Learning to Assess School Mathematics: Context, Multimedia and Transfer

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The study set out to explore the use of a multimedia program on assessment strategies within a preservice teacher mathematics method unit, and to investigate the extent of transfer to classroom practice. A multimedia program was designed to incorporate characteristics of 'situated' learning environments. Preservice teachers used the program in their mathematics method classes, and they and their supervising teachers were interviewed regarding their use of assessment strategies while on professional practice. Results show that all students used a variety of assessment strategies, and according to the beliefs of the students themselves, were influenced in their use of strategies by the multimedia learning environment.

Learning Assessment Strategies

The lack of transfer of pedagogical skills from the theory of teacher education to the practical reality of the classroom has been a source of concern to teacher educators for some time. Several writers have expressed concern that despite the emphasis in teacher education courses on 'reformist' methods of teaching mathematics, teachers frequently revert to methods of teaching derived solely from their own experiences as students (Ball, 1994). Others have noted that preservice teachers' experiences in classrooms during their professional practice have proved inadequate because often students observe teaching 'driven by texts and tests', or are ill equipped to detect the subtle differences between quality and mediocre teaching (Mousley & Sullivan, 1995). Despite the variety of innovative and effective assessment techniques, teachers generally continue to limit their means of assessment to a narrow range of pencil-and-paper methods (Australian Education Council, 1991; National Council of Teachers of Mathematics, 1995).

The study set out to explore the use of a multimedia program on assessment strategies within a preservice teacher mathematics method unit, and to investigate the extent of transfer to classroom practice. The learning environment was designed according to critical characteristics of situated learning (described in Herrington, Sparrow, Herrington, & Oliver, 1999; Herrington & Oliver, 2000), which focused on the creation of an authentic context, activity and assessment, together with expert performances, multiple perspectives, opportunities for collaboration, articulation and reflection, and coaching and scaffolding by the teacher. Transfer was thought to have occurred if firstly, students using the interactive multimedia program on assessment had a good understanding of the types of assessment appropriate in the mathematics classroom and were able to articulate this understanding; and secondly, they employed a variety of the assessment techniques shown in the program, as opposed to the predominant use of pencil-and-paper tests (Cognition & Technology Group at Vanderbilt, 1993).

Design and Development of the Multimedia Program

In order to produce an effective learning environment on the issue of assessment in mathematics, it was necessary to provide preservice teachers with the experience of observing expert teachers using different types of assessment in classrooms. McLellan (1996) points out that a situated context can be represented in 'the actual work setting, a highly realistic or 'virtual' surrogate of the actual work environment or an anchoring context such as a video or multimedia program' (p. 12).

In order to use an actual work setting, it would have been necessary to take groups of preservice teachers to a large number of schools and to have them observe expert teachers in their classes, in addition to their professional practice. The second context, a 'virtual surrogate' of the actual work environment (such as aircraft simulators), was also ruled out very quickly on the basis of prohibitive costs of development, and lack of resources within the university for use of the finished resource. The anchoring context seemed the most viable. A video, or series of videos, as an anchoring context was rejected because of the linear format which could not provide ready access to expert performances and multiple perspectives. Audio-tape and text did not provide the appropriate visual elements to allow peripheral observation of the authentic classroom context.

One medium that did not have these restrictions was computer-based multimedia. The combination of video clips, sound, text and graphics meant that interactive multimedia was capable of supporting 'the kinds of more intimate, supportive, learning environments called for by the constructivist perspective' (Perkins, 1991, p. 22), and presenting it in an efficient and accessible format. Multimedia would also enable a 'criss-crossing of the conceptual landscape' (Spiro et al., 1991, p. 30). In addition, several exemplary published packages within Australia—notably Investigating Lake Iluka (1993), Exploring the Nardoo (1996), and Learning about Teaching (Mousley, Sullivan, & Mousley, 1996)—provided valuable models for the development of successful multimedia learning environments.

Preservice teachers using the program to investigate assessment strategies would need to be able to observe experienced teachers in the field demonstrating a range of strategies and techniques, and to then reflect on the most appropriate strategy to use in a particular situation. Video clips of classroom scenes and interviews appeared to be an appropriate means to provide such opportunities to the students who would use the program. Other important requirements of the program were that the context would need to be in a real or simulated classroom, and authentic activities would require students to address the problems of assessment and to select their own alternatives to paper and pencil tests. It was essential to provide multiple perspectives on assessment, and in so doing, focus strongly on the classroom experience. On this basis, the elements included in the final multimedia program were:

- Video clips of teachers using various assessment techniques (see Table 1)
- Video clips of teachers' comments of the strategies
- Video clips of children's comments on the strategies to present their own thoughts
- Interviews with experts in the field to provide theoretical perspectives

- Reflections by third year preservice teachers to provide practical advice
- Text descriptions of each assessment category
- Teacher and children work samples
- An electronic notebook to enable students to copy text and to write their own ideas
- Problems and investigations to enable the students to complete authentic tasks.

