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Designing an Assessment Method for E-Learning Environment Using Real-Time Simulators

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Abstract: In this study, an assessment method is designed based on real-time simulators. These simulators will be able to facilitate education and play the role of virtual intelligent teacher referring to student capabilities by following the feedback mechanisms. This system, which is constructed by the means of network and expert system, is contained a real-time simulator core that has an inference engine based on a hypothesis testing.

Key words: Integrated e-learning environment, real time simulation, virtual intelligent teacher, rule-based expert system

INTRODUCTION

In recent years there has been an increasing interest for education through the network. It is developed by using information technology and distance learning techniques. In ideal situation, students should be educated globally and collaborate within teams that are geographically distributed. An educational supporting system that constructs a parallel structure besides an actual university and even beyond has been presented. To handle and improve such an educational system, architecture as a backbone to access goals in various educational activities, has been proposed.

Internet has significantly impacted the establishment of Internet-based education, or e-learning. Internet technology evolution and e-business has affected all industrial and commercial activity and accelerated e-learning industry growth. It has also fostered the collaboration of education and Internet technology by increasing the volume and speed of information transfer and simplifying knowledge management and exchange tasks. E-learning could become an alternative way to deliver on-the-job training for many companies, saving money, employee transportation time and other expenditures. An e-learning platform is an emerging tool for corporate training, with many companies developing their own e-learning courses for employee on the- job training. Employees can acquire competencies and problem solving abilities via Internet learning for benefits among business enterprises, employees and societies while at work.

Although, e-learning has been developing for several years, evaluating e-learning effectiveness is critical as to whether companies will adopt e-learning systems. A considerable number of studies have been conducted emphasizing the factors to be considered for effectiveness evaluation. Several evaluation models are considered with specific aspects. The criteria used for e-learning effectiveness evaluation are numerous and influence one another.

By the up growing demand for information and improvement of technology and capabilities of accessing virtual learning, there has been a great interest for learning through the net and establishing e-learning in virtual environment. The extensive use of technologies to render training and education more accessible is a new stage in the life of educational system, with the emergence of the so-called Virtual Educations.

Often concepts like virtual education, e-learning, virtual campus and online courses are confused; while in reality they are quite different concepts. The term virtual education should encompass the concept of an educational system as a whole unit which is referred to students and the teachers. Despite being a modern evolution meant to exist in a new era of distance learning, virtual education often need to provide some evidence for their functioning and training courses. In concept of virtual educations it is going to be focused on three terms; initial evaluation, training process and final valuation. For instance GRE exams are taken computer based since 1993, or Microsoft exams in recent years. It becomes an important issue to implement testing, training

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and evaluating systems on computer networks. Up to now there were different systems of virtual training such as, Markov models, finite state machines, rule-based expert system, decision trees; machine learning and Bayesian networks. These are the tools which could be used in implementing a virtual training system.

Design of complex educational systems, involves multiple disciplines and hence a diverse assembly of engineers and facilities that are not necessarily placed at the same geographical location. Furthermore, there has been a clear interest in the industry in harmonizing technological expertise amongst various societies, which further facilitates outsourcing resources. Consequently, the notion of global virtual design teams (Deghaidy and Noubya, 2008) as a disseminated collection of people and resources that are integrated through geographical, cultural and functional borders, should be applied. In response, the newly-revised engineering curricula have begun to recognize the need for the diversity of scope, expertise and even resources in the engineering education. A multifaceted curriculum aims at training engineers who can work at multinational corporations in teams composed of a wide range of expertise and technical. Therefore, the formation of interdisciplinary, inter-university engineering programs that has changed course from wishful thinking to serious planning, usually labeled as e-learning (Mahdizadeh *et al*., 2008).

An e-learning solution for designing pedagogy must therefore bridge the gap between the physical and virtual worlds with a comprehensive framework based on modular components, which provides students with remote access to software and hardware resources and establishes a Virtual Collaborative Community. Real time simulator is a useful tool for gathering all aspects of education together (Fig. 1).

