The design of interactive media for learners in an organisational setting – the state of the art

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1 ABSTRACT

This paper points to the problem of incorporating theoretical learning concepts into the design of interactive learning media. It reviews some theoretical accounts for the nature of learning, how the learning process may be facilitated by instructional design, and some approaches to the design of software incorporating ideas from instructional and user centred design. Finally, it points to some future directions in research of IT-supported learning.

Keywords

Interactive media, IT-supported learning, e-learning, constructivist theory, instructional design, learner-centred-design

1. INTRODUCTION

"E-learning" is one of the latest hype-concepts in our so-called new economy. Mostly this concept refers to the use of web-technology for learning purposes. For instance, many companies have started to make use of intranets as a distribution channel for learning material. Apparent advantages in using web-based learning instead of traditional teacher lead learning are recognised: employees may take a course at a time and place of their own convenience; they may do it in their own pace and costs may be reduced for teachers and travel. "E-learning" is often launched as leading to more effective learning than learning lacking the "e"-component, i.e. traditional learning. As usual, however, when a new business trend comes along there is a need to sift the wheat from the chaff. Here, research plays an important role. Does the "e-learning" trend contain any substance and is it based on serious considerations of the nature of human learning processes?

Some researchers view the trust in new technology to fill all educational needs as hysterical (e.g. Ausserhofer, 1999). Technology itself will never be a saviour. Without knowledge about pedagogical and psychological conditions for real learning to occur, technology will not generate the learning effects organisations anticipate. This is where extensive research is needed. What characterises favourable conditions for learning to occur and what kind of learning is needed? Learning in general is usually not the major interest of organisations – people learn all the time. Organisations generally expect their employees to learn specific things as effectively and efficiently as possible. Thus, applicable research must focus on issues dealing with how to manage the learning process in such a way that people increase their knowledge in areas being of relevance for the organisation.

The purpose of the present paper is to point to some areas where valuable research is carried out and to suggest areas where more research is needed. There is a need for research to focus on bridging the gaps between design of interactive media for learning on the one hand and theories of learning and pedagogical models on the other hand. In the paper we will review some theoretical accounts for the nature of learning, how the learning process may be facilitated by instructional design, and some approaches to the design of software incorporating ideas from instructional and user centred design.

1.1. A conceptual framework for the research area

Interactive media for learning is a research area, which might benefit from being conceptualised as the intersecting field of learning concepts, information technology and user interfaces (Chiou, 1993). In this conceptualisation learning concepts serve as the root for interactive learning media. These learning concepts should guide the development of interactive learning media. Otherwise we run the risk of facing a development of interactive media for learning which is dominated by technology.

Another approach for regarding research in interactive learning media, which may be more fruitful, is to outline

knowledge areas, which have a potential of furnishing the development of learning media with valuable input. Of course, models of learning play a crucial role, but also the field of design has a lot to contribute. Last, but not least, the principles of user centred development must be considered and emphasised.

2. GOALS IN DESIGNING THE LEARNING SITUATION

All instruction and tuition is based on the assumption that human knowledge is subject to change. When we acquire new knowledge, we either accommodate existing knowledge structures to fit with this knowledge or adapt it to fit with existing knowledge (Piaget et al., 1995). In each case our knowledge changes. The purpose of instruction and tuition is to make this change in knowledge happen, to make people learn. In considering the design of tuition and instruction we assume that *the way* in which knowledge is communicated influences the quality of the learning process. Thus, a basic assumption underlying the design process of any type of tuition and instruction is that human learning may be manipulated by factors of the design.

Learning implies a change of knowledge in an increasing and growing direction. This points to a specific characteristic of the user of interactive learning media, namely her limited or non-existing knowledge of the domain to be learnt. The learner may be regarded as a domain novice who needs to grow in her domain expertise (Quintana et al., 1999).

