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ABSTRACT

Members of the Department of Science and Mathematics Education at the University of Melbourne, Australia have developed a range of multimedia resources for undergraduate education students that allow the students to participate in authentic tasks that would otherwise be difficult or impossible to arrange for large numbers of students. The multimedia resources are designed to project students into their future role as classroom teachers as it has been observed that those students who do this tend to perform better as they can see the relevance of learning opportunities presented in their studies. Observation of student work using these resources shows deeper thinking and enhanced reflective practices in considering how children think and how classrooms can be managed. The first section of this paper describes three recently developed multimedia resources: "Computers and the K-6 Classroom: Kids Can Do!," "Teaching and Learning about Decimals," and "Teaching and Learning about Whole Numbers." Modes of interactivity are discussed in the second section, including analyzing classroom interactions and classroom management, as well as the advantages of multimedia for making children's thinking an object of study. (Author/AEF)

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Authentic Tasks for Authentic Learning: Modes of Interactivity in Multimedia for Undergraduate Teacher Education

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Abstract: Members of the Department of Science and Mathematics Education at the University of Melbourne, Australia have developed a range of multimedia resources for undergraduate education students that allow the students to participate in authentic tasks that would otherwise be difficult or impossible to arrange for large numbers of students. The multimedia resources are designed to project students into their future role as classroom teachers as it has been observed that those students who do this tend to perform better as they can see the relevance of learning opportunities presented in their studies. Observation of student work using these resources shows deeper thinking and enhanced reflective practices in considering how children think and how classrooms can be managed.

Introduction

It has been observed that successful teacher education students are those who can project themselves into their future role as a classroom teacher – these students can see the relevance and application of material they are taught and tasks they are set from very early in their studies. For other students, it is only as they progress through their four year undergraduate degree and gain more classroom experience that the materials and tasks presented at university appear to increase in relevance to them. Staff at the Department of Science and Mathematics Education (DSME) at the University of Melbourne, Australia, have taken up this challenge by developing resources that project undergraduate students into their future role as classroom teachers by setting up authentic tasks and scenarios through multimedia resources. This paper will explore the different modes of interactivity that have been incorporated into the multimedia resources developed at the University of Melbourne for use in teacher education in the Bachelor of Education (Primary) course. [The term 'student' is used throughout this paper to mean a student in a teacher education course.]

The Bachelor of Education (Primary) degree is a four year course of study and is the principal vehicle for the training of primary (elementary/K-6) teachers at the University of Melbourne. In 1995 the degree was restructured and updated extensively. New first year subjects were first taught in 1996, new second year subjects were taught in 1997 and so forth. In 1999 the first cohort of students will complete the final year of their degree. This restructuring has been accompanied by a substantial reassessment of the direction of the course and of the priorities for competing areas. Furthermore, budget constraints have imposed a rethinking of delivery of the course and of the ways in which students undertake practical experience in schools. From the end of 1996, a reduction of 20% was made in the number of days supervised practical

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work in schools ('teaching rounds'). It was therefore an ideal time to invest in revising course delivery in the Bachelor of Education (Primary) degree. Multimedia has the potential to make experience with children a well-integrated part of the university course. In the next sections we describe three recent projects and highlight the ways which we have designed for students to engage actively with the multimedia and the task.

Multimedia Resources Developed

Computers and the K-6 Classroom: Kids Can Do!

For the compulsory second year undergraduate subject 'Computers in the Primary Classroom' a resource entitled *Computers and the K-6 Classroom: Kids Can Do!* (Chambers & Dobbins 1997) was developed in 1996-97 with version 1 being launched late in 1997 (version 2 released in early 1999). This resource contains lecture notes and workshop activities, over 100 articles about using computers in K-6 classrooms, demonstration versions of software, examples of teachers' and children's classroom work with computers, and the *Virtual Classroom* resource. The *Virtual Classroom* was developed in Macromedia's *Director* program and contains QuickTime VR with embedded video clips of three classrooms, and interviews with the three classroom teachers (Fig. 1). The three classroom models illustrated are a classroom with two computers, a computer laboratory, and a 'mixed model' of classroom computers plus access to a computer laboratory. Each teacher has a different view on why their style of using computers works for them and for the children in their class. The inclusion of a range of sometimes contradictory opinions was deliberate so that our students could see that there are many ways of using computers and associated technologies effectively in classrooms. That is, the effectiveness of the use of computers was dependent not on how many computers or the layout of the computers in the room, but rather how the teacher used the resources and managed their classroom.

Figure 1: A 'flattened' image from one of the QuickTime VR photographs from the *Virtual Classrooms* from *Computers and the K-6 Classroom: Kids can Do!*

Some multimedia resources about teaching show lessons or lesson segments. One commercially available product which we have used with our students is 'Learning about Teaching' (Mousley, Sullivan & Mousley 1996). This presents video of complete lessons, which are documented and cross-referenced in many helpful ways. The *Virtual Classroom* resource is quite different, presenting instead a snapshot in time of all that is going on in a busy classroom. As our students 'move' around the room they can see what each group of children is doing and how the teacher is managing the classroom.

