World Scientific Research Journal (WSRJ) ISSN: 2472-3703
www.wsr-j.org

Theoretical and Technological Background of e-Education

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Abstract: This paper proposes an integrated approach for information technology in an educational context. The paper suggests a framework for the design of computer assisted learning activities e-ducation. The framework captures three contemporary interrelated_aspects of teaching and learning and is more pedagogical than it is analytical. The three aspects covered in the e-ducation framework are electronic, engaged and empowered. An implementation of the framework is used to illustrate how e-ducation can be applied in educational research and practice. The paper concludes that the e-ducation framework contributes to both educational research and educational practice.
Keywords: theoretical background, technological background, e-Education

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1. INTRODUCTION

The modern educational system was developed to teach the skills necessary and the facts applicable to survive in the industrial society; facts that would be true and skills that would be useful throughout life. The factory was the model of choice; all students learned the same way and should learn the same things; all should be at the same place at the same time; and facts were transmitted to the students and later measured through instruments like written exams. But things have changed: '*Schools today are structured more for the industrial age…problem is, those factory jobs don't exist anymore*' (Soloway, 1993).

While the most important objective of schools and education used to be the teaching of facts and skills, today there is an intention among many educators to put as much emphasis on the actual process of acquiring the knowledge as on the knowledge itself. Education needs to help students develop conceptual tools to become self-directed learners capable of learning new things and adapt to an increasingly dynamic, and also complex, work situation. Education has changed from teaching to learning with a change of roles and responsibilities in the learning process.

Additionally, there is another element which is changing education — computers. Computers or rather information technology (IT) have become a routine component of many aspects of education. But for the computer to bring about a real and substantial change, its

introduction must be accompanied by improvements in the understanding of learning and teaching.

Today the culture of the educational system is challenged. IT has the power of being both a catalyst and a main vehicle for implementing changes and may help to bring about some important reforms (Barker & Dickson, 1996). But still, IT is used just as any other educational technology for fact or information transfer. If conventional models from the classroom with teacher-centered activities focusing transmitting information to passive learners continue to be re-implemented, only marginal improvement in the quality of teaching, if any improvement at all, can be expected. Just providing universities with an infrastructure, i.e. computers and networks, will not have the desired effect. This push action may actually result in a continuation of technology rejection. Teachers will begin the process of pull when they know for what, why and how technology should be used.

The area of educational technology and pedagogy is full of jargon, confusion and lack of structure. Various models and frameworks have been proposed to give some structure to the field (e.g. Ramsden, 1992; Laurillard, 1993; Leidner & Jarvenpaa, 1993; Harasim *et al*., 1995; Leidner & Jarvenpaa, 1995; Duffy & Cunningham, 1996). These, and many others, provide guidelines for how IT can be introduced and used to improve the teaching and learning processes in higher education. Clearly, in the absence of fundamental changes to the teaching and learning process, IT will do little but speed up ineffective processes and methods of teaching. Whereas the models and frameworks discussed above come from a learning perspective, the e-ducation framework has its roots in informatics.

The methodological and practical guidelines in this paper originate from informatics, which is the '*design oriented study of IT use with the intention to contribute to the development of both the use and the technology itself*' (Dahlbom, 1996). The central interest of informatics is to intervene and contribute to the process of change rather than just to observe and describe it.

The remainder of the paper is divided in the following sections. In the first section the paper gives a review of the theoretical background. The following section is a brief review of technological background applied in the research. In the last section the e-ducation framework in practice is discussed, and the paper ends with some conclusions.

2. THEORETICAL BACKGROUND

Everyone who teaches has some theory of learning. A learning theory is a systematic and integrated understanding of the process whereby people relate to their environment in such way as to enhance their abilities to employ both themselves and their environment effectively (Bigge & Shermis, 1999). Educators may, or may not, be able to describe their theories in explicit terms, but their practice is always exemplifying a theory of learning. The ways in which the educator designs and conducts learning activities reveals how the educator understands the process of learning (Kaplan & Kies, 1995).

Duffy & Cunningham (1996) propose that grounding assumptions are: *'the fundamental assumptions underlying the conception of the teaching-learning process'*. The e-ducation framework embeds five such assumptions:

1) understanding learning as the individual construction of knowledge, i.e. constructivism;

2) insight on how both individual learning and collective learning can be supported by the group, i.e. collaborative learning;

3) problem-based learning as a model for designing educational activities;

4) experiential learning to initiate learning activities.