The main interface of the program, from which these elements can be accessed, is shown in Figure 1.
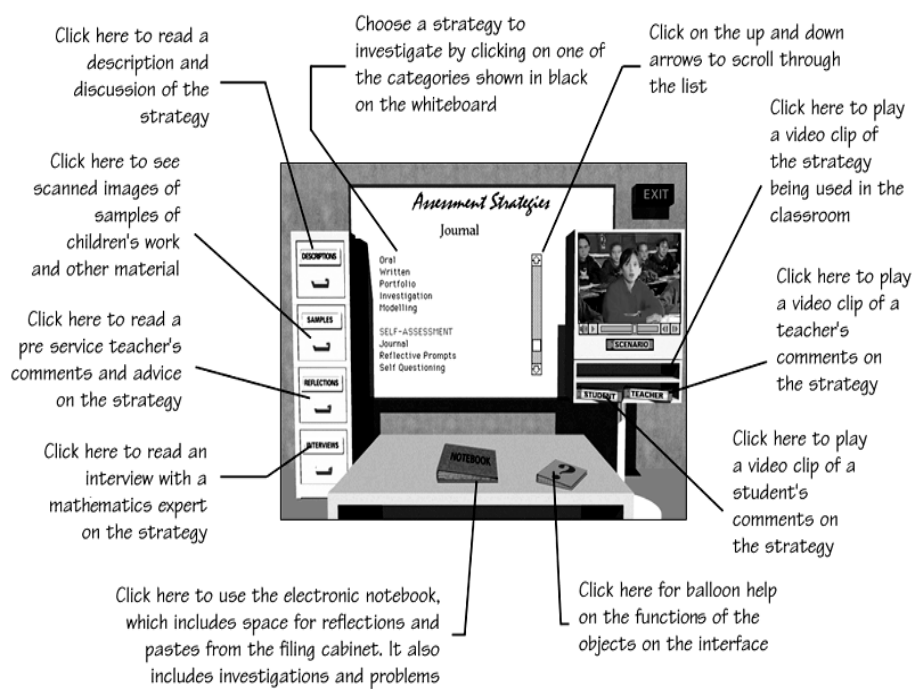

Figure 1. Interface of the multimedia program on assessment.

Assessment strategies were identified from the literature and are listed below, together with the scenario appearing in the video clips, in Table 1.

Table 1
Assessment Strategies Featured in the Multimedia Program

Assessment Type	Technique	Scenario
Observing	Checklists	Teacher observing students and marking a checklist
	Anecdotal	Student doing problem, teacher writing the record
Questioning	Higher order	Teacher asking how and why questions
	Factual	Teacher asking basic facts questions employing wait-time
	Open-ended	Teacher and students working on good questions
Interviewing	Structured	Teacher doing a Newman Error Analysis
	Open	Teacher interviewing on understanding of a concept
	Parent	Teacher interviewing parent
Testing	Diagnosis	Teacher using calculator to diagnose
	Performance-based	Students attempting a tangram activity
	Pencil and paper	Teacher discussing student errors and misconceptions on a test
	Multiple choice	Teacher giving instructions for a test
	Problem solving	Teacher giving a problem and developing a rubric with students
	Attitude	Teacher asks: what do mathematicians do?
Reporting	Oral	Student presenting an oral report to the class
	Written	Teacher giving advice on how to do an investigation
	Portfolio	Leafing through student portfolio of work
	Investigation	Marking an investigation
	Modelling	Teacher viewing students modelling projects
Self - Assessment	Journals	Teachers explaining how to write a journal
	Reflective prompts	Teacher directing class to fill in a lesson check
	Self questioning	Teacher going through a self-question checklist
	Peer assessment	Teacher getting students to write their own questions

The Study

The interactive multimedia program on assessment was cut to CD-ROM (Herrington, Sparrow, Herrington, & Oliver, 1997) and introduced to a class of approximately 24 preservice secondary teachers studying mathematics education method. The students were midway through the first semester of the second year of their course. The lecturer was asked to recommend six students who might be considered as 'typical case' (Miles & Huberman, 1994) with an equal representation of gender, to be observed and interviewed for the study. Students were grouped in pairs to maximise collaborative interactions.

