AN INTELLIGENT E-LEARNING SYSTEM BASED ON THE INTERACTIVITY EFFECT

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ABSTRACT

Many e-learning systems would significantly improve performance if interactivity is seen as part of a system where students are not passive recipients of information, but engaged with learning material that is responsive to their actions. On the other hand, the main goal of e-learning system is to be as good as the highly successful human tutor. This involves intelligence in whole process, and one of the alternatives to provide efficient e-learning in different domains is intelligent agent technology. To overcome some difficulties, an e-learning schema is introduced that provide combination of intelligent and interactive models in e-learning environments.

The key point behind the approach presented here is determining the system’s effectives through integration of interactivity effect in an intelligent e-learning system. The main idea is clarify the concept of interactivity used in e-learning environments. We present an intelligent tutoring system based on an interactivity model used in e-learning systems. The proposed approach is based on the usage of specific features, such as learner control, feedback, and guidance.

Keywords: E-learning, Interactivity, Intelligent E-learning System, Intelligent Tutoring System, Flash Card Model

1. INTRODUCTION

The growth of the new technologies and the Internet bring one of the mayor revolutions in education, e-learning. It is believed by many educationalists [1] that they must focus on the intersection of Human- Computer Interaction (HCI) and e-learning in order to make students’ interaction with the systems as natural and intuitive as possible. HCI theories and methodologies can support the design of appropriate e-learning settings. As the technical qualities of e-learning systems are important factors, also didactic effectiveness and usability are also important in construction of such systems.

At present, a lot of e-learning tools with varying functionality and purposes exist. [2] E-learning is an alternative concept to the traditional tutoring system. E-learning applications should become smart enough to adapt themselves to the students’ learning styles and to assure high standards of accessibility and usability. A major challenge currently faced by e-learning systems’ designers is the development of user interface that should hide systems’ complexity, providing an easy and flexible interaction suited to catch students’ interest.

Unlike traditional text based learning systems, e-learning systems offers lot more interactivity. Interactivity is the major promise of e-learning. E-learning have to provide interactive learning content that is responsive to learners, allowing them to actively participate in the learning process. The aim of this study was to determine whether the addition of interactivity to a computer-based learning system enhances the learning process.

In our approach, the key point is determining the system’s effectives
through integration of interactivity effect in an intelligent e-learning system. Based on this approach, we propose an e-learning environment in the framework of GREAT PYRAMID includes an interactivity model used in e-learning: flash cards model. It is based on an intelligent tutoring system schema, considering ITS architecture.

The structure of the paper is as follows. First, the technologies used in this work are presented in Section 2, while in Section 3 we present the system architecture. In Section 4, the Great Pyramid system is described as a case study of the proposed concept of interactivity. Finally, Section 5 gives our concluding remarks and describes future work.

2. BACKGROUND TECHNOLOGIES

The approach presented in this paper involves the utilization of interactivity effect in e-learning systems in order to overcome some of the common problems in e-learning systems. In this section, we briefly describe all terms referred to the topic under question and the technologies involved in the project.

2.1. From traditional learning systems to interactive e-learning systems

Web-based learning has become an important way to enhance learning and teaching, offering many learning opportunities. Today Internet is commonly adopted as channel for delivering teaching material in electronic form. Internet is involved in effectively producing and integrating meaningful interactivity into online learning. New technologies enable flexible combinations of interactive or non-interactive learning materials.

Traditionally, students used the print textbooks as the standard learning tool. In general, textbooks cover a large number of topics in detail, but they are static. Problem with textbook also include necessarily revisions for newest scientific knowledge. Textbooks also cannot provide the intersections between different disciplines and can be are costly to students. Those are reasons why traditional learning tool are insufficiently effective for some students.

Using new technologies does not mean to reject traditional and successful teaching strategies, and a learning system should allow integrating all teaching strategies. E-learning defines the teaching methodologies involving electronic aids. E-learning systems evaluated from static old-fashioned applications to modern educational multimedia environments which include open and dynamic learning and information networks.

Computer-based instruction (CBI) are used in the classroom, particularly because their technological advancements that include visually rich and interactive environments. Computer-based multimedia learning environments with animations and narrations can improve student understanding of learning materials.

Students can benefit from technology-enhanced learning systems, but without the intelligence, the computer based learning systems are little more than books and other traditional learning materials for learners. An e-learning system must be able to act as a real teacher.

