

# Avenues to Understanding: A Qualitative Study into How Students Learn From Multimedia

Jan Herrington

Edith Cowan University, Pearson St, Churchlands, 6018, Western Australia.  
email: j.herrington @cowan.edu.au

Ron Oliver

Edith Cowan University, Bradford St, Mt Lawley, 6050, Western Australia.  
email: r.oliver @cowan.edu.au

## Abstract

Many interactive multimedia programs direct learners down a one-way street. This paper describes a program based on a situated learning model which sought to open up the 'avenues to understanding'. Nine critical characteristics were defined from the extensive literature on the situated learning and used to inform the instructional design of a program on assessment strategies in mathematics. The paper describes a preliminary evaluation of the situated learning framework by investigating the use of the multimedia program by two students, and their thoughts opinions and feelings about learning from this type of program. Early findings indicate that it is a successful approach enabling students to construct their knowledge about the topic in an effective, non-linear, and collaborative manner.

## Introduction

There has been much use of the travel metaphor in the educational technology community in recent times. There is talk of the superhighway, the fast lane, traffic congestion, and express delivery. And yet much of the interactive multimedia available today is more akin to a single, one-way street than a superhighway. In the one-way lane, there are few options once you begin. There are no feeder roads, no exits, no turns, no signposts, no choices. The student using such a program is a captive audience who must proceed from beginning to end, responding in a manner deemed appropriate by the designers, interacting with the program in foreseen ways, and exiting at the end without contributing to the lonely, sober journey.

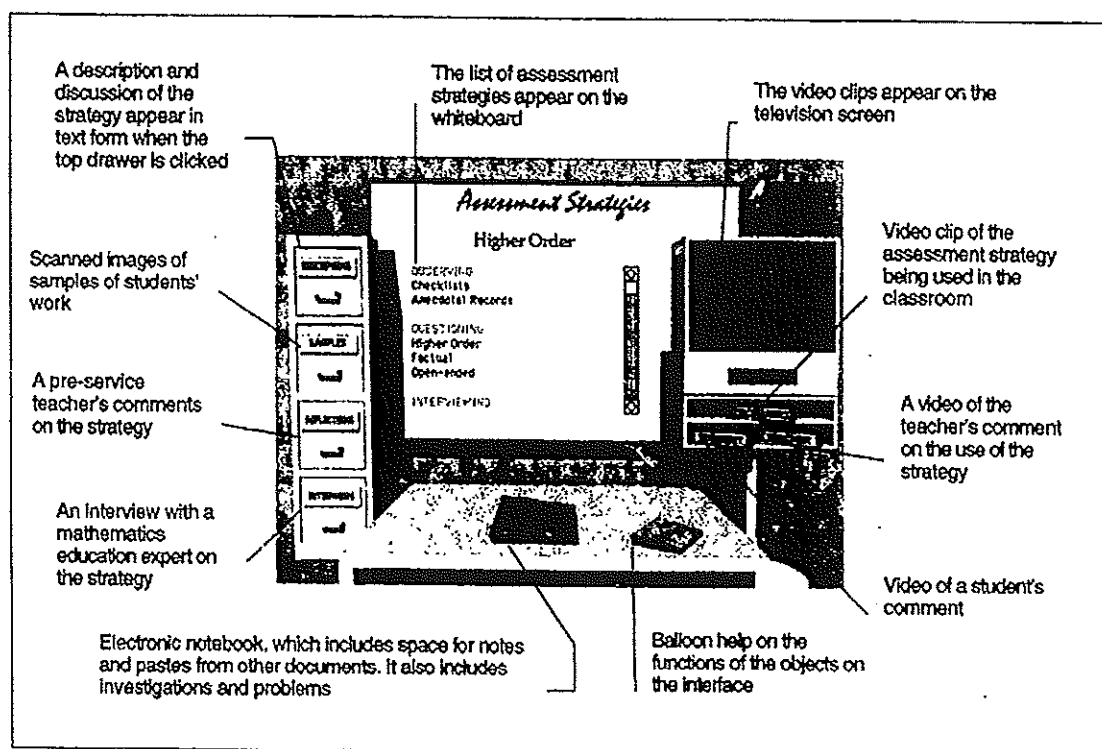
This paper describes a program which was designed to put the student back in the driver's seat with a map, a destination and co-drivers. It enables learners to leave the one-way lane and investigate whichever avenues or highways they choose. The program began with a different theoretical framework. The prevailing model for the design of multimedia programs at the time of commencement was comprised of several steps, typically: a question or problem of some sort is displayed; the student is required to respond actively, for example, by selecting an answer; feedback is given, such as praise for a correct answer or correction of an error; errors are minimised by presenting material in small steps or by using techniques such as prompting and chaining; and students are free to work at their own pace. This model has been used to guide much of the multimedia developed to date. It is the format used by Skinner in the 1950s for the programmed instruction used with early teaching machines (Farnham-Diggory, 1992), but is still recognisable in many contemporary multimedia programs. It is understandable that Brown (1994) has asked for recent learning theory to be used in preference to 'outmoded theories of learning that are relics of psychology's behaviouristic past' (p. 11). Other authors and developers, such as Park and Hannafin (1993), and Lebow (1993) believe that little more than technological capacity and the intuition of designers are driving the design of multimedia, rather than research and theory.