In this study, present concept is to design a coefficient conceptual real time simulator expert system which can be used in the process of e-learning assessment and provide all requirements of education. For having a dynamic system that could be changed time by time, we use real-time simulator as a controller of the proposed system. Hypothesis test is able to increase the performance of the system.

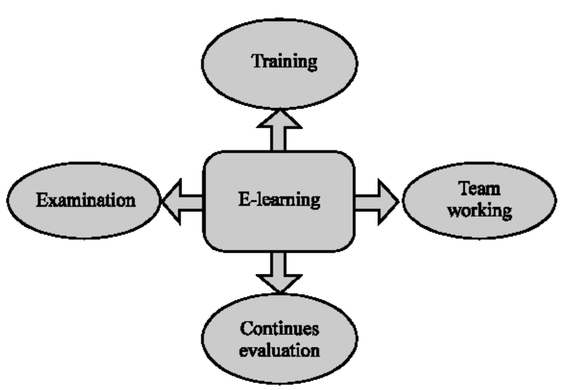

Fig. 1: E-leaning support all aspect of education

VIRTUAL LEARNING ENVIRONMENT

Virtual Learning Environments (VLEs) are computer-based environments that are relatively open systems, enabling interactions and encounters with other people and providing access to a wide range of resources (Mangina and Kilbride, 2008). VLEs can supplement face-to-face teaching methods, or totally replace these teaching methods in the case of distance learning. VLEs offer a number of advantages over traditional teaching environments in terms of convenience and flexibility (Wu *et al*., 2008). There are no geographical boundary limitations for using VLEs. They are capable of reaching potential learners in remote areas around the world at very low cost. For these reasons, VLE is becoming one of the fastest growing areas in educational technology research and development. Many traditional colleges and universities, individually or in various forms of partnerships, are embracing information technologies to create new learning models that enhance the effectiveness and reach of their programs (Liaw, 2008).

Researchers and developers are making rapid improvements in the design and implementation of VLEs, resulting in continuous progress toward successful VLEs. However, online learning is not always effective and sometimes fails to meet learning objectives because of the following limitations:

- **Unstructured learning materials:** Online learning materials are usually unstructured across different media, without any close associations with the e-learning processes. Learning material is distributed without consideration for learners' capacities and prior learning and therefore lacks contextual and adaptive support.
- **Insufficient flexibility:** In many current VLEs, the content materials and choices have been predefined, regardless of the learning process and learners' differences. Online learners have little flexibility to adapt the learning content and process to meet their individual needs.
- **Insufficient interactivity:** Studying online, by its nature, requires online learners to be more actively engaged and interact with their VLEs. However, some current VLEs are not very interactive. There is less

opportunity for receiving instant responses and feedback from the instructor or VLEs when online learners need support.

Nowadays there is a growing trend of web-based technology applied for distance education. Particularly Web-based Educational Systems have many advantages because they can adapt the course for each specific student. Different types of computer based educational system are proposed such as follows:

Type 1: Stand-alone learning, in which the direct linking with the virtual educational system without the presence of teacher or any collaboration is done.

Type 2: There is a remote teaching system in which everyone is conducted with the aid of individual connections between a teacher and multiple students that provides a method of teaching more students during a lecture.

Type 3: Indicates a group learning session where multiple connections between participants are arranged and thus a level of support for co-operative work is offered.

The advantages of the stated systems for the students is to experience and to access education and training courses that otherwise wouldn't have taken and besides to participate in a distributed learning environment which they feel is stronger than a traditional and also getting the opportunity to discuss their own professional situations with other learners and with their colleagues. From the teacher view point it is important to experience teaching in virtual university in order to gain specialized understanding and to offer the possibility of learning to those learners who would not find it possible to participate in a traditional face to face experience (Van Raaij and Schepers, 2008).