3. CONSTRUCTIVISTIC LEARNING

A great deal of education builds on an objectivist model, e.g. the lecture method (Leidner & Jarvenpaa, 1995), or the transfer model (Lave, 1988). The objectivist approach is criticized for stimulating surface learning (O'Neil, 1995), knowledge reproduction and being a knowledge telling strategy (Schank, 1997), instead of knowledge building (Scardamalia & Bereiter, 1993). A knowledge building strategy sees the learner as an active participant, interacting with the environment. In this view, learning is *'the active struggling by the learner with issues'* (Duffy & Cunningham, 1996). The constructivist model stresses the crucial relationship between new experience and what is already known, since people can only understand what they construct themselves (Leidner & Jarvenpaa, 1995). Learning develops through encounters with new information that is different enough to be stimulating, but not so alien that it cannot be assimilated into learners' mental structures that constitute their present state of understanding (Watson, 1996).

Constructivism covers a wide diversity of perspectives, which have the following in common: *'learning is an active process of constructing rather than acquiring knowledge and instruction is a process of supporting that construction rather than communicating knowledge.'*(Duffy & Cunningham, 1996)

Writings on constructivistic learning have altered in their perspective over the last 20 years to include more than the mental activity of individuals in learning (Watson, 1996). Social interaction among the learners is added to the constructivist model and it becomes collaborative (Slavin, 1990).

4. COLLABORATIVE LEARNING

Collaborative learning consists of peer interaction, peer evaluation and peer cooperation, with some structuring and monitoring by the teacher. The basic premise is that learning emerges through the shared understanding of multiple learners (Leidner & Jarvenpaa, 1993). The essence of collaborative learning is that active participation is critical in the learning process and that learners have knowledge valuable to other learners. Learning is sharing and the more that is shared, the more is learned. It is assumed that students are likely to learn as much from each other as from course material or from the tutor. It is even claimed that the most powerful

and sustainable learning process occurs among peers who pull each other rather than being pushed by experts. This way, collaborative learning is a creative process of articulating ideas, *'having them criticized or expanded, and getting the chance to reshape them or abandon them. all in the light of peer-discussion'* (Rowntree,1995).

Collaborative learning can be understood in terms of distributed cognition, which is about sharing information and building knowledge. It implies collaboration as people are interacting and learning together using technology (Roschelle & Teasley, 1995), but also collectiveness, when people are successful in building a shared representation and, to some extent, a shared cognitive system (Dillenbourg *et al*., 1996). Distributed cognition extends beyond an individual's mental activity to include everything in that individual's environment; it comprises the individual, peers and tools. Hence, it is the interaction among these that ensure individual as well as collective knowledge building.

5. PROBLEM-BASED LEARNING

Problems that are real, that might arise in the learner's life or that are known to the learner, have enormous potential for learning (Guzdial *et al.*, 1996). Problem-based learning is not just another way of teaching since it builds on a fundamentally different understanding of learning than conventional teaching. Problem-based learning represents a significant challenge to orthodox beliefs about learning (Margretson, 1991). Boud & Feletti (1991) describe problem-based learning as:

'... a way of constructing and teaching courses using problems as the stimulus and focus for student activity. It is not simply the addition of problem-solving activities to otherwise discipline centered curricula, but a way of conceiving of the curriculum which is centered around key problems in professional practice'. (p. 14)

The problem-based learning process can be more or less structured or open for the students (Harden & Davis, 1998). Two end points of a continuum can be distinguished (Ellis *et al*., 1998). First, in a guided problem-based learning approach, the students face a problem (usually one that is defined by the teacher) to solve as a group. While this drives the students' needs for knowledge construction, both the nature of the student (e.g. less experienced in self-directed learning) and the nature of the subject require guidance and some sequencing of the learning events (i.e. the acquisition of knowledge).

Second, full problem-based learning, where the nature of the problem guides and drives the whole learning experience. There are no formal expositions of knowledge from the expert, and the students develop resources based on requirements they determine. While some resources for both the support of the process and the subject content may be predefined and developed, the students also develop appropriate resources to assist in their learning. In fact, the students themselves become a resource in the collaborative process.

Often problem-based learning (PBL) attempts have failed because what the educator has chosen as a problem has actually not been a problem in a psychological sense, since a learning

problem in a PBL context must create psychological tension in the learner (Bigge & Shermis, 1999). Ownership of the problem is essential. If the students do not own the problem, they will spend their time finding out what the teacher wants and wait for extrinsic cues from the teacher.