Teaching and Learning about Decimals

Teaching and Learning about Decimals (Stacey, Steinle, Chambers & Asp 1998) is a rich resource for practising teachers and education students alike to assist in teaching children about decimal numbers, an area of mathematics which is difficult for many children. This project is an offshoot of a major research project about the learning of decimals by children (*Improving learning outcomes in numeracy: Building rich descriptions of children's thinking into a computer-based curriculum delivery system* funded by the Australian Research Council) undertaken by Professor Kaye Stacey and Vicki Steinle of DSME and Associate Professor Liz Sonenberg of the Department of Computer Science at the University of Melbourne (Stacey & Steinle 1998).

Teaching and Learning about Decimals consists of background information, case studies of children with common misconceptions about decimals, and teaching strategies and ideas, including games that challenge children's common misconceptions about decimals. In the 'Case Studies' section, students engage in a range of modes of interactions with multimedia materials that challenge them to 'think like a teacher'. In this section there are five case studies of the most common misconceptions about decimals. For each case study there are examples of the child's work, such as a completed quiz about decimals (Fig. 2), and interviews with the child where he or she is questioned as they undertake a range of tasks that explore their understanding of decimals. The interviews are available in a static version (images with text, suitable for printing) and as QuickTime movies that have expert comments as subtitles. This range of resources within each case study gives our students practice in picking up clues about children's thinking about decimals.

Our students are challenged to deeply understand the misconceptions that children they will teach are likely to have by answering questions about decimals as if they were a child with a particular misconception. This is so that they will be able to more easily 'diagnose' misconceptions about decimal numbers and select teaching methods most appropriate to move the child past their misconception toward a greater understanding of decimal numbers.

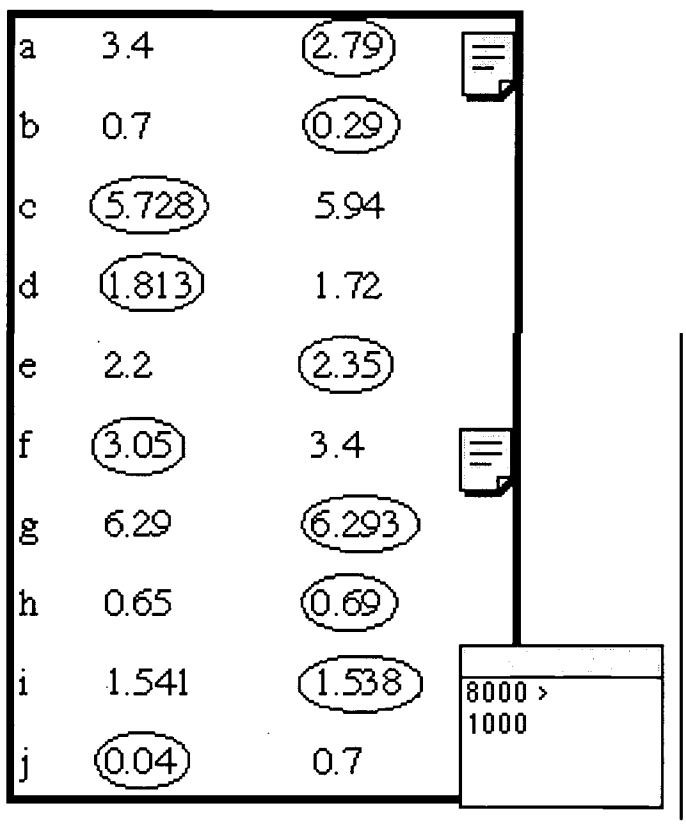

Figure 2: Choices that 'Caitlin' (a child in a case study) made on a decimal comparison test (where the child was asked to circle the larger number of each pair). The notes give a brief explanation of why a child with that misconception may have given the answer.

Teaching and Learning about Whole Numbers

This resource was developed for our first and third year undergraduate mathematics education subjects and explores operations with whole numbers including subtraction and multiplication. This resource targets specific workshops where, for example, students view video of a child doing a mathematical exercise and verbalising the steps they take (Fig. 3). The students then must categorise the method that the child has used based on mathematical principles. This challenges our students to understand the processes the child takes to do the mathematical task and deepens their understanding of the range of ways a task may be undertaken by children. Another component is based around small 'movies' which demonstrate the stages of children's learning to count.

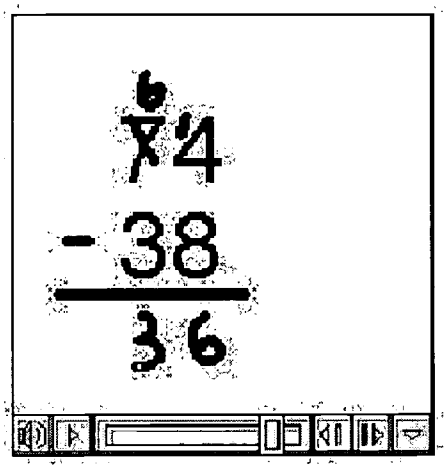

Figure 3: An example of a QuickTime movie that illustrates how one child undertakes a mathematical task with whole numbers (subtraction using the decomposition, or renaming, method).