THE PROPOSED E-LEARNING MODEL

Currently e-learning is based on complex virtual collaborative environments where the learners can interact with other learners and with the tutors or the teacher. It is possible to give to the learner's different synchronous and asynchronous services. The former group includes virtual classrooms and individual sessions with the teacher or tutors. The latter group includes the classic didactic materials as well as Web-based seminars or simulations always online. These functions can be usually accessed by means of software platforms called Learning Management Systems (LMSs). Among the other functions, the LMS manages learners, keeping track of their progress and performance across all types of training activities. It also manages and allocates learning resources such as registration, classroom and instructor availability, monitors instructional material fulfillment and provides the online delivery of learning resources.

Typically, we have assumed two kinds of student, local student and remote student. The local students are instructor of our knowledge expert bases system. The integrated e-learning environment model is shown in Fig. 2.

For the ability and performance of real time simulators to create real models, the real time simulator that can control our virtual environment in the best way and make it update is used. Real time simulator should control the e-learning system during the execution of education. The elements of the e-learning application that make it unique to a specific learning application are as follows:

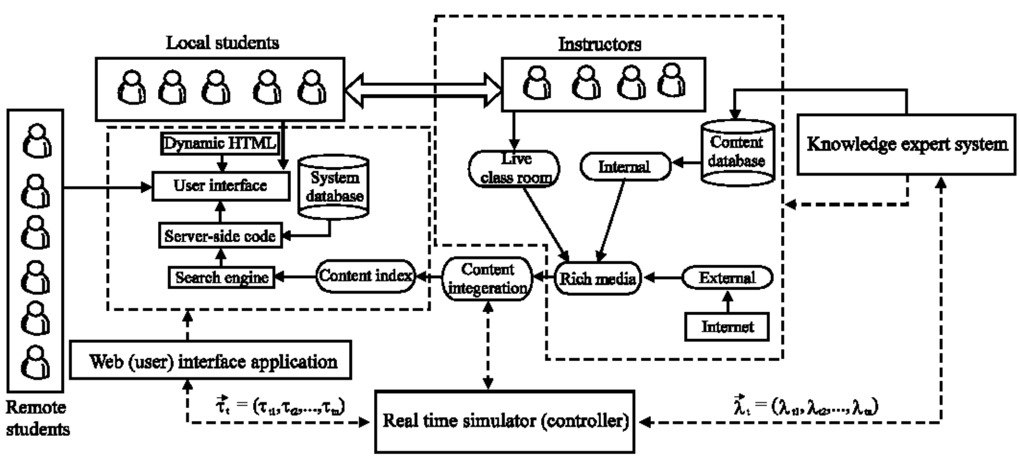

Fig. 2: Integrated e-learning real-time simulators

- User interface (or web interface)
- Knowledge expert system
- Real-time simulators (controller)

User interface: The training simulated environment aid a student to achieve the theoretical and practical aspects of education simultaneously. Frequently, when the students try to use the learning system remotely, they confront some module like simulation learning, hypermedia learning, training and etc.

Present render model should apply practical and theoretical courses. Thereby, the student should have suitable understanding from the concept of this system. The fundamental premise for training in simulated environments is: if the student can understand how a system operates from a theoretical point of view, he or she will better troubleshoot real life malfunctions or other unexpected behaviors in a more effective and efficient manner. By the simulation and appropriate graphics, a student learns the practical functioning of a system without risking a hazardous live environment, or inquiring the use of real equipment in an expensive training environment (Mangina and Kilbride, 2008).

In a typical environment, a student sees system schematics which can be represented by simple block diagrams and/or detailed computer graphic drawings and images. The student can select and display schematics of specific systems and subsystems along with a graphic display of diagnostic tools. The schematic displays draw values from the simulation and display the system status in response to student inputs and actions. Furthermore, they should pass the practical courses at their place via e-learning system because one of the important aspects of education is practical courses.