The theoretical framework used to guide the development of this program was that of situated learning (Brown, Collins, & Duguid, 1989; Collins, Brown, & Newman, 1989; Lave & Wenger, 1991; McLellan, 1993; Young, 1993). Nine critical characteristics were defined from the extensive literature on the subject and used to inform the instructional design of the program. The learning environment needed to:

- provide an authentic context that reflects the way the knowledge will be used in real-life;

- provide 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 at critical times;
- promote reflection to enable abstractions to be formed;
- promote articulation to enable tacit knowledge to be made explicit; and
- provide for integrated assessment of learning. (Herrington & Oliver, 1995, p. 255).

A program was developed to enable teachers and pre-service teachers of mathematics to explore issues of assessment, entitled *Investigating Assessment Strategies in Mathematics Classrooms* (Herrington, Sparrow, Herrington & Oliver, 1996). Twenty three assessment strategies suitable for use in K-12 classrooms were identified and presented in a multimedia format. Five complex, authentic activities were designed consisting of memos and other documents, to enable students to explore the resource within the parameters and constraints of a realistic task. The interface simulates the front part of a classroom with the resources located in full view (see Figure 1). The student accesses each resource by clicking on the appropriate part of the picture.



**Figure 1: Main interface of the assessment strategies program**

A study was designed to observe students' use of the interactive multimedia program and to investigate the effect of the situated learning framework on how students learn. Two preservice teachers were videotaped as they used the program and presented a report, over a period of three weeks' class time (9 hours). At the end of the period, each student was interviewed. Data was transcribed and analysed with the assistance of NUD\*IST, a computer-based qualitative analysis program.

### **Authentic context**

The authentic context presented to students was one of a physical and conceptual structure of a classroom which users were free to explore. The various media elements available to the user of the program provided authentic

data from a variety of perspectives. Students had access to more than 60 video clips, over 60 text files and over 20 graphic images and documents, as well as a notebook facility to record their own notes. A sufficiently rich and complex knowledge base was necessary to enable students to solve realistic and complex problems. Generally however, students did not recognise that they were working in a complex learning environment. This is consistent with Honebein, Duffy and Fishman's (1993) premise that it is not necessary to simplify learning environments to enhance learning, and that providing 'realistic levels of complexity' in a learning environment can help to make learning easier (p. 95). While the interface and navigational paths of the program were deliberately kept as simple as possible, the conceptual nature of the contents was far from simple. This was acknowledged by one student:

I was actually surprised at how much you can learn from such a simple brief program. There was just so much in there that you could learn from. (Interview with Deborah)

The predominant feature of the context of the assessment program was that students appreciated 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:

It wasn't like academics discussing the relative theories and things like that, which is what we get lot of at uni. It was actually teachers showing how they'd implemented it, and discussing it afterwards. (Interview with Glen)

### **Authentic activities**

The activity was designed to incorporate all the uncertainty and unpredictability of an authentic task. Students were provided with a copy of a letter of complaint from a parent, together with a memo from the Principal requesting a plan of action to remedy the problem. The task was ill-defined. There was no summarising question or topic for the investigation, simply the presentation of the two documents. Students' first task was to work out exactly what they were required to do. Collins (1988) has pointed out that students often invoke 'suboptimal schemes' for remembering information and to help them cope with the day-to-day demands of school learning. For example, arithmetic students might conclude that any word problems including the word 'left' (How many did she have left?) are subtraction problems. One student revealed the 'suboptimal scheme' she used for 'finding the question':

We had to read it four or five times to actually get out what it was asking us to do... because the actual question was in the middle, it wasn't at the bottom and it wasn't at the top, we sort of had to look through and go 'Oh there it is'. (Interview with Deborah)

This comment reveals that the student's standard procedure of looking at the beginning or end of an activity for the 'actual question' did not work in this case. The students spent considerable time not only identifying the requirements of the task, but also in breaking that global task into sub-tasks. There was active engagement in finding and defining these complex problems as well as solving them.