In order to improve learning goal, learning systems must adapt to students’ profiles. Students have to reach the learning goal that is compatible with their knowledge background. Effective learning includes control of students’ skills and feedback between students and their teacher. The designers of e-learning system are forced to really listen to the learner feedback to be able to create functional e-learning tools.

The use of multimedia-based curriculum in education is rapidly gaining popularity where multimedia means a package that combines video, text, photos, simulations, animation and/or graphics in a hypertext environment.
An effective e-learning system should:
- be interactive,
- provide adequate feedback,
- have specific learning goals,
- avoid any factor of nuisance interrupting the learning stream,
- motivate and challenge students,
- provide suitable tools,
- be pedagogically suitable.

2.2. The interactivity effect in e-learning and multimedia learning

William Horton [6] suggested that learning activities are coordinated actions that exercise basic intellectual skills, thought processes, and analysis techniques. He also claims that interactivity boosts learning. People learn faster and develop more positive attitudes when learning is interactive. [6]

Different students have different needs, researchers shown that every student has his own sensual preference for exchanging ideas, and acquiring and passing on knowledge (Driscoll and Garcia (2000), Fleming (2001), Fleming and Mills (1998), Fuller, Norby, Pearce, and Strand (2000), and Murphy, Newman, Jolosky, and Swank (2002)). Students have a tendency to prefer one sensory input including visual, auditory, or kinesthetic (Sadowski and Stanney (1999)). Some research shows that most students prefer combination of multimedia elements. An effective multimedia learning system should focus on interactivity used in e-learning.

Interaction between people can be a sort of a dialogue and can means exchange of ideas. "Interactive" in computer programs is defined as choice points in the software, with pre-defined answers provided for pre-defined choices. Generally, interaction is described as two way communication between two entities, each acting on or influencing the other. [7]

Interactive media is the integration of digital media including combinations of electronic text, graphics, moving images and sound, into a structured computer based environment that allows people to interact with the data for appropriate purposes.

Wagner (1989) has suggested that interaction functions as an attribute of effective instruction, while interactivity functions as an attribute of contemporary instructional delivery systems. [5] Interactivity in e-learning is process where students actively engaged with other students, teachers and learning materials. Interactivity is the active involvement, participation, and engagement of the student in the learning process. In interactive distance education, flexible,
innovative, long distance curriculum allows students to adjust their studies to their own daily schedule. Interactivity is a variable that is likely to be critical to the success of distance education.

Manipulation and interaction are key aspects of effective learning resources:
- by interaction students construct their own understanding and use of the learning material;
- by embedding digital assets or information objects into an interactional framework, students give them educational purpose and value

2.2.1. Types of interaction

The fundamentals of interaction between humans and computers in a learning environment include two types of interactivity: student-initiated interactivity and computer-initiated interactivity.

Generally types of interactivity include indicative and simulative interactivity. Indicative interactivity refers to use of button rollovers and system navigation. Simulative interactivity enables students to learn from their own choices in a way that provides some form of feedback. Simulative interactivity requires the user’s involvement in realistic virtual environments (Nichols, 2003). [8] At the table 1 is presented examples of indicative and simulative systems.

Interactivity incorporated into many types of learning programs can be in the form of:
- clicking on appropriate responses to questions
- clicking to animate an object or start a process
- dragging and dropping items to practice a skill

There are three important principles that the e-learning system should support:
- student interaction
- interaction with each other
- interaction with the content
- interaction with the teacher

Types of interaction in e-learning:
- student to content
- student to teacher
- student to computer (system/user interface)
- student to student

The term interactivity is used to describe a variety of learning activities including interactions between students, interactions with the tutor and interactions with the teaching material itself (Moore, (1989), Schrum & Berge (1997)). [10][11] In student to content interaction the student interacts with the learning materials. The process of gains and constructs knowledge is conducted by working with the subject matter. Student to teacher involves teacher assist with direct communication between the student and the teacher. Process between student and computer include interaction by clicking and navigating from one page to the other. Student to student include collaborative environment where interaction depends on a dialogue between two participants.