Knowledge expert system: Expert system is a kind of information system which could execute the system like real expert person. For modeling expert system considering to each condition that were happened in real world like that in real system, we should do special react in front of each problem. The expert system can do this for us like real person (Teachers, University and etc.). There are two kinds of expert systems: heuristic and model-based. The former which try to mimic the reasoning of human expert, are usually implemented by sets of rules. The paradigmatic rule-based expert system is MYCIN. In contrast, model-based expert systems (Tzouveli *et al*., 2008) are based on the explicit representation of cause-effect relations. Knowledge represented by knowledge expert systems which should be able to confront student training and their up growing problems. The knowledge expert system is the expert system that could decide and solve all problems of the students during their education under virtual environment (e-learning). For preparing knowledge expert system, information from students and teachers in real life should be gathered. Present proposed knowledge expert system model is shown in Fig. 3.

We use three parts (two Databases and one Inference engine) to configure present knowledge expert system which should be based on the student. Global data base consists of students and teachers information. Also, the grade of the students, their needs and their situations are gathered in the global database. After gathering the information from student and teacher by using inference engine we analyze and investigate the teacher's explanation situation, database information and knowledge base rules and facts. By this model a suitable expert system that could provide the whole requirements is prepared.

Real time simulators: There are a number of characteristics that make real-time simulators a powerful tool, considered as one of the most used techniques in modeling procedure. Firstly, its inherent ability to evaluate complex systems with a large number of variables and interactions for which there is no analytic solution. Secondly, real-time simulation can model the dynamic and stochastic aspects of systems, generating more precise

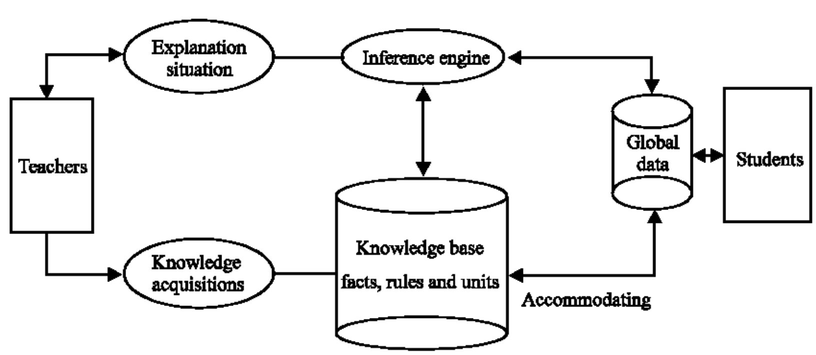

Fig. 3: Knowledge expert system

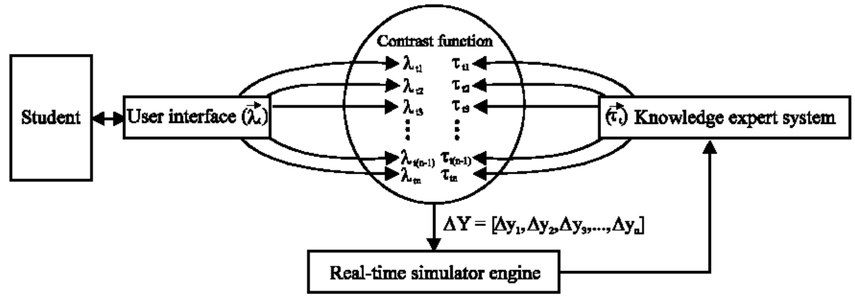

Fig. 4: The real-time simulator as controller

Table 1: The expert system (teachers) and student time vector specifications

Expert system	
Specifications	
Teachers	
Exercise level	(τ^l_{t1})
Project level	(τ^l_{t2})
Exam level	(τ^l_{t3})
Interesting course	(τ^l_{t4})
Student level	(τ^l_{t5})
Student	
Level exam	(λ_{t1})
Teaching content	(λ_{t2})
Teaching method	(λ_{t3})
Teaching schedule	(λ_{t4})
Degree of creating motivation	(λ_{t5})

results when compared with static and deterministic spreadsheet calculations. It is also considered as a tool to answer What if questions. In this case, real-time simulation could answer not only What if questions but also it answers How to questions, providing with the best set of input variables that optimized the performance of the system (Xua and Wang, 2008). According to Siddiqui *et al*. (2008), real-time simulators can be classified into 3 categories regarding to the optimization of quantitative variables: the first category tends to use the trial and error method, varying the input variables in order to find which set gives the best performance. The second category tends to systematically vary the input variables, to see their effects on the output variables. The third category will apply an automated simulation optimization approach. In this study the concentration is on the first category.