To begin the lesson, the lecturer held a discussion with the students on the issue of assessment in mathematics. The discussion was prompted with questions such as: What does assessment mean in mathematics? How were you assessed in mathematics when you were at school? Minimal instruction was given in the use of the program itself, except for a brief introduction to the elements of the program and how each could be accessed through the main 'menu', the classroom interface. Students were given an authentic and complex activity to investigate while using the program, simply in the form of two letters. The activity required the group of students to assume the identity of new teachers in a school given responsibility to prepare a report to staff on assessment strategies. The request has been prompted by a letter to the school from a parent whose child becomes very anxious before each test, and who requests whether there are alternative means of assessment that could be used in mathematics. The six students were observed using the interactive multimedia resource over three weeks in their normal lecture time.

Approximately five weeks after the conclusion of the use of the assessment multimedia package in their mathematics method course, the six students in the main study completed a two-week professional practice in six different metropolitan schools. All the students were required to teach mathematics classes in this practice, and it was expected that they would have the opportunity to implement different assessment strategies. In order to assess whether students used a variety of assessment strategies during their mathematics classes on professional practice, both the students and their supervising teachers in the schools were interviewed and the comments were analysed.

Students were given a list of the assessment techniques featured in the interactive multimedia program on assessment (Table 1) and asked whether they had employed any of the strategies listed. The questions mirrored those asked of the supervising teachers to assist structural corroboration of data. Findings are presented below, with names substituted with pseudonyms.

The Findings

A situated view of transfer is not one that suggests that a person can acquire a set of skills that can be lifted and applied in a totally novel situation. The view of transfer adopted by the proponents of situated learning and used here, is that knowledge is more likely to be transferred to novel situations when it is learnt in the context of use and is "a central or integral part of one's cognitive structure" (Prawat, 1992, p. 375).

It appeared from analysis of the comments made by students that assessment issues had been incorporated into their cognitive structures. They spoke openly and knowledgably about assessment issues after teaching practice. They acknowledged the complexity of the area and were well acquainted with the types of assessment that might be suitable in the mathematics classroom, and they used appropriate language with familiarity and ease. None of the students thought that being unaware of appropriate assessment strategies was a relevant factor in their teaching practice. The students were also aware of the usefulness of assessment in performing more functions than the summative appraisal of students' understanding (for example, as listed by authors such as Burton, 1992; NCTM, 1995;

Clarke, 1988) including: to improve the teaching of the child, to inform the teacher, and to make instructional decisions.

Comments by the majority of students indicated that they were aware of many important roles for assessment, and that it could be used, as noted by Jonassen (1991) as "less of a reinforcement or behaviour control tool and more of a self-analysis and metacognitive tool" (p. 32). For example, Louise distinguished between 'formal' and 'informal' assessment when asked whether assessment was necessary on short professional practice:

> It depends what you mean by assessment. When we used the multimedia, it looked at questioning and monitoring as part of assessment and some people don't think that is assessment. So I think maybe formal assessments like long investigations where a lot of work is done, maybe that's not necessary, but I think the informal like questioning and monitoring is. (Interview with Louise)

Carlo also pointed out that assessment has a critical role in helping him to monitor his own performance as a teacher:

> As a teacher, you need to know where they're at and the objectives you've set yourself. I think it's quite important because you have a feel for how you're doing, especially if you can see that they're learning something. It actually allows you to assess your own teaching. (Interview with Carlo)

The students were able to speak knowledgeably and confidently about the issue of assessment. Lave and Wenger (1991) point out that learning the language and stories of a community of practice is necessary for full participation in that practice, and the students' ability to speak both within and about the practice was clearly evident in their discussion.

The second indicator of transfer as described above, was that students employed a variety of the assessment techniques, shown in the multimedia program, in the classes they taught while on professional practice. The findings for each student were analysed and evaluated. These findings are summarised below.

Evie

Evie's professional practice was conducted in a co-educational, non-government secondary college where she taught Years 8, 9 and 11 mathematics. During the two week practice, she was supervised by Carol at all levels. The use of the different categories of assessment strategies used by Evie, as defined in the interactive multimedia program, is presented below in Table 2. It shows both Evie's, and her supervising teacher's, reports of the types of assessment used under the headings of the major categories of assessment strategies shown on the main interface of the assessment program.