### **Expert performances**

The assessment strategies program gave students access to expert performances in three ways. Firstly, the video clips of the scenarios being demonstrated in the classroom were generally performed by experienced teachers who were well acquainted with the use of the strategy. Secondly, students had access to the commentaries provided by 'experts' in the field of mathematics education and assessment strategies in the *Interviews* drawer of the filing cabinet. Thirdly, students were able to read the reflections and advice provided by third year student-teachers who were only one year more experienced than the students using the program. While students were generally very positive about the exemplary teaching provided in the scenario videos, none commented on the 'window into practice' or the social or cultural insights into classroom life that the video scenes might have afforded. They were very much focussed on the videos as demonstrations of the assessment technique in a real life context.

### **Multiple perspectives**

The assessment program enabled students to access multiple perspectives in two distinctly different ways: one related to the way the assessment strategies were presented in the program, and the other to the task that students

were given to complete. The program 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. One student, comparing the program to a traditional lecture, indicated that the multiple perspectives provided many 'avenues to understanding':

In a lecture you can't click onto the video and get the video to play. When you've got a huge lecture situation, the lecturers can't keep stopping and going ... Whereas with this it gives you so many avenues to understand it from. You may not understand the theory side but you can understand the scenario side and then find out what the teacher thought. There's just so many different ways of looking at that one strategy. (Interview with Deborah)

The task students were set as an investigation also required them to present a report which included implications for three different groups. Prompted by a complaint from a parent, the 'new teachers' at the school were asked to prepare a suggested plan for assessment in mathematics 'including benefits and problems for parents, students, and teachers'. The group did not complete the different perspectives required in this task beyond recommending a suggested assessment plan for the school. Nevertheless, there was much evidence to suggest that students viewed the material several times, in different ways, and used 'alternative routes of traversal ... criss crossing a topic in many directions' (Spiro, Vispoel, Schmitz, Samarapungavan, & Boeger, 1987, p. 188). Regardless of which pattern of use was adopted, students rarely used a linear or regularly systematic approach in searching the media elements. Both students spoke of looking at items more than once if necessary, going back over items, and investigating individual elements in greater depth.

### **Collaboration**

While using the interactive multimedia program on assessment, students worked in small collaborative groups of 2-3 students grouped around each computer. Students perceived many clear advantages in working collaboratively. One advantage is that the completion of the task benefited from collaboration with another person, essentially that view that 'two heads are better than one'. A frequently mentioned advantage of working collaboratively was that the partner often helps by telling or explaining something that the student didn't know or understand. The view was also expressed that, at times, collaboration is essential to continuation of the task. In the absence of a partner, this support would be provided either by the teacher, or as one student pointed out, by 'annoying' the person on the next computer:

The fact that if you're confused about something you can ask somebody and they're right there next to you. You don't have to put your hand up and wait till the teacher gets to you. And you're not ... trying to annoy the person that's on the next computer, ... you've got someone to ask. (Interview with Deborah)

This view sees collaboration as essential to learning, that it is sometimes obtained by stealth, and that it is given necessary legitimacy by the arrangement of students into small groups.

### **Reflection**

In order to provide a learning environment which would promote reflection, the assessment program was designed primarily with an authentic context and an authentic activity to enable students to engage with the program and to reflect upon it in a meaningful manner. It was also designed to enable multiple entry points, non-linear navigation, and access to an electronic notebook to enable students to note their reflections and ideas immediately. Neither of the students overtly attributed the non-linear navigational aspects of the program as an aid to reflection, although this did appear to be a contributing factor to reflection. The findings suggest that the learning environment did allow students to freely reflect on their learning by providing them with a multimedia program and collaborative working arrangement which enabled them to return to experiences, attend to feelings and to re-evaluate the experience (Boud, Keogh & Walker, 1985). The students were able to share their reflections with each other and use the notebook facility to conveniently record them, confirming Ennis's (1985) belief that reflection is a social process.