One of the important elements of e-learning system is the real time simulator, as their controller. The student condition might be changed within education periods. Present integrated system should support this concept. At the beginning of the education the student should select one module between educational modules which is constructed in knowledge expert system.

We identify two kinds of specifications, the student specifications and teacher specifications. It should be noted that these specifications might be changed time by time. The real time simulator is the tool that provides this application. The students and teachers specifications are shown in Table 1.Our variable depend on time; as a result we have got two time vector, for the teacher (expert system) $\vec{\tau}_t$ and students $\vec{\lambda}_t$.

$$\vec{\lambda}_t = (\lambda_{t1}, \lambda_{t2}, ..., \lambda_{tn}) \qquad \vec{\tau}^l_t = (\tau^l_{t1}, \tau^l_{t2}, ..., \tau^l_{tn})$$

The real-time simulator model is illustrated in Fig. 4. Our knowledge expert system has a default levels $1 \le l \le L$, for example three levels (L = 3), the low level, middle level and high level. The students start their studies at low level. After they are connected to the system during their studying period the real-time simulator check their performance time by time. If their performance improved the system automatically improve their level, else their level becomes lower.

Hypothesis testing: When the students start their work within this system, the level of our expert system is random. In each time, by the means of real time simulator, the student's level of studying is being checked by applying hypothesis testing.

H_0: The student level is lower than the level l
H_1: The student level is upper than the level l

Notation:

$\mu_{\vec{\tau}^l_t}$	:	The mean time (t) vector variable of expert system at level l
$\mu_{\vec{\lambda}_t}$	:	The mean student time (t) vector variable that should compare with level l
n_τ	:	No. of expert system variable
n_λ	:	No. of student variable
σ^l_τ	:	The deviation of expert system variable at level l
σ_λ	:	The deviation of student variable
Z_t	:	Z-statistics that compare the mean of expert system and student level time by time

$$\begin{cases} H_0 : \mu_{\vec{\tau}^l_t} \le \mu_{\vec{\lambda}_t} \\ H_1 : \mu_{\vec{\tau}^l_t} \succ \mu_{\vec{\lambda}_t} \end{cases} \qquad Z_t = \frac{\mu_{\vec{\tau}^l_t} - \mu_{\vec{\lambda}_t}}{\sqrt{\frac{\sigma_\tau}{n_\tau} + \frac{\sigma_\lambda}{n_\lambda}}}$$

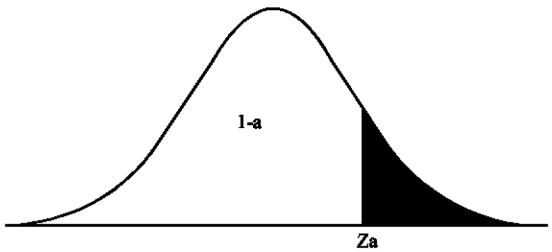

Fig. 5: Normal curve show acceptance area

The hypothesis test is done in α reliable area, If $Z_t<Z_\alpha$ then H0 is accepted and the student level change to the higher level, else the student level don't change. The acceptance area is represented in Fig. 5.

The real-time simulator tests the student expert level time by time and discovers the effect of change. As a result we have got special correlate between student and expert system.

CONCLUSIONS

In the recent years by growing demand for information and capabilities of accessing virtual learning, there has been a great interest for e-learning in virtual environment. We design a real time simulator that first render the course by an expert system and then evaluate student's educational performance. By such a system we are able to measure student level in comparison with the level of the courses which are offered time by time. For the future work we propose such a model in a case study to evaluate its performance in real life and a discussion will be done to replace the inputs with fuzzy inputs to assess the performance rather than the existing system.

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