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Computerized Learning Environments: Problems, Design Challenges and Future Promises

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Abstract

This paper examines and analyzes computerized learning environments (CLEs) in terms of their problems, design challenges, and their future promises. It highlights the fact that despite the need for improvement, the future of these environments seems bright. If the instructional designers of these environments are able to establish strong and solid scientific connection between learning theories, instructional theories, instructional design principles, and CLEs, the near future will witness great potentials to deliver and receive effective learning programs inside and outside of the classroom.

The Association for Educational Communications and Technology (1977) recognizes the importance of learning environments and considers them an important element in learning resources and instructional system components. These learning environments range from authentic and physical ones to virtual environments. Innovations in educational technology have led to various learning environments and the educational uses of computers are rapidly increasing. Schools and universities are placing more courses on computers to supplement and sometimes replace traditional classroom teaching. Recognizing the potential of computers, academicians are increasing their use of computers by putting more courses on the Web. They believe that technology can assist in learning, because it provides rich experiences to the learner. In order to put these rich experiences to work, instructional designers think of computerized learning environments wherein learners are given opportunities to explore and interact.

Computerized learning environments (CLEs) are systems that provide rich databases, tools, and resources to support learning and information seeking and retrieval, as well as individual decision making. They emphasize empowerment through meta-knowledge which individuals invoke and refine while attempting to make use of their learning tasks. CLEs have many other labels such as online learning environments which include using the Web to supplement face-to-face instruction, using the Web in a mixed mode with face-to-face instruction, or e-learning, using Web-based instruction instead of face-to-face instruction (Mishra, 2002). Other names are open learning environments (Hannafin, Land, & Oliver, 1999), computer-supported learning systems (Janicki, Schell, & Weinroth, 2002), constructivist learning environments (Wilson, 1995), virtual learning environments (Edelson, Pea, & Gomez, 1996) and the like. The common factor among them is the dissemination of coursework via the Internet by the use of computer as a medium to transfer the information.

This paper traces and discusses the historical development and recent trends of CLEs. It also examines the general problems, design challenges, and the future promises of computerized learning environments in the learning process.

Historical Development of Computerized Learning Environments

The history of learning environments has rich conceptual developments. John Dewey (1933) characterized schools as settings in which students received life apprenticeships. But schools, in most cases, failed to convey an effective apprenticeship because they lack suitable settings. The development of these settings started with the idea that teaching (teachers' presentation activities) is what goes on in classrooms during a certain period of time through the applications of principles of behaviorism. Laboratories and demonstration rooms were not enough to provide real or semi-real experiences for students because of the financial problems facing educational systems. When ideas about teaching changed to a package to be delivered to the learners at the same time but at different places (synchronous), then a new setting consisting of audiovisual aids was introduced. This new setting of audiovisual aids failed to meet the needs of the learners. Researchers like Clark (1994) questioned the ability of audiovisual aids to teach. Piaget (1952) pointed to the need for more interaction between the learner and his or her surrounding learning environments to build better understanding. Teachers sometimes fail to create an environment for such interaction. More recently, the concept of systems approach in which the emphasis is on the individual learner as a system interacting with instructional materials entered the horizon. The idea of interaction between the learner and instructional systems stems from cognitive learning theory, constructivism, and information processing models.

The development of CLEs was heavily affected by the advancement of computer technology and the development of learning theories such as information processing theory and constructivism, which call for a more open systems view of teaching and learning. The emergence of information systems such as the World Wide Web led to a new era in both information system management and organization, and in the way teaching and learning are conceptualized and delivered. The Web has expanded information systems to include online access to an unlimited number of documents and resources for learners at different places and different times (asynchronous). As a result, new learning environments that consist of the learner and the surrounding environment in which the learner acts, have come into existence. These new environments emphasize learning over teaching, calling for learner-centered systems instead of teacher-centered systems. These systems have been influenced by the movement of optimizing the use of teaching and learning resources to become more wide and inclusive (e.g., resource-based teaching and learning environments). This new vision of learning environments adopts new concepts such as interaction and cooperation between learners, facilitation, support, scaffolding, guidance, delivery systems, immediate feedback, electronic portfolio, and the use of a variety of tools and information resources to achieve goals and solve problems (Hannafin & Land, 1997; Papert, 1993). Thus, the quick evolution of computerized learning environments has led to a new generation of Web-based learning environments. Abdelraheem (in press) listed the potentials and characteristics of Web-based learning environments as follows:

