Using situated learning in the design of interactive multimedia-based learning environments.

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Abstract

The design of learning materials using interactive multimedia (IMM) provides scope for many different forms of instructional settings. Much of the learning potential of IMM materials is derived from the interactivity that is supported and the resulting levels of cognitive engagement of the learners. There are, however, many instructional design strategies that can be used for developing IMM materials, some of which are clearly less effective than others in providing the forms of learning environment required for effective teaching and learning.

This paper describes a project currently underway in Western Australia which is investigating the utility and efficacy of using situated cognition as a design model for IMM materials. Situated cognition is based on the notion of providing authentic contexts and activities as the basis of the learning process and appears to be well suited to IMM design and development. Our project has used situated cognition in the development of a CD-ROM for use in a teacher-education program. The paper describes the principles of situated cognition and their application in the development of this product, together with a discussion of findings from a preliminary implementation and trial of the software.

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Introduction

Interactive multimedia is rapidly growing in prominence and popularity as an instructional medium. Much of the popularity for this medium is derived from its capacity to replace conventional face-to-face teaching in a convenient and cost-effective fashion. It is an appealing medium to work with from the perspectives of both the instructional developer and the learner. Its popularity, however, is often derived from advantages and attributes that are not necessarily associated with learning quality. Frequently the technology is used as an alternative for face-to-face teaching where users and developers are content when the applications are able to return similar learning outcomes to those achieved by conventional means. To many the value of the medium comes from the administrative and functional conveniences it affords. But multimedia has the potential to do far more than this. The purpose of this paper is to discuss aspects of multimedia design that can bring about this learning advantage through the use of situated learning in the design and development process.

Situated Learning

Situated cognition, or situated learning as it is sometimes known, was first expounded by Brown, Collins and Duguid in 1989 in a treatise that drew heavily on the work of the such researchers as Vygotsky, Leontev, Dewey and Lave. At this time, many academics were espousing the merits of instructional settings that bridged the gap between formal learning and the places where the learning was to be applied. These ideas of cognitive apprenticeships and authentic instruction were based on the successes which were evident in learning settings where there was little distinction between the learning and the actual implementation of the learned skills and knowledge. Collins (1988) defines situated learning as: ‘the notion of learning knowledge and skills in contexts

that reflect the way the knowledge will be useful in real life' (p. 2). The model arose out of observation of successful learning situations by the researchers. They set out to find examples of learning in any context or culture that were effective, and to analyse the key features of such models. An analysis of common features found in all the successful models was a set of six critical factors: apprenticeship, collaboration, reflection, coaching, multiple practice and articulation (McLellan, 1991).

In proposing their model of situated cognition, Brown et al. (1989) argued that, contrary to many existing teaching practices which abstract knowledge from context, meaningful learning will only take place if it is embedded in the social and physical context within which it will be used.

Many of the researchers and teachers exploring the model of situated learning have accepted that the computer has provided a valid alternative to real-life settings, and that such technology can be used without sacrificing the authentic context that is such a critical element of the model (McLellan,1994).

Critical Characteristics of Situated Learning for Instructional Design

There have been many attempts by researchers and writers to describe the general aspects of this evolving learning theory. Most have agreed on key points of the theory and have contributed components based on their own interpretations and personal philosophies. Our synthesis of the existing situated learning literature has revealed a number of consistent characteristics. We have found that a useful way to study the theory of situated learning has been to describe the salient features of a learning environment based on these principles. Our interpretations reveal that for a learning environment to be considered situated, it needs to display the following features in some form:

- an authentic context for learning that reflects the way in which the knowledge and skills will be used,
- learning derived from authentic activities,
- provide access to expert performances and the modelling of processes,
- provide multiple roles and perspectives,
- support collaborative construction of knowledge,
- provide coaching and scaffolding as instructional supports,
- promote reflection to enable the construction of meaningful abstractions,
- promote articulation to enable tacit knowledge to be made explicit,
- provide for integrated assessment of learning with learning tasks. (Herrington & Oliver, 1995).

Learning is a process that is influenced by, and results from, the interaction of three areas of influence: *agent*, *activity*, and *world* (Lave & Wenger, 1991). Other writers, for example, Brofenbrenner (1979) provides similar descriptions for these influences such as *person, process* and *context* approach (as cited in Ceci & Ruiz, 1993). In terms of the instructional design for interactive multimedia programs, we have found a framework of three mutually constitutive elements: *the learner, the implementation* and *the interactive multimedia program* to be useful in describing the roles and responsibilities within the learning process. The three elements correspond to the role of the teacher, learner and the materials themselves, in the instructional setting. When this framework is applied to the design of interactive multimedia materials using situated learning, each of the critical characteristics fits comfortably into one of the 3 domains *(*Figure 1).

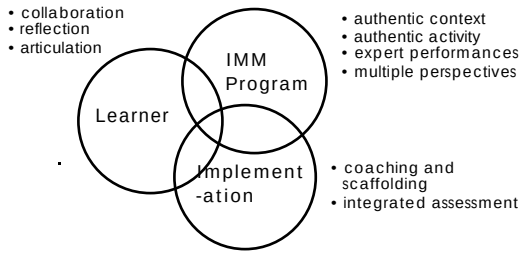

Fig 1. Constitutive Elements of situated learning in interactive multimedia design

Investigating Assessment In Mathematics

An example of a multimedia program which has been designed to accommodate the critical characteristics of a situated learning environment is one developed for mathematics education students at Edith Cowan University (Herrington, Sparrow, Herrington, & Oliver, in preparation). The approach adopted is similar in part to those developed by Mousley and Sullivan (1995), Ball (1994), and by Cunningham and Brown (1994). All these projects use multimedia to enable students to access teacher actions in classrooms videotaped over various periods of time, and encompassing a broad range of pedagogical issues.

