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Research Article

Using Effective Models of Information and Communication Technology in Higher Education

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Abstract: This study is going to represent some effective models of information and communication technology in higher education. The growth of educational content in the Internet industry and the increasing use of the Internet in the educational system have been quite rapid in the last few years. In the information transfer model, knowledge is passed from the experts (tutors) to the learners (students) by means of lectures and text books. The hope of increasing the educational impact by using impressive tools Based on ICT has serious disadvantage of increased cost. In this study we argue that new Low-cost Educational models based on constructivism can be used in parallel with traditional Learning introducing a blended (or enhanced) learning approach. In such a blended environment, organizational, educational and technological issues need to be considered as a Whole. We introduce a light-weight blended educational model based on cooperation and experimentation.

Keywords: Higher education, ICT, internet in the educational, knowledge

INTRODUCTION

The growth of educational content in the Internet industry and the increasing use of the Internet in the educational system have been quite rapid in the last few years. Although the educational sector is not a business in the conventional sense, there has been tremendous interest in the role of the Internet and of electronic commerce as they relate to educational spending (Stefani *et al*., 2006). This interest has taken two forms, the supply of education online through for-profit Internet start-ups and the demand for Internet technology and access on the part of non-profit public schools. Knowledge is a critical concept in social research. The knowledge gap literature, for example, argues that people with higher socio-economic status may acquire political and scientific knowledge at a faster rate than people with lower socio-economic status (Tichenor *et al*., 1970). The underlying assumption of this research is that knowledge is directly and positively associated with various participatory activities, which has been supported by numerous studies (DelliCarpini and Keeter, 1996). The role of knowledge in the process of Internet acceptance, however, has not yet received enough attention. Internet knowledge has been defined as a set of individual characteristics or qualities that develop over time and that generalize from one set of tasks or uses involving the Internet to another (Potosky, 2007). It is what people know about the Internet, both Internet terminology and Internet skills. As a central concept of social learning theory, knowledge has a great potential to supplement technology acceptance model. Based on the theory of reasoned action, the technology acceptance model posits that technology adoption decisions are predicated on the individual's affective reaction or attitude toward using an innovation (Ajzen and Fishbein, 1980). The technology acceptance model is valuable for mapping technology adoption issues, but because of its generality and parsimony, it may need to be supplemented with other theories and models and to include other variables such as human and social change processes (Lippert and Forman, 2005). Bandura's (1977) social learning theory is one of the theories researchers believe can advance the literature of technology acceptance (Legris *et al*., 2003). Nevertheless, past efforts focused on two other constructs: experience (Stoel and Lee, 2003) and self-efficacy. But not on knowledge, while integrating social learning theory and the technology acceptance model. In fact, there has been confusion between knowledge, experience and self-efficacy, both conceptually and operationally (Bozionelos, 2004). Little has been done to establish Internet knowledge as a reliable and valid construct and to examine its potential effects on Internet acceptance. As the learning environment goes digital, virtual and Internet-based, good use of the Internet is a critical factor that determines students' academic

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success in the school (Cheung and Huang, 2005). Despite the advances in ICT (information and communication technologies), productivity in terms of pedagogy and actual learning gains are not as significant as expected (Groccia and Miller, 2005). Current teaching and learning practices are based on the information transfer paradigm information is passed from the teacher to the student. Although technology offers impressive possibilities for e-learning other factors, such as the underlying pedagogy, educational models flexibility and cost effectiveness are often overlooked. The plethora of advanced tools supporting e-learning and the difficulties in their adoption in real situations has only demonstrated that the primary need is a paradigm shift the current information–transfer educational model (Romano *et al*., 2005). Many researchers have proposed that this shift should focus on knowledge construction that will enhance, not replace, the traditional information transfer paradigm (Rodrguez *et al*., 2007). Human peers are supported by using different kinds of collaboration technologies and especially, enhanced presence. Human learning is a social process, through sharing and executing tasks. It is a major enabler of the knowledge construction paradigm: active collaboration among learners in order for them to reach a common goal. In this context, learning is not an isolated activity.

We consider a blended educational paradigm: traditional learning methods are supported by e-services. E-services are designed with the sole purpose of maximizing the impact of traditional methods and covering their drawbacks or flaws. A major requirement is both methods should complement each other in the best possible way in administrative, educational and technological terms. This kind of mixed learning (traditional and web-based) is not a new concept: major investments in similar learning environments in universities and other higher education institutions across the world have been made in recent years (Bonk and Graham, 2006). Most of these efforts involve small scale, single institute adoption of web based tools which have drawn some useful conclusions. Cross-institution or nation-wide efforts were small in number but significant in impact (Jackson, 2004). According to the above mentioned issues, the researchers represented some effective models in using information and communication technology in higher education.