- Relevant and well-designed challenging activities could be designed in Web-based learning environments.
- Adequate and timely feedback from instructors in rich environments for student-to-student interaction could be achieved.
- Enabling active engagement in construction of knowledge with an easy-to-use and powerful navigation system are provided.
- Deep learning could be encouraged through question design and links to thought-provoking sources.
- Student learning could be self-paced to suit the individual needs of each student.
- Student autonomy could be encouraged since the student is in charge of his or her own learning.
- Students are given the opportunity to study various other points of view via online resources, including Web sites that they can seek out for themselves.

Current Status of Computerized Learning Environments

Online learning environments have changed course delivery and the Internet has been used extensively in learning and instruction. However, educators still examine its effectiveness and usability in education (e.g., Siragusa, 2002). Siragusa (2002) suggests that there is an expansion of universities using online technological solutions and that led to changing the culture and practice of teaching and supervision, "with 'inevitable loss of quality of learning experience for students'" (Ryan, Scott, Freeman, & Patel, as cited in Siragusa, 2002, Background, ¶ 5). Although online learning environments may not be fulfilling all of its potentials, there have been some indicators of success (e.g., The World Bank-funded African Virtual University, British Open University, Ohio State University, University of Central Florida, University of Phoenix, Virginia Polytechnic Institute, and Michigan State University).

Current literature suggests that there is a discrepancy between the body of knowledge related to learning theories, instructional design principles and research into student learning, and the body of knowledge pertaining to online learning technologies. Siragusa (2002) indicated that students struggled to identify learning strategies that worked best for them in online learning environments while they were satisfied with feedback, interaction, and the content provided by these environments. Moreover, recent research involving online education has emphasized the learners' achievement and course evaluation (Kearsley, 2000; Russell, 1999). In addition, research shows that online learning promotes self-learning and develops an understanding of learning styles (Hoven, 1999). It combines the study materials with the exciting context. Online learning also fosters the concept of "open curriculum" (Candlin & Byrnes, 1994), in which students are encouraged to look beyond the structure and the content of the course and explore multiple channels of information. Several studies compared CLEs with methods of instruction (Almusawi & Abdelraheem, in press). Instead of comparing CLEs with other modes of instruction, it would be more beneficial for educators to go beyond the "no significant difference phenomena" (Russell, 1999) and study the major challenges such as improving quality, increasing access, and reducing costs for education.

Some General Problems of Computerized Learning Environments

Despite the obvious advantage of CLEs, there are certain problems that need to be resolved. Among these problems are the misuse of technology and the theoretical bases upon which the design of these CLEs is based. Concerning the theoretical bases, three schools of thought have been widely used: behaviorism, cognitive psychology, and constructivism (Villabla & Romiszowski, 2001). Among these theories, constructivism has been acknowledged to be the most suitable one for CLEs (Hung, 2001; Hung & Nichani, 2001). However, many of the current approaches to CLEs adopt the traditional instructional design models in which learning is viewed as an information delivery process coupled with practice of procedures. To be more effective, CLEs must address carefully the suitable support for the learner. The role of instructional support in CLEs is very important. But there is still a difficulty in determining exactly that support due to learners' diversity. In order to design powerful learning environments the following questions should be answered by the instructional designer: What are the critical characteristics of the learners that are needed for special learning tasks? What do the designers know about the learners' interpretations of instructional supports? And how can an environment be created to facilitate different learning domains? CLEs require certain tasks from learners such as organizing and controlling the learning process. These tasks are traditionally performed by teachers. Considerations for individual differences and abilities need to be taken into consideration in technology-based products and implementation efforts. Learning system designs which adopt a traditional instructional design paradigm do not offer suitable support in performing these new learning tasks. Applying a traditional instructional design paradigm in CLEs is just like implementing old solutions to new problems. This way makes CLE courses nothing more than a set of classroom lecture materials presented through the Web. They simply lack basic design considerations (e.g., analysis, synthesis, evaluation, and the underlying learning theory). New instructional design paradigms should offer guidelines for the design of learning environments that provide suitable combinations of challenge and guidance, of empowerment and support, as well as of self-direction and structure (Reigeluth, 1996).