Using the issue of assessment in mathematics education, the interactive multimedia program has been developed to provide preservice primary and secondary mathematics teachers with a number of classroom-based episodes presenting alternative forms of assessment. Users are able to pursue their own investigations of the resource, and examine each example from a variety of authentic perspectives: the classroom interaction, the teacher's decision-making processes, the child's thinking, expert opinion and written documentation. About 25 short video sequences of 1-2 minutes of the assessment example is presented as the foundation piece. This is supplemented with a video of the teacher's reflections on the use of the assessment type, and a video of a student's thoughts on the task (if appropriate). An audio recording of an expert comment is also available, as well as scanned examples of any activities or samples of students' work used in the video.

The role of the learner in using the package has been carefully considered. The resource is used by students in small groups. They are encouraged to design their own investigations, after a sample modelling exercise by the teacher, and to articulate their thoughts and findings both within the group and to the larger class. The implementation aspects of the resource are largely accomplished by the teacher rather than the program itself. Groups explore the resource over several weeks, in collaboration with other students and their teacher, who provides the necessary coaching and scaffolding. Students report their enquiry and findings in presentations to the larger group as part of the unit assessment.

Fig 2. Investigating Assessment in Mathematics

This project has set out to develop an approach to teacher education which deliberately makes use of the social and physical context of teaching (Brown, et al., 1989). It uses real-life contexts and tasks, and reveals authentic practice in a variety of classrooms, but at the same time clearly considers both the learning and implementation aspects of interactive multimedia. The situated learning model applied in the design of this multimedia program has also been applied to the design of a simi-

lar program aimed at helping students to learn alternative teaching strategies for mathematics teaching.

Evaluation

At this stage in its development, an initial implementation of the program has been conducted with a class of 12 preservice primary teachers studying mathematics education method. Students were asked to work in small collaborative groups of 2-3 students. The activity given to the students required them to assume the identities of new teachers in a school given responsibility to prepare a report to staff on assessment strategies.

An evaluation was conducted during this implementation to investigate student learning and the impact on this of the critical components of the situated learning design model on which the software was based. The entire class was observed using the resource. In addition, two students were videotaped and were interviewed after the class. The students were interviewed about the elements of situated learning which had been incorporated into the design of the materials, and whether they felt these elements contributed to their learning. They were also questioned about design aspects of the interactive multimedia program itself, such as the interface design.

Students responded positively to the interface. The students appeared to conceptualise the layout of the various resources and their contents very quickly. One student mentioned that you always knew where to find things. Generally, students had very little trouble acquainting themselves with the navigational systems provided by the program, and they readily accomplished the means to investigate the resources. Students also liked the nonlinear layout of the program. The freedom to access material in the order of their own choosing was commented on by a number of students. Search strategies employed by students varied considerably between groups. Students could choose to approach the search systematically, or use an unstructured path through the program. Students who approached the task systematically generally opted to investigate the resource by strategy (the assessment strategies written on the whiteboard in the interface) or by media element (the video clips or the documents in the filing cabinet).

The predominant feature of the context of the assessment program was that students valued the real-life relevance of the material they were using. They frequently pointed out the contrast between the authentic context presented in the program and the decontextualised approach frequently employed in their courses. Other comments relating to the context were that students could relate to the episodes and saw them as being very lifelike. One student related the feeling that she could go beyond the computer representation of the program into the classroom itself.

The authentic activity was designed to incorporate all the uncertainty and unpredictability of an authentic task and to allow students to apply sustained thinking on a single topic over a lengthy period of time. The program also presented a variety of perspectives on each assessment strategy, from the teacher's, student's, pre-service teacher's and expert's point of view. Students were very positive about the variety of sources of information presented on the same strategy.

Students perceived many clear advantages in working collaboratively. One recurring advantage, was the benefits of articulating their knowledge to their part-

ners. Reflection is a very personal aspect of learning, and as such, no program can force students to reflect as they use it. However, in order to provide a learning environment which would promote reflection, the assessment program was designed to enable multiple entry point, non-linear navigation, and access to the electronic notebook. Students using the program frequently mentioned the electronic notebook as aiding reflection.

Students articulated their understanding of assessment strategies in two ways: the formal report to the staff meeting, and in their discussion with their partner as they used the program. Students using the assessment package were very much aware of the value of formally articulating their learning in presentation of reports to their classmates.

Coaching and scaffolding is generally seen by the students as an important aspect of the learning process. The role can be undertaken by both teacher and student partners in collaborative learning situations. An important concern of students was that it was essential that assistance be available at the time of need, and that failure to attend to these immediate needs would result in time being wasted.

Conclusions

From this preliminary research, the theoretical framework of situated learning used to design the assessment program appeared to be very successful as a model of instructional design for this type of software. Further, more comprehensive, systemic research on the use of the program is planned to be conducted in the near future.

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