to different degrees in the University of Jaén.

Our future work is aimed at developing the proposed set of educational games for mobile devices that allows students to carry out the processes of self-evaluation and self-training about their skills on a topic/subject, using their mobile device at any time and any place.

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REFERENCES

- Carballar, J.A.: *Internet, el mundo en sus manos*. Ed. Rama (1999).
- Mjoset, L.: *Stein Rokkan's thick comparisons*. Acta Sociológica, 2000. 43(4): p. 381-397.
- Piccoli, G., R. Ahmad, and B. Ives: *Web-based virtual learning environments: A research framework and a preliminary assessment of effectiveness in basic IT skills training*. Mis Quarterly, 2001. 25(4): p. 401-426.
- Trochim, W.M.K., et al.: *Development of a model of the tobacco industry's interference with tobacco control programmes*. Tobacco Control, 2003. 12(2): p. 140-147.
- Ho, L.A., and Kuo, T.H.: *How can one amplify the effect of e-learning? An examination of high-tech employees' computer attitude and flow experience*. Computers in Human Behavior (2010), 26, p. 23-31.
- González-Videgaray, M., Hernández-Zamora, G. and Del-Río-Martínez, J.H.: *Learning objects in theory and practice: A vision from Mexican University teachers*. Computers & Education (2009), 53, p.1330-1338.
- Sabry, K. and Baldwin, L.: *Web-based learning interaction and learning style*. British Journal of Educational Technology (2003), 34, No 4, p. 443-454.
- Atman, N., Inceoglu, M.M., and Aslan, B.G.: *Learning Styles Diagnosis Based on Learner Behaviors in Web Based Learning*. Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics) 5593 LNCS. PART2 (2009), p. 900-909.
- Ritchie D., and Hoffman B.: *Incorporating instructional design principles with the world wide web in Web-Based Instruction*. Educational Technology Publications (1997), Englewood Cliffs, NJ, p. 135-138.
- The American Journal of Distance Education*, Moore M Editorial (1989), 3, 2, 1-7.
- Dewey, J. (1916, 1966) *Democracy and Education* Free Press, New York.
- Rosenberg, Marc J.: *E-learning: strategies for delivering knowledge in the digital age*. Ed. Cartoné, (2001).
- Block, H.: *The e-Bang Theory: Education Industry Overview*. Illuminismo (1999), Vol. 2.
- Browning, P., and Williams, J.: *Using the internet in teaching and learning: A U.K. perspective*. Computers and Geosciences (1997), 23 (5), pp. 549-557.
- Casamayor, A., Amandi, A., Campo, M.: *Intelligent assistance for teachers in collaborative e-learning environments*. Computers and Education (2009), 53 (4), pp. 1147-1154.
- Sánchez, P.J., Martínez, L., Mata, F., Bernardino, A.: *Una aplicación de entrenamiento y auto evaluación para un sistema e-learning*. I Simposium en Informática y Telecomunicaciones, SIT01 (2001). A Coruña (Spain), pp 403-413.
- Martínez, L., Araque, F., and Salguero, A.: *Complement Contents in Virtual Learning Environments with Interactive Conceptual Maps to reinforce training and learning processes. An Experience in Management Degree*. Second International Conference on Interactive Mobile and Computer Aided Learning (IMCL).Amman, Jordan. Abril (2007).
- Martínez, L., Araque, F., and Salguero, A.: *Complement Contents in Virtual Learning Environments with Interactive Conceptual Maps: An Experience in Management Degree*. IEEE multidisciplinary engineering education magazine, vol. 2, no. 3, September (2007), p.13-17.