The second problem related to technology is technology itself. Although this problem in CLEs is not so serious as the problem of theoretical bases of instructional design, it needs to be highlighted due to the rapid advancement of technology applications. To most educators, technology is the answer to unknown questions. Detailed evaluation of CLEs frequently reveals that courses tend to be electronic versions of the conventional print-based versions from which they have been derived (Dehoney & Reeves, 1998). This shows that technology has been misused and could be considered as an additional cost. Other problems of technology arise from a lack of training, from teachers' attitudes toward using technology, and from hardware issues.

How learners and lecturers have used CLE interaction to assist student learning has often been the subject of investigation in online environments (e.g., Graham & Scarborough, 1999; Jiang & Ting, 1998). Therefore, instead of replicating traditional methods by the use of technology, it should be used to solve well-defined problems such as improving learning processes based on a solid learning theory. CLE integration with the curriculum constitutes a serious problem, too. Practitioners need to consider the affordances of their specific environment including money, technology resources, and

technology support structures. Developers need to figure out how to work effectively with the broad spectrum of experts needed to design technology resources and implement them effectively into learning environments (Abdelraheem, in press). Those who support and use technology resources need to develop appropriate technology and teaching skills and enhance their perceptions of technology as a part of the teaching and learning environment, rather than being the driver of teaching and learning.

Design challenges of CLEs

The vast body of literature in the area of instructional theory has been largely overlooked by designers of CLEs. Although implementing CLEs is relatively easy, creating educationally effective and useful Web sites is still difficult (Pan, 1998). Designers of CLEs need to respond to the new learning theories and models of instructional design and incorporate them in their designing of meaningful CLEs. It is clear that CLEs do not provide the complete cost-effective solutions once hoped for by earlier advocates of the use of these environments for learning. It is well known that teaching an online course is very different from teaching a face-to-face one. If learners are expected to experience successful learning through the use of CLEs, the designers must consider the learners' needs and their interaction with those environments. Here, the interplay of different theories is necessary in the design of CLEs. The recent challenges for instructional designers are to design cost-effective and educationally effective systems for use in the new millennium. It is important that the environments should be grounded in the theory and practice that corresponds with the epistemological perspective adopted. Different assumptions about the nature of learning and the utility of knowledge require different enabling contexts, tools, and scaffolds. The environments should be designed to respond to the needs of the learner. They should facilitate rapid detection and selection or discovery and manipulation. Hannafin (2001) asserts that

> the designer needs to be aware not only of the framework adopted, but also needs a clear understanding of how different frameworks influence how a learning environment is created and implemented. By adhering to practices associated with grounded design, the designer can represent fairly the features and requirements associated with a given epistemological perspective. (p. 73)

Designing environments for learning is dependent on the descriptive knowledge base of learning and instruction. It usually consists of task analysis, problem solving, and testing by a team of experts in complex domains. One of the major challenges for the field of instructional design is to seriously recognize the importance of participatory and collaborative modes of designing (Hakkinen, 2002, p. 466).

A greater challenge consists of understanding, exploring and supporting new learning paradigms such as self-directed learning, learning on demand, informal learning, collaborative learning, and electronic learning. At the moment, the development of innovative content and learning scenarios are rare and are not well documented or systematized (Schroeder, 2002). This is why CLEs are required to be flexible in order to be applied in different learning contexts. As CLEs grow in their capabilities and affordances, the need to better support learners becomes increasingly critical. The promise of these environments has been widely recognized, but the potential has yet to be

realized. Hence, balance is needed between the efforts to refine the structure and features of CLEs and efforts to empower individuals in their use.