Modes of interactivity

Analysing classroom interactions and classroom management

In the *Virtual Classroom* our students can explore the classrooms of teachers at three schools. The classrooms and teachers were selected as each is using computers effectively across the curriculum, yet there are major differences in how the computers are used and how they are set up in (and out of) the classrooms. The observation of classrooms and their workings by our students is made considerably easier through the use of multimedia as it allows all students to observe exemplary practice in the uses of computers in the classroom – something not all students have an opportunity of observing during their time in school experience ('teaching rounds') and the same experience is shared by all classmates. In addition, students can visit and revisit the *Virtual Classroom* and as their own experience grows they extract new significance from the interactions they observe.

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Students investigate aspects of the room in a QuickTime VR environment and by clicking on hotspots a video clip of an interaction is played. Our second year teacher education students analysed the classrooms in the *Virtual Classroom* resource to investigate the interactions and to identify the key issues in classroom management in using computers effectively that were illustrated in the video clips. Students worked in pairs for this activity and they engaged in thoughtful discussions. Their responses indicated deep reflection on the set-up and activities in the classrooms – the level of reflection and focus on the task was greater than during other activities with these students. Below is an example of one second year undergraduate student's response to an aspect of this task. It indicates both detailed observation and identification of the key issues illustrated in one video clip.

> *The classroom was well set-up with different activity tables relating to the same theme. This scene showed how organised the boys were when they had finished their computer task. They immediately went straight to the roster chart, marked it off and checked which activity they had to move to next. It showed them working cooperatively, and they were not distracted as they knew exactly where they had to go next. The roster was placed strategically near the teacher so that she could also keep an eye on who should be where and when. All computers were placed against the back wall, with their wires placed at the back of the tables.*

Making children's thinking an object of study

Children's thinking could not be easily studied in the past because it is a complex behaviour producing minimal artefacts (usually written records) and can only be observed indirectly. One of the reasons why thinking is hard to study is that it is hard to capture. In recent years, as technology has progressed to tape recorders and video recorders, the research study of thinking has blossomed. Multimedia now has the potential to bring this into teacher education courses. This technology is enriching teacher education and is being used in the *Teaching and Learning about Decimals* and *Teaching* and *Learning about Whole Numbers* resources.

Multimedia can capture children's thinking and turn it into something that students can study. For this purpose multimedia derives its advantages from the following features:

- A vast amount of information can be stored (needed because thinking is complex behaviour).
- Examples can be stored in a catalogued form.
- Examples can be stored in an accessible form. Access for students can be vastly better than any other form of retrieval - from many places (home or university) and at any time.

By capturing episodes of thinking and enabling them to be well catalogued and easily accessed, multimedia can now provide a 'database' to be studied conveniently. Multimedia is now giving us the opportunity to create a collection of examples of thinking, which could revolutionise teacher education.

Although not a substitute for experience with children, resources such as these have distinct advantages as the scenarios presented have been distilled from research data and clearly illustrate representative case studies found in all classrooms. Our resource takes advantage of the careful analysis of selected interactions with children, to build awareness of well-documented, widespread features of children's thinking. In the classroom, teachers often have limited time to observe individual children's work and would therefore be greatly assisted if they were able to spot patterns in children's thinking. To do this, they must be very familiar with what they might expect to see. They need to gain this awareness in ways that supplement and build on their real life experiences. Mathematics education research is providing knowledge concerning things teachers can expect to see as children learn mathematics, and our resource and others such as the *Professional Development in Chance and Data* CD (*'C&D PD CD'* Watson 1996, Watson & Moritz 1997) are working to bring this knowledge to prospective and practising teachers. In this way advances made in education research are being translated into practice. The children in the case studies (child actors with scripts) are very real to our students which increases the level of engagement and

makes the tasks authentic. This projects our students into their future roles as classroom teachers with the responsibility of understanding how a child is thinking about a task. Feedback from students is very positive and assignments on this material reflects a deeper thinking than had previously been apparent.

Conclusion

The multimedia resources that have been developed for undergraduate teacher education studies at the University of Melbourne allow our students to have experiences where they can see exemplary practice in a classroom or investigate how a child is thinking about decimal or whole numbers. The development of multimedia is an expensive enterprise and we have been fortunate in receiving financial support from our University and from the Australian government for these projects. On the other hand, the choices of development modes (largely HTML and QuickTime video) and technological advances mean that keeping these multimedia resources up-to-date is now within the capabilities of our department and will require only relatively modest resources. High initial costs of time and money make it highly desirable that multimedia resources are shared amongst universities. The relatively low cost of modification, however, means that the changing needs of several different courses can be accommodated, making sharing such resources feasible.

Our experience to date has been that multimedia has enhanced our teacher education courses. It enables complex behaviours to be captured and studied 'on demand' in the lecture room - be it the complex behaviour of a class during a lesson or the complex thinking of a child puzzling over a problem. In this way, experience of the classroom can be built into every aspect of a teacher education program and shared as never before.

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