### **Articulation**

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. Many interactive multimedia programs do not allow either form of articulation to occur. Students are assigned individually to computers to

work alone, and in so doing, the knowledge remains tacit. Lave and Wenger (1991) point out that being able to speak the vocabulary and tell the stories of a culture of practice is fundamental to learning. The students were aware of the difference between tacit knowledge and verbalised knowledge. One student pointed out the difference between 'knowing' and verbalising in a manner which suggests that the knowledge is incomplete unless it can be articulated, and that knowing 'in my mind' is little more than a good starting point for further research. The students were also clearly aware of the importance of articulation to learning. However, they almost invariably viewed articulation as an act of clarifying an issue rather than an integral part of the learning process itself. Counsellors and psychologists have long been aware of the importance of verbalisation in beginning to affect change in problematic behaviours. A frequently quoted psychological law of counselling is 'I learn what I believe as I hear myself speak' (Saunders & Herrington, 1995, p. 8). Similarly, Bakhtin (1986) contends that 'any true understanding is dialogic in nature' (cited in Brown & Campione, 1994, p. 267). The implication is that the very process of articulating enables development, refinement and awareness of thoughts:

If you have to put something into words, you have to think. (Interview with Glen)

Students using the assessment package were also very much aware of the value of formally articulating their learning in presentation of reports to their classmates, or as Pea (1991) describes it 'creating rich conversational artefacts for discussion and presentation' (p. 65). Students were surprisingly positive and comfortable with the prospect of presenting a report to a larger group (given that fear of public speaking is often ranked more highly than fear of death in popular surveys) and in this sense, they may not have been typical. However, one student pointed out that reports to class were more and more becoming a standard feature of their university classes.

### **Coaching and scaffolding**

From the analysis of the data, it is apparent that coaching and scaffolding is provided essentially from two sources: the teacher, and the student's partner in the collaborative groups. The teacher of the class being observed was thoroughly familiar with the program and its possibilities, and knew the requirements of the coaching and scaffolding role. The role of the teacher was seen as one which essentially clarified issues for students and was important because it saved time. It enabled the students in the study to proceed with the knowledge that their effort was 'on the right track' and that the support given to them was precisely at the point they needed it. The assistance provided by the teacher was essentially procedural on both content (e.g., Is it meant to be a written report?) and software (e.g., There's no sound on this video). In the lessons observed, students rarely consulted the teacher on higher-order questions related to the task. However, the arrangement of students into collaborative groups meant that the student's partner could provide a coaching and scaffolding role. This support was particularly evident in the higher order thinking related to the investigation the students were doing. The students were aware of the influence interactions with their partner had on the depth of their learning. For example, when asked to describe the advantages of working in pairs, Glen showed considerable understanding of the concept of scaffolding and how it relates to his own learning:

If you've got somebody else ... you scaffold a bit. Like when you go 'Oh cool, this is what it means' and the other person, who might not have even considered it goes 'Oh yes' and then takes it a step further and you end up doing more indepth thinking about it. Otherwise I might just have a bit of a superficial look at it. (Interview with Glen)

Students were very positive about the supportive role their partner played, and clearly linked the arrangement of students into collaborative groups to the value of articulating their own growing understanding of the issues.

### **Integrated assessment**

The assessment program included an activity which required students to propose new assessment strategies for the mathematics department in a school. It was this one activity which they investigated for the entire three week period, and it was this activity upon which they were assessed. Students were required to give both an oral and a written report of their proposal. When questioned about the value of a type of assessment which is closely tied to the use of the program, the two students were very positive about it. Both felt that such a close connection between activity and assessment meant that it was virtually impossible to 'regurgitate' information in a meaningless manner. Similarly, with the written report, they felt that an essay, had it been set, would have allowed a lot more 'drive' as opposed to the tighter requirements of an authentic report.

## Conclusion

This paper has described a preliminary evaluation of a theoretical framework for the design of interactive multimedia based on a situated learning model. In so doing, it has investigated the use of a multimedia program by two students, and their thoughts opinions and feelings about learning from this type of program. Early findings indicate that it is a successful approach enabling students to construct their knowledge about the topic in an effective, non-linear, and collaborative manner. This preliminary study is currently being followed by a more extensive evaluation of six students' use of the program, including an investigation into their practical use of assessment strategies in teaching practice in schools. It is hoped that the current and more extensive study will suggest many seeds for further research, both analytic and systemic (as described by Salomon, 1991), into the manner in which students learn from interactive multimedia.

It is proposed that roadblocks have been set up by interactive multimedia programs which seek to deny students any choice in how they progress, which try to control the nature of the interaction between the computer and the student, and which limit collaborative opportunities by insisting upon a single user at each computer. The multimedia program described here is an attempt to open up those avenues of understanding.

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