EDUCATIONAL MODELS, COSTS AND TECHNOLOGY

In order to achieve optimal exploitation of the possibilities provided by modern web engineering approaches, theories of learning, technology and management should be incorporated into planning of a blended learning environment (Demb *et al*., 2004). We envisage a service (we call it e-Course) that incorporates experimentation (through VSEs) and collaboration (through virtual classroom services). Virtual classroom services (collaborative and social learning) should include functionalities, such as virtual classroom space, private student space, forums, messages, search facilities (Campeau and Higgins, 1995). Access to educational related material should not be restricted to class members; students from other classes may access resources, if they have the appropriate access rights (knowledge reuse). Since many virtual classes are formed, a virtual pool of information for each course should be constructed. Some information should be restricted and other should be widely available (knowledge sharing). Access to the e-Course services should be made available through a common access point (e.g., a portal). When logged in, the student accesses his/her private integrated and highly personalized space (personalized learning) including:

Private Shared Space (PSS): Private work space where learners store learning and other material, search engine, news, forums

VSE service: Participate in an experiment, access experiment history (intermediate results, supporting Los)

Collaborate: Use online collaboration tools

The e-Course should be operational throughout the duration of the actual course that is for VSEs to be used both for collaborative and social learning. VSEs should be modular, comprised of many parts which in turn serve specific learning goals. A student must complete all parts of a VSE (Louca *et al*., 2004).

During the second step, students perform a simulation using the loaded data. Simulation parameters are configurable. The simulation step may include several more steps, depending on the specific experiment. The first step may include live data acquisition from a remote sensor thus requiring management of remote equipment. Online assessment tests should be performed by students between steps. These steps may include multiple choice questions and judgment questions. In the latter case, argumentation can be used to back up student answers including data facts or any kind of evidence. They are used in order to help students assess their own strategies. Feedback should be provided at the end of each test round (Warschauer, 2003).

During a VSE learners may communicate with each other using online tools which are provided by e-Course services or external tools. Students may reorganize parts of their repository, create links or construct learning objects (Los) (self-direct learning). These activities are recorded by special services. An important function is to save a VSE status at any time.

Table 1: Collaborative VSE functions and their characteristics

Function	Description	Educational value	Cost
Collaboration			
Forum	Post/read messages	Medium	Low
Email	Send/read messages	Medium	Low
Chat	Chat with other learner	High	Low
Video conference	Video conference with other learner	High	High
Share	Resources (files, results, knowledge)	High	High
Virtual scientific experiment			
Load data	Load initial data for simulation (may involve access of remote instruments)	Low (Medium)	Low (medium)
Simulate	Run a VSE	High	High
Save	Save current state	High	High
Configure	Configure VSE parameters	Medium	Medium
Train	Train for using the VSEś GUI	Medium	Low
Feedback/Assessment			
Playback	Playback a VSE	High	High
Test	Take online test	High	Low
Ask tutor	Query the tutor	Medium	Low
General			
Access LO		Medium	Low
Search	Search the internet for learning resources	High	Medium
Help	Access the help function	Medium	Low
Annotate	Attach comments to content to context	High	High

Since a VSE is a complex procedure, learners should also have the opportunity to be trained in a test VSE. This collaborative learning phase helps students to understand the online experimentation concepts and introduces them to concept of collaboration and to the VSE environment. A technologically tedious but educationally valuable option is recording and playback. Playback should be available to learners participating in the experiment and to the tutor. Table 1 summarizes the previously-mentioned functions (Stoel and Lee, 2003).

DEEPER LOOK AT EXPERIENTIAL-LEARNING ASPECTS EXPERIMENTATION

Experimentation by way of simulations has been proposed as an effective means for a richer learning experience (Sage, 2000). Such interactive sessions attract the interest of the user and greatly increase the efficiency of the learning process but, in many cases, they are difficult to support or expand. Nevertheless, their educational value cannot be overlooked. In the words of Albert Einstein, “in natural sciences courses, the first lessons should contain nothing but what is experimental and interesting to see. A pretty experiment is in itself often more valuable than twenty formulae extracted from our minds.” This statement underlines the importance of experimentation in many scientific fields. Computer supported experiential learning means use of visual content in order to enhance the learning experience of students and supplement the methods that are already in use (such as text books, online content, synchronous and asynchronous collaboration) (Schwier, 2004).

Experiential learning through cooperation or collaboration is valuable educationally but difficult to realize technologically. Imagine an interactive simulation environment where several students use the same virtual instrument for performing the same experiment. Several problems that would not appear in a real life experiment arise, for example: what happens if one user turns on a button and another turns it off at the same time? The software that supports such an environment should be carefully designed in order to cope with such situations and at the same time retain an adequate level of flexibility and realism (Drossos *et al*., 2006).