Table 2
Assessment Strategies Used by Evie During Professional Practice

Source	Observing	Questioning	Interviewing	Testing	Reporting	Self-assess
Evie	Anecdotal records	Mainly higher-order	Open and structured interviewing	Pencil-and-paper problem solving activity (formal requirement)	None	None
Carol	Wrote notes on individual students	Mainly factual recall	Open interviewing	Pencil-and-paper problem solving activity (formal requirement)	None	None

The main form of observation, as an assessment strategy, used by Evie was anecdotal records. She used this strategy during mathematics classes by taking notes on individual students as she moved around the classroom:

> I observed with anecdotal, so I did take a note down of people who did seem to have problems with things, and I jotted down what they were, so I could actually go back and help them at any time or in their free time or whatever. (Interview with Evie)

This use of anecdotal records was acknowledged by her supervising teacher who also noted that some of the records appeared in annotated form as part of Evie's self-assessment of her own teaching. Evie's use of anecdotal records was something she initiated without the suggestion being made by her supervising teacher.

Carol felt that Evie's questioning technique comprised mainly factual recall rather than open-ended or higher-order questioning. However, she did acknowledge that Evie used questioning both with groups and individually, and that 'she was able to do the question and answer thing quite well' (Interview with Carol). Evie herself said that she felt quite confident with questioning and used it frequently, particularly higher order questioning. Again, questioning was used on her own initiative, especially with individuals, as she moved around the classroom. While acknowledging that some kinds of interview were not feasible during professional practice, such as parent interviews, Evie felt that she had used open-ended and structured interviewing extensively:

> I did a lot of interviewing, I'd walk around and ask them if they were having any problems and if they were, then why, and what did they find difficult, and questions like that. (Interview with Evie)

The supervising teacher corroborated this comment and also pointed out that this strategy was used on Evie's own initiative. Evie did not use any paper-and-pencil tests that she herself had designed, but was required to administer a problem-solving test. Neither Evie nor the supervising teacher initiated the formal test:

> Neither of us [initiated the test]. It was a requirement, a policy of our school … we'd set dates from the beginning of the year and that was the day that it was going to be administered, so she did that. (Interview with Carol)

Evie did not use any self-assessment strategies such as journal writing or reflective prompts, and no reporting strategies such as oral, written, portfolios or modelling. Her justification for this was that such strategies needed to be an ongoing part of the learning environment, rather than something that could be quickly introduced in a short professional practice period:

> I was limited in what I could do. If you're doing something like a portfolio, you need to start at the beginning of the year and progress. If the teacher hasn't done that from the beginning of the year, it's not worth doing in two weeks. (Interview with Evie)

Generally, Evie used a variety of assessment strategies, and was proactive in initiating the use of alternative strategies that were under her control, such as the strategies that could be used with individual students as she monitored students' work.

Louise

Louise was assigned to a single sex, non-government secondary college for her professional practice. As a double major, she shared her teaching practice between two areas: language and mathematics. She taught Year 9 mathematics, and was supervised by Michael. Their views of the assessment strategies used are summarised in Table 3.

Table 3
Assessment Strategies Used by Louise During Professional Practice

Source	Observing	Questioning	Interviewing	Testing	Reporting	Self-assess
Louise	None	Higher order and factual recall	Open interviewing	Informal pencil-and-paper tests	Individual students reporting orally to the class	None
Michael	None	Factual recall	Open interviewing	Informal pencil-and-paper tests	Individual students reporting orally to the class	None

Louise did not use any formal method of recording the observations she made of students, such as recording anecdotes or the use of checklists. However, she did use higher order and factual questioning:

> I used a lot of questioning when introducing similar triangles to find out what they knew, and increasing it, trying to let them work out how to do it first rather than me just explaining it to them. And the factual questioning, I probably used for mental. (Interview with Louise)

Her supervising teacher stated that Louise had used mainly factual recall questioning, but did agree that she used questions in a class discussion on her own initiative. Both Louise and Michael agreed that she used open interviews with individual students to help diagnose possible problems with understanding. Paper-and-pencil tests were also used by Louise, but they were used informally in a manner designed to gauge understanding rather than the 'right' answer. Her supervising teacher explained the method she used:

> It was informal. She didn't actually collect it, she assessed it from the point of view of walking around the class ... querying students question by question and just getting general feedback on whether there were any problems with a section of the work. (Interview with Michael)

Self-assessment strategies were not used by Louise in her professional practice classes. She pointed out the difficulties of using strategies such as journals and peer assessment in what was effectively, another teacher's class. Her comments echo those of Evie in her concern for the difficulties associated with implementing procedures and techniques in a short space of time on professional practice. Nevertheless, at times when it was within her control, she did utilise many alternative assessment strategies.