Future promises of CLEs

If the designers are able to meet the design challenges of CLEs, the future of these environments will be very bright and promising. Three areas will be deeply influenced: content, learners, and learning strategies and activities. First, the content which is usually in the form of objective-based course units supported by CLEs will be presented in so many ways through the capabilities of information technology and the Internet. Hyperlinks play an important role in connecting the components of the content through the instructional analysis of the goals done by the designer and subject matter experts. It is important to determine which content is relevant to the instructional goals, in what sequence its components should occur, and which Web links are relevant. In many studies, students have been asked to give their perceptions of the content's quality, comprehensiveness, relevance, and sequence (e.g., Pujola, 1998). Studies of CLEs show that students have been provided with satisfactory online support for the content they were studying (e.g., Siragusa, 2002). New developments in online learning technologies are focusing more on intelligent content management systems (e.g., WebCT and Blackboard) that are able to change the way the content is presented to individual students depending upon the learning style they demonstrate (Martinez, n.d.). Effective Web-based materials go far beyond simply transferring traditional materials to the Web, since a simple transfer cannot improve learning. Rather than replacing textbooks, these materials supplement them with activities such as actively manipulable interactive simulations, challenging tasks, and immediate feedback on performance. Good Web-based materials engage the full range of the human senses through multimedia technology (e.g., visual examples of concepts, short news clips, or foreign language conversations that can be reviewed as many times as the student desires) and almost always force students to make learning decisions. In other words, good CLEs encourage active learning of the content.

Second, the learners are kept at the center of the instruction and learning process. Their responses lead the process of learning. They actively interact with the instructional materials and their mates. Learning communities are formed and every person in that community is responsible for his/her learning. In CLEs, learners enjoy all types of online support (e.g., learners' guide, online mentor support, online library, social interaction, and chatting). Learners' motivation is highly considered in CLEs. There are a number of factors that contribute to making CLEs pleasing to use, such as the appearance of the site, the use of text and graphics, the amount of materials presented on each page, and so on. How students persevere with technical problems and how these problems are resolved also contribute to students' level of motivation (Everett, 1998). Online learning content management systems (e.g., WebCT and Blackboard) have facilities for learners and teachers to be able to send and receive assignments and feedback. How effectively these facilities are used will affect the quality of the help and feedback that learners receive.

Third, learning strategies and activities in CLEs are very flexible to meet the diversity of students' abilities and needs. The traditional approach of "one size fits all" will no longer work. In CLEs each learner selects the strategies that work with him or her

and chooses the activities that suit his or her preferences. The help menu assists the learner and provides him/her with the support s/he needs. Some learners need elaborate support and others need minimal support. So, the learner has to decide which path and support s/he likes from the help menu. Other potential promises of CLEs include the increase of interactivity during learning, the breakdown of social barriers in multicultural environments, just-in-time training, the facilitating of group collaborations, the refinement of assessment and evaluation procedures, the motivation and provision of hands-on experiences in virtual, realistic settings, and access to new sources of information.

The significance of CLEs is growing in all kinds of learning domains and electronic learning is generally seen as a chance for innovation in learning. It will be possible for learning to take place anywhere, and at the time needed. It can be individualized concerning time, place, duration, and learning style. Learning can be taken out of the classroom and formal educational institutions, and integrated into work and private life (Schroeder, 2002). The 2 (content between two covers) x 4 (four walls) x 6 (six periods per day) model of the currently dominant schooling systems is not suitable to the 21st century. Even if critical opinions exist and empirical verifications of success evidences are not enough, most educators still agree that CLEs have great roles to play in the process of learning and instruction.

Conclusion

This paper has examined and analyzed computerized learning environments in terms of their problems, design challenges, and their future promise. Despite the need for improvement, the future of these environments seems bright. If the designers of these environments are able to establish strong and solid scientific connection between learning theories, instructional theories, instructional design principles, and CLEs, the near future will witness great potential to deliver and receive effective learning programs inside and outside the classroom. The researcher suggests that instructional designers should go beyond this study and attempt to develop and test computerized learning environments based on the conceptual knowledge of the nature of learning, student learning, and technologies of CLEs.

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