Empirical research indicates that there is a correlation between learning style and the effect of learning. Learners may have different, mostly unconscious styles for learning. Marton et al. (1986) have distinguished two styles they call atomistic and holistic styles of learning. The atomistic style focuses on facts and details. The different parts constituting the learning material are delimited, ordered and grouped. Holistic learning, however, focuses on understanding. The learner organises the contents of the material to be learnt into a complex whole and integrates it with the text. This type of learning style generates comprehension and, thus, a more effective learning. If it would be possible to design interactive media to promote a holistic learning style, it would probably also be possible to promote more effective learning.

3. HOW DO PEOPLE LEARN?

In this section we will briefly review some of the currently most cogent models of learning. These models are frequently referred to in discussions on fundamental ideas, forming a base for design directions of interactive learning media.

3.1 Constructivist theory

Traditional education has been guided by the paradigm of "didactic instruction", where learning is viewed as an information transmission process. According to this view teachers have the information, students don't, and teachers' lectures serve to move information into the minds of students. Thus, didactic instruction views the learner as passively receiving information. During the last decade, however, this view has been criticised. The role of active engagement in learning is being advocated. It is argued that by *constructing* understanding and meaning, the learner interprets and acts upon the material being learnt and thereby produces a better understanding of the material (Lave et al., 1993). Design implications for this includes inviting the learner to actively engage in her own learning. Invitations for learners to critically analyse learning materials may constitute examples triggering such activities.

3.2 Sociocultural theory

In addition to effective learning involving active and constructing processes of the learner, it involves learning in a contextual setting. This idea rests on the foundations of the work of Vygotsky, a Russian psychologist who was interested in applying Marxist social theory to individual psychology. His approach to cognitive development is sociocultural; working on the assumption that action is mediated and cannot be separated from the milieu in which it is carried out. His sociocultural theory of learning emphasises that human intelligence originates in our culture. Individual cognitive gain occurs first in interaction with other people and in the next phase within the individual:

> *Every function in the child's cultural development appears twice: first, on the social level, and later on the individual level; first, between people (interpsychological), and then inside the child (intrapsychological). This applies equally to voluntary attention, to logical memory, and to the formulation of concepts. All the higher functions originate as actual relations between human individuals* (Vygotsky, 1978:57 in Lock, 1989)

Vygotsky's theory emphasises that the range of potential each person has for learning when the learning is shaped by the social environment in which it takes place is greater than the actual ability of the individual when the learning is facilitated merely by someone with greater expertise (Wertsch, 1991). This range is referred to as "the zone of proximal development" and is central to Vygotsky's ideas. It is in the zone of proximal development, through social interaction that we learn how to use the psychological tools available to us.

As the constructivism model of learning stresses active engagement for effective learning to take place, the sociocultural model stresses the importance of interpersonal communication. The two models are not, however, mutually exclusive. They merely focus upon different aspects of the learning process. These two aspects probably represent two main streams of theoretical ideas in the field. There are other central directions comprising ingredients of constructivism as well as socioculturism. In the paradigm of situated cognition, the central notion of learning is enculturation, the process by which learners become collaborative meaning-makers among a group defined by common practices, language, use of tools, values and beliefs (Brown et al., 1989). These theories are based on the same underlying assumptions that individuals are active

agents and that they are purposefully seeking and constructing knowledge within a meaningful context.

4. HOW MAY THE EFFECTS OF LEARNING BE ENHANCED?

The models of learning briefly reviewed in the above section maintain a view of the learner as an active constructor of her own knowledge as well as a social being, operating in a cultural context to develop her knowledge. We have also argued that the purpose of education is to influence the development of knowledge in some desired direction.

The learning process serves as a bridge between old and new knowledge. The more effective this process, the greater the chances are of obtaining the kind of knowledge desired. The challenge of influencing the learning process should actually be one of the core issues in the design of any type of instruction, computer based as well as non-computer based.

The learning process is a process involving a variety of cognitive activities, each of which might be manipulated to generate a more effective learning process. Some processes decisive for learning to occur are memory processes, problem-solving processes and meta-cognitive processes. The kind of processes dominating the learning, depend upon internal factors of the learner and contextual factors including the presentation and design of the learning material. The learner's experience and learning style are examples of internal factors. A facilitating type of experience for learning may be experience and knowledge of cognitive techniques for memorising and comprehending complex material. Applying techniques such as mind-maps (Buzan, 1989) and mnemonics involves meta-cognitive processes.