Rowan

Rowan completed his professional practice in a co-educational, government high school catering for Years 8-12. Under the supervision of Rob, Rowan taught Years 8, 9, 10 and 11 mathematics. Rowan's and Rob's reports of the assessment strategies used during the professional practice are presented in Table 4.

Table 4
Assessment strategies used by Rowan during professional practice

Source	Observing	Questioning	Interviewing	Testing	Reporting	Self-assess
Rowan	Anecdotal records and checklists	Factual questioning	Open interviewing	Two formal tests	None	Reminders as reflective prompts
Rob	None	Factual questioning	Open interviewing	Pencil and paper test of parabola	None	None

While Rowan's supervising teacher was not aware of any observation of students, Rowan himself reported that he tried to use both types of observing presented in the interactive multimedia program on assessment, particularly anecdotal records:

> I was trying to do both of these actually, not fully into the checklists, but observing and ... writing down some little notes about how certain ones were doing … if you've got those little notes there you can see that they've been having a problem. (Interview with Rowan)

Rowan admitted to having a problem with group questioning, pointing out that he found it difficult not to use rhetorical questions, a point also made by Rob. Nevertheless, he showed that he was willing to use the strategies and try to perfect his techniques:

> Towards the end, in certain classes I was asking the How and Why questions. To actually find out where they're at, I prefer to use individual questions, you know, going around ... then I'll tend to use like all three types of questioning techniques. (Interview with Rowan)

Both the supervising teacher and Rowan concurred that he used open interviewing to help students who were having difficulty understanding mathematical concepts, and that this assistance was provided on Rowan's own initiative. Rowan used two pencil-and-paper tests during his professional practice. The tests were administered in a formal manner, as explained by the supervising teacher:

> [He] stood at the front of the room explaining that it was a test, what they were to have on their desk, pens, pencil and calculator, gave out the test, ensured everyone knew it was 2 pages, right you've got 40 minutes, look at the clock, get to work. (Interview with Rob)

Rowan explained, however, that he used the results as the basis of a discussion on students' understanding of the problem. This procedure was demonstrated in the scenario on pencil-and-paper testing on the interactive multimedia program. Rowan's comment reveals an insight which suggests his use of the tests was to gain a true assessment of students' understanding rather than to obtain a score:

> The teacher wanted me to keep the tests for my own record, but the last day was a sports test and only 10 [students] were there, so I—this was interviewing as well—I went through the test and discussed things and clarified things where they'd got it wrong and to see whether they actually did know it. A lot of the time in a test they get it wrong but they still might understand the concept. That's all part of assessment, not just whether they got it right on the day. (Interview with Rowan)

Rowan did not use any reporting strategies to assess students' understanding during his teaching practice, nor did he use any self-assessment techniques other than encouraging students to assess their own understanding at regular intervals.

Rowan appeared to use a variety of assessment strategies in his classes during professional practice. Like the other students, he was limited in the strategies he could use by the time constraints of the placement. Rowan's comments reveal a far deeper understanding and application of assessment than was evident to his supervising teacher.

Carlo

Carlo's professional practice school was at a co-educational government high school, catering for Years 8 to 10. The school had four timetabled periods per day, and Carlo taught 8 periods of Years 8, 9 and 10 mathematics during the two week practice under the supervision of Peter. During his teaching practice, Carlo reported using a number of different assessment strategies. These are summarised, together with the views of his supervising teacher, in Table 5 below.

Table 5
Assessment Strategies Used by Carlo During Professional Practice

Source	Observing	Questioning	Interviewing	Testing	Reporting	Self-assess
Carlo	Informal observation	Open-ended questioning	Open interviewing	Mental tests to start every Year 8 lesson	Observed modellilng	Informal reflective prompts
Peter	None	Factual recall questions	Open interviewing	None	None	None

Both Carlo and his supervising teacher agreed that no observation techniques were used by Carlo to assess students in his practice classes, although he did explain that he observed their progress without writing notes: 'It was just seeing' (Interview with Carlo). While his supervising teacher claimed that Carlo used only factual recall questioning with students, Carlo himself related a different view:

I used open-ended questions, because I had to introduce means and standard deviations, so there were quite a few ideas around that. You could use them in investigation type activities ... that's just the nature of the activity. There are so many different ways of doing it. (Interview with Carlo)

The supervising teacher reported that Carlo did not use open-ended questions:

They were factual recall. He knew what answer he wanted and students responded accordingly. (Interview with Peter)