6. EXPERIENTIAL LEARNING

In classroom learning, the emphasis is on the assimilation of information and the steps involved are: receiving knowledge, assimilating and organizing information to ensure the understanding of the principles, inferring a particular application from the general principle, and lastly applying the knowledge. In contrast the steps involved with experiential learning are: concrete experience, observation and reflection, formulation of abstract concepts and generalizations and lastly the testing of the implications of the concepts in new situations (Kolb, 1984).

Various terms have been used to label the process of learning from experience. Learning by doing was introduced by Dewey and used by for instance Graf & Kellogg (1990). Others have discussed this in terms of experience-based learning, trial and error and applied experiential learning (Gentry, 1990), reflection in action (Senge, 1995), and action learning (Marsick & O'Neil, 1999). Pedler (1997) defines action learning as: *'an approach to the development of people in organisations that takes the task as the vehicle for learning. It is based on the premise that there is no learning without action and no sober and deliberate action without learning'.* Action learning activities help people to learn from risk taking and errors (Marsick & O'Neil, 1999).

Experiential learning is meant to be a relatively safe laboratory for learning in which concrete experiences are subjected to individual and group reflections (referred to as process evaluation), as well as attempts to generalize in order to be able to experiment with new behavior. But, experience alone does not automatically lead to learning. An experience must be accompanied by reflection on the experience. Reflection is a conceptual tool for understanding the ambiguous and inexhaustible. Rosenorn & Busk Kofoed (1998) distinguish three forms of reflection, or reflection periods. First reflection-in-action, which is similar to Senge's notion (1995), second, reflection-on-action, which takes place after the learning activity, and third, reflection-for-action, where participants in an learning activity reflect on which types of problems they hope to solve more successfully in the future than in the past.

7. TECHNOLOGICAL BACKGROUND

Information technology is a powerful tool (Pea, 1993), which can *'facilitate the development of knowledge building communities'* (Scardamalia & Bereiter, 1993; Scardamalia & Bereiter, 1994). The importance of understanding the underlying pedagogical assumptions when designing IT for education is emphasized by Laurillard (1993); Leidner & Jarvenpaa (1993) and Leidner & Jarvenpaa (1995).

The use of IT in an educational setting will reflect, either intentionally or inadvertently, a theory of learning as discussed above. Much of the use has suffered from a lack of a sound

educational perspective. Hawkins (1993) is among those who stress that computer technology has been brought into the education system in the wrong way. It has been integrated with conventional teaching, which, as discussed above, emphasizes active transmission and passive absorption of factual information. Traditional teaching may not be viable for the contemporary technological environment and new teaching approaches will be needed to exploit recent technological advances (Leidner & Jarvenpaa, 1993).

The earliest attempts to use instructional technology date back to the first quarter of this century when the first teaching machine was introduced. Individualized education became possible with self-instructing and self-assessing computer programs. This detailed and systematic potential has seemed irresistibly attractive to over 30 years of computer experts who have worked in the area of computer-based instruction (CBI) or computer-based training (CBT). Of course there are applications and areas where CBI and CBT is very useful. Examples are computer literacy and instructions for learner drivers.

Communication technologies such as electronic mail, bulletin board services, computer conference systems, world-wide web, etc. have a profound effect on education as they create environments suitable for learning. The asynchronous learning network (ALN) is commonly used as a notion to integrate these technologies with an explicit pedagogical idea (Hiltz, 1994; Bourne *et al.*,1997). The asynchronous learning network is supporting ‘anytime, anyplace’ learning (Wegerif, 1998).

In an ALN, learners form a community engaged in collaborative learning at the time and place of the individual learner's convenience (Bourne *et al*., 1997). By slowing down interaction, learners are given time for reflection. Ideas, questions, comments, etc. can grow and mature before being shared with other learners. Online course material is provided as well as areas for submission of individual and group assignments. Learning processes and the role of educators and learners in ALNs are radically different from conventional classrooms (Harasim *et al*. 1995). A discussion of participation vs. presence highlights some strengths of ALNs over conventional classrooms. To be present is simply to passively attend group sessions, and to participate is to actively contribute to group sessions. Attendance does not imply active participation and this is where conventional classrooms are weak. In a conventional classroom, learners can attend and seemingly participate. In an ALN, those who just attend are considered lurkers and they are invisible.

8. CONCLUSION

In this paper it is suggested that there is a need for a more integrated approach when using IT in an educational context. The e-ducation framework was suggested as a model to understand and design educational activities, and as a way to conduct research in education.

New educational activities supported by information technology are replacing the older. E-ducation is one example where research becomes practice and the other way round. Still, the

design and use of information technology in educational activities must be pedagogically well grounded. Information technology in itself will not solve the perceived problems in education.

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