There are many pedagogical and technological factors that affect simulation use. Pedagogical factors include complexity (e.g., simple, medium, hard), educational context (e.g., predetermined based on learner’s choices or online tests), motivation (how well learners are motivated to use the simulation) and duration (number of sessions required to complete the simulation = reach the educational objectives). The most important factor is how well the simulation is linked to the educational objectives. A weak link will probably reduce significantly the value of the simulation even if its user interface and its collaboration and cooperation capabilities are impressive. Clear feedback is often not considered in many applications although it allows learning to become tangible. Technology can also be misleading (Garrison and Kanuka, 2004). Advanced technological options create over-enthusiasm leading to too complex approaches that are not appropriate for the given educational objectives. Complexity is the main reason for end-user confusion, frustration and disappointment (Xenos *et al*., 2002). Simulations are not always the most effective means for learning. They may be used as stand-alone e-learning modules or as capstone experienced to classroom lecture, but they excel only in specific contexts (Hung and Nichani, 2001). Technological factors mainly include the significant difficulty and the accompanying costs to design, develop and support simulations. Depending on the type of simulation (games, virtual laboratory, remote laboratory), its mode (cooperative, collaborative, single user) and adaptive to the learner, costs vary. End user system requirements are sometimes important. Finally, organizational factors should be considered when introducing simulations for an enhanced learning experience: cost-effectiveness, cost for introducing simulations and support.

VIRTUAL SCIENTIFIC EXPERIMENTS

Simulation and online collaborative experimentation is a difficult educational and technological endeavor. Development, support and expansion costs are also important when applying these methods in real world cases. Standard web technology, if properly used, can provide a cost-effective means for enhanced learning even in higher education environments (Etheris and Tan, 2004). Fine paradigms of blended learning are VSEs with incorporated collaboration and cooperation functions. Experimentation takes place using simulations while collaboration and cooperation takes place both between learners and between learner and tutor. The tutor actually becomes a mentor rather than the holder of knowledge. This means that the tutor should be able to employ and encourage social negotiation. Although educational goals for each module that comprises a course are predetermined, the underlying learning model should partially support negotiation rather than imposition of goals and objectives (Hong *et al*., 2001).

Social interaction during VSEs is effectively supported through virtual structures such as Virtual Classrooms (VCs). The concept of virtual classrooms is difficult to accomplish especially in traditional universities: they are difficult to be formed, maintained and supported. They also require a significant part of the educational process be focused on the interaction with the instructor and tutor. As mentioned previously, traditional higher education institutes do not have the organization structure to directly support full e-learning solutions. Thus, a consensus should be reached in this case, for example services should not require the online presence of a tutor but rather provide automatic support where possible. Online support by tutors should be provided in rare occasions and only when the institution has anticipated such a role (Harris *et al*., 2003). Furthermore, a lighter version of virtual classrooms (i.e., personalized workspace) should be used for online collaboration and sharing of knowledge. In any case, the administrative and educational burden for the tutors should be as light as possible. Another difficulty in using VSEs is students are used to classrooms and they need to adjust their learning and teaching styles, respectively. For example, in one class, two students who work at different subjects can both share resources and reuse each other's knowledge electronically, a feature not easily supported by traditional learning methods (Jackson, 2004). In the case where the educational institute decides to support a full VSE option a different method should be used. In our vision, at such a collaboration an e-Course is formed, supported both, by VSEs and VC services. VSEs (experiential learning) should be multi-step experiments closely linked to educational goals and supported by LOs (learning objects). During an experiment conducted by two or more students collaborating together, participants should be able to communicate using synchronous services (Pace, 2003).

CONCLUSION

As more powerful, flexible and affordable technologies become embedded in society, the balance of expectation in higher education shifts to towards their deployment across a range of activities. Advances in the use of ICT in sciences teaching have been reflected in many higher education institutions, albeit with varying degrees of success. The growing importance of ICT in teaching and learning has been fostered by national government investments and a variety of cross-institution support initiatives; however, research indicates that its potential has yet to be fully realized since economic and pedagogical parameters affecting the final technological solutions have not been fully considered. Web based technology is the technology of choice for e-learning due to its cost-effectiveness, its simplicity and its flexibility. New blended or enhanced models use traditional teaching methods combined with static or dynamic tools based on simple web technologies. Furthermore, new technologies have facilitated collaboration and experimentation enabling the cost-effective introduction of these models in traditional higher education institutions. The ultimate aim of our study was to explore how we can fully integrate tutoring techniques in a computer-mediated collaborative environment. In other words, to use the integration of personal workspace and low-cost offline collaboration tools as a first step toward developing a fully integrated, low cost environment.

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