Nevertheless, when asked whether he had suggested the idea to use this type of questioning or whether it was Carlo's, the teacher replied that Carlo's role in the matter was one of classroom discipline, a protocol possibly more suited to the constraints of factual recall questioning rather than the more open arrangement required for open-ended questioning:

I didn't make any suggestions, the only thing I stressed was on the discipline side to make sure that when he asked the question, first of all that the students listened and that they put their hand up. (Interview with Peter)

Carlo used open interviewing with individual students to assess their understanding of the content of his lessons, and he was careful to point out that he viewed interviewing as something with a specific purpose, not just 'every interaction you have'. Interviewing was done on Carlo's own initiative, and not on the recommendation of his supervising teacher.

Carlo was not happy about the fact that he had to take mental arithmetic pencil-and-paper tests in every Year 8 lesson. While his supervising teacher did not recognise them as tests—as he claimed that Carlo did not administer any tests on his teaching practice—Carlo saw them as less of an assessment strategy and more as a means to obtain classroom order:

The only thing I wasn't happy about was mental. You'd always have to do mental, come into class and do mental. And I'd take it. I suppose that defeats the purpose of it, but I suppose it's been done for years. It's just a strict pencil and paper test, but the

teacher said that Year 8s needed it, because they have to be structured. They have to be sitting down doing the work. (Interview with Carlo)

Carlo observed students using modelling as an assessment strategy, and while he participated in the activity, it was clearly not his own initiative. He described a modelling project which had been initiated prior to his commencement on teaching practice:

In the modelling class they had to do a couple of reports. They had to design an outdoor area and discuss all the factors and stuff. They had a portfolio as well and a quick presentation. That was an ongoing thing. It took about 6 or 7 weeks and some holidays as well, because they had to go away and look at the prices of bricks and things. (Interview with Carlo)

Like Rowan, Carlo admitted to using self-assessment techniques only in the most casual manner, with just the occasional reflective prompt. Carlo's supervising teacher attributed this to lack of time, and pointed out that most of the assessment techniques used by Carlo were done in an informal manner. Again, Carlo seems to have capitalised on situations where he was free to implement strategies of his own choosing, although he appears not to have done this to the same extent as the other students in the study.

Zoe

The school in which Zoe completed her professional practice was a co-educational, government senior high school. She taught Years 8 and 10 mathematics under the supervision of James. Zoe's view of the assessment strategies she used on teaching practice are presented in Table 6, together with a summary of the views of her supervising teacher.

Table 6
Assessment Strategies Used by Zoe During Professional Practice

Source	Observing	Questioning	Interviewing	Testing	Reporting	Self-assess
Zoe	Checklists for homework Anecdotal records	Higher order	Open interviewing	None	Oral reports	None
James	None	Factual recall	Open interviewing	None	Oral report	None

While her supervising teacher did not recognise that she was using this assessment strategy with the students, Zoe reported that she used both checklists and anecdotal records to assess students in her teaching practice, although she qualified the use of checklists as simply being a list against which to mark homework. Nevertheless, she appeared to have a good understanding of the use of anecdotal records, and used the technique in her classes:

If some kids didn't understand—I guess that's anecdotal records—I'd write little things like what mark they'd got and why they did pretty bad and I'd try to spend some time with them in the next lesson. So they were really helpful in that way. (Interview with Zoe).

Zoe appeared to have a good understanding of how to use higher order questioning to determine whether students understood the procedures they were required to follow. For example, she explained how she used the strategy with Year 10 children:

I'd explain to them what to do and start using the higher order questions to see if they really understood what they were doing or just saying things to get rid of me. (Interview with Zoe)

While Zoe admitted that she had trouble with open-ended questions, and that they usually came out as 'And then we ...?', she claimed to use a lot of higher order questioning in assessing students' understanding as opposed to simply getting the 'right' answer. Her supervising teacher complained about her reluctance to accept an answer without an explanation of its meaning:

She'd get the kids to come up and put the answers on the board, which she probably overdid early on if anything ... Virtually every answer she got from the kids she would want them to justify on the board ... she probably took it too far. (Interview with James)

Both Zoe and her supervising teacher agreed that she used open interviewing assessment strategies with students. As Zoe described it: 'I'd sit there and say "Why did you do that?" and "What did you do next?"' James admitted that this was done on her own initiative but qualified this by insisting that such a technique would be standard practice in any classroom. Zoe did not initiate any pencil-and-paper tests, and was not required to administer any. The supervising teacher pointed out that all the tests were done the week after the professional practice finished, in the last week of the term.