5. INSTRUCTIONAL DESIGN

An important task in the design of instructional material ought to be to facilitate for the learner to apply appropriate cognitive techniques. The way in which course material is designed may induce the learner to apply strategies to increase her own learning. This type of learning is sometimes referred to as self management (e.g. Danoff et al., 1993). Self management is based upon the idea that learning is facilitated by metacognitive processes, that is, the learner's knowledge about her own learning. Well designed course material utilises techniques encouraging metacognitive process.

Scaffolding and cognitive apprenticeship are examples of such techniques. Scaffolding refers to providing support to learners while they engage in activities that are normally out of their reach. It involves guidance in the forms of hints, questions, and materials that lead learners through a process of solving problems. When used in traditional teaching, scaffolding implies that teachers must set up the environment to help students identify what they need to do rather than tell them, which steps to perform in an algorithmic manner. Students must learn ways to solve problems and overcome obstacles (Dunlap and Grabinger, 1996). Similar to scaffolds used in construction work scaffolds in education are meant to serve as a strong support in the beginning of the construction work/learning process and eventually fade away as the building/knowledge becomes steady enough to stand by itself. The scaffold is only temporary and is there to support the development of a certain type of knowledge or skill and finally the learner is supposed to manage on her own.

Cognitive apprenticeship is a term for the instructional process that teachers provide and support students with supports as the students develop cognitive strategies. Wilson and Cole (1994, referred to by Hsiao) describe the core characteristics of cognitive apprenticeships model: heuristic content, situated learning, modelling, coaching, articulation, reflection, exploration, and order in increasing complexity. Cognitive apprenticeship is an instructional technique, which embodies ideas from situated cognition. It permits peers to learn through their interactions, to build stories about common experiences, and to share the knowledge building experiences with the group.

5.1 Directions in design of interactive learning media

Design of interactive media for learning is a multidimensional issue. The endeavour includes questions dealing with presentation of material, with learners' interaction with software applications, and with the communication between learners and tutor (e.g. Doherty, 1998). In addition, it's important to consider how the design process should be carried out in order to produce high quality designs. In order to assure usability, care should be taken early in the design process to focus on users and follow a user-centred approach, paying particular attention to the user as a learner (Soloway et al., 1996).

Doherty (1998) criticises interactive learning media, especially web-based media, because they reflect a very passive view on the learning process. According to him, teachers present an increasing amount of traditional learning material on the Internet with little consideration of the Internet's many unique features. These features, if properly identified and utilised, can make learning on the Internet an active experience. Some of the active learning potential of the Internet has already been discovered, making use of computer conferences and e-mail discussions. However, Doherty argues, it is ironic that a dynamic technology such as the Internet is being used to publish information in a static way - the style of the vast majority of Web publications is no different in principle from the pages of a newspaper or magazine.

5.2 Learner centred design

A fruitful approach to bridging the gap between theoretical models of learning and the design of interactive media for learning may be the learner-centred design (LCD) approach (Soloway et al., 1996; Quintana et al., 1999). The central claim of LCD is that interactive media may embody learning supports, e g in terms of scaffolding, which can address the learner's growth, motivation, and diversity. Quintana et al. (1999) describes these three dimensions as follows:

- *Growth*. Learners need to grow in their domain expertise. Interactive learning tools should present the work domain in a manner that meets the learners' current level of expertise and supports them in transitioning to more sophisticated, more complex activities.
- *Motivation*. Learners do not necessarily have the intrinsic motivation that experts have. Domain complexity can pose obstacles to learners, resulting in frustration and loss of interest. Interactive tools should support learners in completing complex work activities to keep them focused on their work.
- *Diversity*. Users of a particular type of interactive learning tool usually form quite a heterogeneous group. Differences between learners may consist in differences concerning learning level, experience, culture, learning styles, etc. The design of interactive learning tools should take these differences into careful consideration.

5.3 Designing scaffolds

In their endeavour to approach the design of interactive learning tools in a learner-centred manner, the research team around Elliot Soloway have focused on designing supports which address the dimensions of growth and motivation. Their research has adopted the pedagogical technique of *scaffolding* referred to earlier (Soloway et al., 1996; Quintana et al., 1999).