<table>
<thead>
<tr>
<th>Indicative interactivity</th>
<th>Simulative interactivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>clicking a button to start an animation</td>
<td>selection between different web pages</td>
</tr>
<tr>
<td>clicking a button to start an video clip</td>
<td>ability to drive a virtual car in a realistic virtual environment</td>
</tr>
<tr>
<td>turn the page</td>
<td>answering a question</td>
</tr>
</tbody>
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Table 1: Examples of indicative and simulative interactivity in e-learning systems
Difference between simple interactivity and instructional interactivity refer to levels of interactivity. E-learning systems afford different levels of interactivity with the students. For example, turn the page can be simple interactivity while answering a question can be an instructional interactivity. So, instructional interactivity is an activity that makes the students interacts with the system and knowledge domain.

The presentation of interactivity depends very much on the learning and teaching style. Students have their preference for learning. The most common and widely-used categorizations of the various types of learning styles include visual, auditory and kinesthetic learners. Students also can be defined as pragmatist, reflectors, theorist, and activists but common for these different types of students is preference to interactivity learning content.

The active-learning hypothesis predicts that learning from interactive systems increases learning by engaging students more closely with the learning material. The passive-learning hypothesis predicts that learning from interactive systems has no special effect on learning since the learning content is no different from that contained in a non-interactive system. [3]

Stimulating multimedia presentations present information content highly interesting and engage the learner. [14] The teaching material presented in the form of a multimedia computer system, takes forms of student–content interactions. This interaction can be initiated by the student, and initiated by the computer system. The ability of the system to initiate interaction includes initiation, response, and feedback. Those actions involve an exchange of information between two agents and they are connected. When first agent inviting input from the second they take the action of initiation. Response means that the second agent provides the input from first. When the first agent passes back information as a consequence of the response they take action of feedback. The feedback is always connected to the response, as the response must be a direct consequence of the initiation. [9] In order to be completed, a multimedia lesson can be described as non-interactive if requires little or no computer-initiated interactivity and can be described as interactive if it uses computer-initiated interactivity as an essential part of the lesson.

For example, an e-learning system labeled as interactive should allows the student to navigate content, take an online test and provide a simulation where a student can actively explore a simulated system or process, etc.

2.3. Interactive intelligent tutoring system

The intelligent tutoring system (ITS) provides a flexible, independent, individual and personalized e-learning process for each student. Intelligent tutoring systems are a class of asynchronous e-learning systems designed to support and improve learning and teaching process in particular domain knowledge. ITSs should try to adapt to and understand the student’s way of thinking.

The integration of ITSs and web-based technologies could have numerous advantages, but most of the educational applications that have been delivered through the Internet are just electronic books with very limited interactivity. The e-learning environment should include interactivity effect in order to deliver individual feedback according to the student individual preferences.

2.3.1. ITS architecture

An ITS describes the knowledge and possible behaviors of experts, students and tutors. A typical architecture of an ITS includes following modules: the domain module, the student model (learner model), knowledge model, the pedagogical and interface module. ITS architectures should focus to planning intelligent collaboration between different components.
On each phase of the process: analysis, design, development, and implementation of the system ITS developers should focus on the integration of interactivity effect.

The student communicates and interacts with the interactive multimedia presentation. Interactive multimedia modules provide adequate feedback through the interaction with expert model, student model and pedagogical model.

3. SYSTEM ARCHITECTURE

The general architecture of the proposed intelligent e-learning system includes three main components: Student, Expert and Applications including all hardware and software systems. In order to bring efficient computer tutoring in e-learning environment the architecture of Great Pyramid require well differentiated modules. The main architecture of an ITS traditionally contains four interdependent components: the student model, the pedagogical module, domain knowledge and the communication model. The communication model includes user interface and interactive multimedia model. Figure 3 shows the main architecture of Great Pyramid.
The basic principle that Great Pyramid considers is that a computer-based learning system is interactive if it uses computer-initiated interactivity as an intrinsic part of the lesson. Great Pyramid achieves the flexibility and generality of a tutor in ways that adapt to individual student’s needs and abilities.

Knowledge-based expert system is interactive computer programs and typically consists of the basic components represented in Figure 4. Great Pyramid uses knowledge-based model because includes: (1) the domain knowledge with examples and explanations, (2) the principles used for teaching (3) student knowledge including all data referred to the student work.