Zoe used oral reporting by requiring students to present and defend their findings to the class. This was the only type of reporting she initiated. As pointed out by her supervising teacher, time constraints meant she could not attempt some of the more sustained types of assessment strategies:

You're talking about a two week prac! They're really doing assessments that you've already set aside for them to do, and she came in a week where there weren't a lot of assessments to do. I'd say no, but not because she didn't want to, it was because it wasn't required. (Interview with James)

Zoe did not use any form of self-assessment with the students in her professional practice classes, although she pointed out: 'I could have, should have!' Zoe's general interest in assessing her students was summed up by her supervising teacher who expressed surprise at her enthusiasm for marking:

The only comment I have, which is a strange one, is that she was very keen to do marking. I'd like to talk to her about that in 10 years time but she was itching to do marking. The assignment was the only thing we had in that particular time frame, so I had to dig up a bit of intro calc just to keep her going. (Interview with James)

Generally, Zoe appeared to implement a variety of assessment strategies in areas that were under her control. As James pointed out, many of the assessment strategies had been planned in advance for the preservice visiting teachers leaving them very little choice. However, in areas where the students have some discretion, Zoe, like many of the other students in the study, was able to implement some of the strategies of her own choosing.

David

David's professional practice was conducted in a private non-government, co-educational school. During his teaching practice, he taught Year 8, 10 and 12 mathematics under the supervision of Frank. David's view of the assessment strategies he used is summarised in Table 7, together with the views of his supervising teacher.

Table 7
Assessment Strategies Used by David During Professional Practice

Source	Observing	Questioning	Interviewing	Testing	Reporting	Self-assess
David	Anecdotal	Higher order questions	Open interviewing	Pencil and paper test	Getting students to explain their solutions to others on blackboard	Occasional reflective prompts
Frank	Anecdotal	Open ended questions	Open interviewing	Pencil and paper test	Getting students to explain their solutions to others on blackboard	None

David reported that he made use of observation techniques to assess students' understanding on the classes he taught during his professional practice. The technique used by David was anecdotal records and he described the process in the following manner:

> I did use anecdotal notes. Just little notes as I walked around. It was just observation, but you can't help but write things when you see them. (Interview with David)

David's supervising teacher was aware of his use of anecdotal records and expressed surprise at how effectively David used the technique, albeit in this example, not as a measure of understanding but effort:

> I saw evidence that he observed ... I was worried at one point that he may not notice students not working, one in particular that I was concerned about. But he actually mentioned to me after the lesson 'Chris actually did some work, I checked'. He was identifying and monitoring on task on the spot. (Interview with Frank)

When asked what types of questioning David used during his teaching practice, Frank pointed out that effective questioning is a complex skill that needs a great deal of practice to perfect. David himself reported that he had used higher order questioning, but that it wasn't specifically planned that way. Frank's comment indicated that while the intention to use questioning beyond the level of factual recall was there, and that David was as capable as one would expect, he needed time and practice to be able to use questioning effectively:

> He used open-ended questions but we talked about the need for them to be a bit specific and he's not at the stage—I probably wouldn't expect him to be at this stage of his practice—to be able to bounce questions from one student to another, and at no stage giving the answer but posing another and making them think. (Interview with Frank)

Both David and his supervising teacher reported that David used open interviewing techniques with students. David commented that if a student asked for help, he questioned them, rather than simply giving the answer. Frank was happy to encourage David to practise these techniques where he himself would have left the students to find out for themselves:

David was required to give a test which had been designed by his supervising teacher. His contribution to the test was to prepare one question on graphing representations of data. David marked the test but was not in a position to give the test back to students or discuss the results. Both David and Frank agreed that the only reporting strategies used by David were oral reports of students' findings in lieu of providing the right answers:

> He did have students doing answers on the board for others. He used students to do work, instead of putting the answers up. (Interview with Frank)

When asked whether David used any self-assessment strategies with students, his supervising teacher reported that he did not and that he tended to concentrate on 'more fundamental skills'. David himself admitted that the only self-assessment he used in students' learning was to prompt the occasional reflective question:

> I guess self-questioning, say you know 'What's the question asking?', that sort of thing. (Interview with David)

Like all the students in the study, David was limited in the types of assessment strategies he could use. He was required to administer a pencil-and-paper test and other predetermined methods on the direction of his supervising teacher, but used more varied methods of assessment when he had the discretion to do so.