The Soloway team has brought the idea of scaffolding into the design of interactive learning media in the development of the tools Theorybuilder (Jackson et al., 1998) and Symphony (Quintana et al., 1999). Both are directed towards supporting the science inquiry process. Theorybuilder supports learners in building and testing dynamic models of complex systems. Being a scaffold it adapts to the needs of users, giving a lot of support early in the learning process and gradually fading as the users get more and more proficient.

5.4 Computer supported collaborative learning

Another interesting direction in the design of interactive media for learning is the approach referred to as computer supported collaborative learning (CSCL). Computer supported collaborative learning (CSCL) has grown out of wider research into computer supported collaborative work (CSCW) and collaborative learning. CSCW is defined as a computer-based network system that supports group work in a common task and provides a shared interface for groups to work with (Ellis et al. 1991). The purpose of CSCL seems to be to support students in learning together effectively. CSCL systems are typically tailored for use by multiple learners, working at the same workstation or across networked machines. These systems can support communicating ideas and information, accessing information and documents, and providing feedback on problem-solving activities.

Clear-cut definitions of the field of CSCL are hard to find. The concept of collaborative learning, though, is sometimes defined as groups working together for a common purpose (e.g. Resta, 1995). However, some would argue that "collaborative" is often not a descriptive term for what learners do in instructional settings (Koschmann, 1996).

Researchers in the area of CSCL often speak a lot about the theory underlying their work. This might be an indication of the state of the field. In an established paradigm in which the theories and methods are well agreed upon, such discussion is less central. CSCL, however, has not yet reached the stage of "normal" science.

CSCL aims at providing both an authentic environment and multiperspectives that can tie in students' prior knowledge. Computer supported systems are cognitive tools that can team individuals with the technology to form a joint intelligence which shares the labour during the group process. An explicit goal of the CSCL environment is to facilitate deep understanding. A general characteristic of CSCL applications is to promote reflection and inquiry that assist the in-depth learning. There is some empirical evidence demonstrating that CSCL leads to more effective learning than individual learning (Shute and Psotka, 1996). Students who have taken computer-based tutorials in a group have learnt more effectively and have enjoyed the instruction more than students having taken the course individually (Hannfin et al., 1996).

6. CONCLUSIONS AND FUTURE DIRECTIONS

Apparently, there is plenty of research on learning relevant for the design of interactive learning media. This paper has only touched on the surface of the literature describing theoretical models of learning. Nevertheless, there seems to be a gap between this field of research and its application in the design of interactive media for learners. Dillon (1998), who also observes this paradox, reflects that despite advances in telematics generally, there is still a separation between theories of learning and instructional design. Willis (1995) observes that most of the literature on constructivist/cognitive approaches to learning technology focuses on instructional theory rather than instructional design. Boucher et al (1997), in their survey of the learning technology literature, found some evidence that research and development in instructional design, teaching and learning take place "on the back of" instructional media, which is the primary focus of a large proportion of publications. Dillon (1998) explains that this partly may be due to the historical influence of the film and video industries that have established styles, rules and protocols for using visual images.

Clearly then, research is needed to decrease the gap between theoretical models of learning and their application in the design of learning media. A fruitful way of pursuing this type of research might be to follow the track of the learner-centred approach (e.g. Soloway et al., 1996). This approach involves experimentation with actual design solutions as well as attempts to integrate techniques promoting effective learning strategies.

Another important direction for research to follow is to refine the issues involving CSCL designs. How may the

attributes of the CSCL systems be exploited in designing a particular subject domain? The best computer-supported tools should not simply offer the same content in a new format; rather they should provide new ways of thinking in those domains. What are the important design considerations for developing CSCL applications? For instance, how do we replace the role of the teacher/tutor in order?

Finally, future research needs to focus more on emotional and affective aspects of learning. For instance, the importance of motivation for the ability to learn is well documented. But with a few exceptions, this feature of learning is rarely addressed in the literature. How do we design for motivation, engagement and immersion?

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