Knowledge base includes expert knowledge and all relevant data of domain knowledge. Knowledge base of Great Pyramid is developed in form of question and answers. Heuristic includes rules and the Artificial Intelligence (AI) techniques. Heuristic in Great Pyramid includes rules of flash card models (rules similar to the Leitner system). Knowledge technology includes multimedia content and network technology. Great Pyramid use multimedia and hypermedia content in web based environment.

Pedagogic design involves opportunities for active and effective learning in most simple ways through flash card model, and also involves opportunities for the student interaction to be carried out in an on-line environment.

The student model consists all information about the individual learner. It provides the information such that what the student knows or does not know, and degree of student actual (and historical) knowledge.

The user interface of Great Pyramid is context-specific instructional layer between the student interface and the system and it is highly flexible.

Great Pyramid uses a traditional flash-card method to help students memorize question/answer pairs, but it uses a sophisticated algorithm to schedule the best time for a question to come up for review. Difficult items that students tend to forget quickly will be scheduled more often, while things those students remember well will be scheduled significantly less.

An advantage of this approach is detailed statistics that is kept on student’s learning process. This statistical data is storage in student model and it is important factor when system concludes what is next question to present student. The student at all times has information of his work and progress. Also, with the statistical data about student learning process teachers can check student knowledge. The statistical data include historical detailed statistics about student learning process.
With flash cards model the students can on easy and simple way learn facts or information. This model offers information in form of question or hints. Students learn by clicking on each of cards (then system presents the answer).

4. GREAT PYRAMID: A CASE STUDY

The flash card model, which proposes an e-learning system that includes interactivity, can serve to clarify existing findings as well as to structure future research. Great Pyramid presents the application of the flash card model that provides a web based e-learning framework based on interactivity effect.

Common concepts related to interactivity include specific features, such as learner control, feedback, and guidance. [12] Great Pyramid defines this concept in the following.
4.1. Great Pyramid learning control

In order to promote cognitive activities as well as student’s interest and motivation Great Pyramid attempt to include several form of learner control. (1) Control over learning rate (control over pacing) enables student to start, pause, replay and finish correspond to individual information delivery. (2) Control over content enables the student interacts with the learning materials. After students select preferred information units they have detailed statistic about their work. The process of constructs knowledge is conducted by working with the subject matter. Control over representation allows students to access information that is appropriate to their prior knowledge. All types of learner controls can help the students to adjust information to individual cognitive needs.

4.2. Great Pyramid guidance and feedback

Similar to learner control, guidance can take many different forms. Researchers frequently distinguish direct and non-direct support. [13] Direct support guides the student in a specific direction. Great Pyramid guides the students with intelligent system selection of next question. Non-direct support is presented by detailed statistic about students learning process, with which the students can plan they work.

Feedback is typically described as a guidance technique. Different types of feedback provide different kinds of instructional support. The feedback is always connected to the learning control and it is consequence of the student’s response. Great Pyramid provides feedback by detailed statistics.

Figure 7: Computer initiation in Great Pyramid
4.3 Great Pyramid three-stage model of computer-initiated interaction

Great Pyramid considered as interactive because uses computer-initiated interactivity as an essential part of the lesson. It includes student-initiated interactivity and computer-initiated interactivity.

Computer initiation is promoted when the computer presents a task or a series of options to the student. Great Pyramid present options to the student in the form of a question and button. After computer initiation student selects an action in response to the presented options which present student response. Computer feedback in Great Pyramid is promoted when the computer presents the learner a new screen containing an assessment of the learner’s response including detailed answer to the previous question.

5. CONCLUSION AND FUTURE WORK

We have combined a flash card model of interactivity with intelligent tutoring system in order to improve efficiency of e-learning system. Great Pyramid is based on the concept of interactivity by the proposed graphical interface with the active participation of students. Great Pyramid incorporated the dynamic process between the learning system and the learner.

As the essential elements needed for effective learning is feedback, Great Pyramid provides feedback that allows the comparison of the student’s actual performance with performance standards. It also uses the student learning history for feedback between students and system.

In the current generation of e-learning systems, interactivity is important part of whole concept. Future studies based on these assumptions could provide valuable results. We consider that the system presented here fit properly in the general framework of interactivity and intelligent tutoring system described in the first part of the article. Future works will be about the implementation of the other interactivity models used in e-learning which will represent our complete model of the Great Pyramid.

REFERENCES