Discussion

Analysis of the data shows that all the students could speak knowledgably and confidently about assessment, and all the students used a variety of techniques to assess children's understanding. Prior to the commencement of the study, a prediction was made that the students would use a variety of assessment techniques in their mathematics classes during teaching practice, and this was true of all six students. In spite of the fact that one student reported the prediction to be untrue and another was unsure, all the students did use a variety of strategies. Evidence to

support this conclusion was provided by the students on their own admission in interviews, and this was generally corroborated by their supervising teachers.

If students had reported using only pencil and paper tests to assess students, only Testing strategies would have been used. However, as shown in Tables 2-7, all the students used assessment strategies from the Questioning and Interviewing groups, most used Observing and Testing, and some students used Reporting and Self-assessment strategies. Generally, the students used the assessment strategies that had been predetermined for use by the supervising teacher. However, this was supplemented by the use of strategies that were under the students' own control. Many of the students expressed concern about the difficulties associated with implementing procedures and techniques in a short space of time on professional practice. All the students in the study were limited in the types of assessment strategies they could use, but chose varied methods of assessment when they had the discretion to do so.

Resnick (1996) has been critical of one aspect of the learning model used in this study: 'the disappearance of the individual'. According to Resnick: 'Individual knowledge and skill—characteristics of individuals that can be carried with them from one situation to another—are replaced by emergent cognition that belongs to no one and disappears when the moment of emergence has passed' (p. 41). The findings of this study, within the parameters of transfer given here, refute this assertion. The students had used the multimedia program in groups, and had collaborated on their presentations and reports. Nevertheless, they had clearly internalised the assessment issues investigated within the situated learning environment, and were able to use them competently in situations where they had the discretion to do so, lending firm support to Vygotsky (1978) who maintains: 'Any higher mental function was … social at some point before becoming an internal, truly mental function' (p. 62).

One of the principal challenges of teacher educators is to promote the view that teachers can be purposeful in the methods they use, and that they do not have to limit themselves to methods they learnt as school children from their own teachers—the view that 'you teach as you were taught' (Australian Education Council, 1991). An interesting issue to emerge from the analysis of the data on transfer was the manner in which students critically appraised both their own school teachers and other teachers they observed in teacher training. One student admitted to being influenced by his own school experience to the point where he found himself using the same style. However, most of the students evaluated the experience more critically, some to the point of being determined to do the opposite. Not all the students' school teachers were used as negative role models. One student reported that she was very positively influenced by her mathematics teacher, and some students saw a real value in observing and learning from experienced teachers.

Generally, the students in the study were active in choosing the methods of teaching and assessment they used on their teaching practice. With the exception of one student who expressed the view that it is human nature to teach as you've been taught, most critically appraised both their own school experiences and exposure to other teachers and were not blindly duplicating either in their professional practice teaching.

Two factors mitigated against a realistic appraisal of whether the students' use of the assessment program influenced their adoption of a variety of assessment practices in a real-life classroom: the substantial influence of the supervising teacher, and the brevity of a two week professional practice. The choice of the professional practice nearest to the use of the interactive multimedia program meant that any transfer effect could more reliably be attributed to the influence of the situated learning environment on assessment rather than an accumulation of influences and practice in the students' entire course.

While many models of transfer exist, it was difficult to find an appropriate model of transfer to use in the study. Although transfer did appear to occur within the parameters given, many questions remain about the types of transfer and whether the effect is long-term, for example: What is an effective model of transfer for situated learning environments? Do students apply assessment strategies presented in the interactive multimedia program when working as fulltime teachers? Is there long-term retention of assessment strategies?

Ideally, the students needed to be appraised in the real world context, possibly in their first or second year as practising teachers, and over a lengthy period of time. Nevertheless, in the current study, and in the beliefs of the students' themselves, the multimedia program on assessment influenced the types of strategies they employed and their thinking about assessment as they taught mathematics and other classes during their professional practice in schools. In the words of the students:

> It influenced me greatly, I really took it to heart. So I basically did implement a lot of the assessment types that were identified in the multimedia. (Interview with Evie)

> It made me think about assessment a lot more, each time I was writing up a lesson plan. Each time I came to assessment … I was a lot more conscious of it. (Interview with Rowan)

> It's opened my eyes a lot more … and also watching my teacher and really disagreeing with a lot of the assessment strategies he'd use. He only used pencil and paper assessment strategies. Of course I didn't say anything, but I'd sit there thinking 'Oh remember what we learnt'. (Interview with Zoe)

> There were only limited types of assessment that I could use, but hopefully in the future I'll be able to use a wider range of the ones that were on the multimedia. Hopefully I'll be able to ... start journals and things like that. (Interview with Evie)

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