

Chapter XIV

An Authentic Approach to Facilitating Transfer of Teachers' Pedagogical Knowledge

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Abstract

The pedagogical knowledge learned by pre-service teachers often fails to transfer to teaching practice. Instead, new teachers revert to instructional strategies they observed as children. This chapter describes design research conducted over four years, where pre-service teachers were immersed in an authentic learning environment using multimedia to learn mathematics assessment strategies. The first study was conducted with pre-service teachers in the second year of their degree, and then the second study followed up with the same people in their second year as practising teachers. The first study revealed several constraints for the participants

on professional practice, including limited time and the influence of the supervising teacher. Later, as practising teachers, they faced cultural and practical constraints within the school environment that prevented them from fully operationalising the pedagogical principles they learned as pre-service teachers.

Transfer of Learning

Transfer — or the lack of it — continues to be a critical issue in education. Educators (as described by Whitehead, 1932) have been challenged to develop strategies to ensure that learning does not remain “inert” at those times it is needed to solve real problems. Elliot Eisner summed up the problem well:

The really important dependent variables in education are not located in classrooms. Nor are they located in schools. The really important variables are located outside schools...It's what students do with what they learn when they can do what they want to do that is the real measure of educational achievement. (Eisner, 2001, p. 370)

While the transfer of learning is important in the school context, the issue has continuing relevance for university educators as well. In particular, the outcomes for teacher education courses must go beyond knowledge of the theoretical notions encountered in philosophies, psychologies and sociologies of education, to reflect how these theories apply in practice in the classroom. Unfortunately, the evidence to show that theory transfers to practice in teacher education courses is not strong. In mathematics education courses, for example, modern constructivist theories of learning have been promoted in recent years. However, the practices of novice teachers in schools continues to reflect traditional approaches to teaching, based on their own school experiences as students (Brown & Borko, 1992; Raymond, 1997). These traditional practices reflect beliefs about teaching and learning, built up over many years of schooling, that are deeply ingrained and difficult to change (Ball, 1990).

Another reason for the inability of teacher education courses to transfer theory to practice is too little engagement with genuine situations and too much emphasis on theoretical perspectives (Resnick, 1987). The challenge for teacher educators is to make meaningful connections between theory and practice, where practice is often reflective of traditional approaches to teaching and learning. School practicums, for example, should provide real world experience

where theory can be observed in practice (Ensor, 2001). For many pre-service teachers, however, their school practicum experience is often a reaffirmation of the traditional approaches that are already ingrained from their own schooling (Comiti & Ball, 1996). Breaking the cycle is critically important for teacher educators, and for the school students who will inevitably benefit from a rejuvenated and informed approach.

So, how can pre-service teachers experience practices that reflect current theories of education? And more importantly, how can they experience practices that challenge their pre-existing beliefs and practices, and enable them to transfer their learning to the classroom?

This chapter describes an authentic learning environment that used multimedia to engage pre-service teachers in solving complex problems — the kinds of problems encountered by teachers in their day-to-day teaching. It was hypothesised that teachers using this multimedia would modify their existing beliefs about assessment practices and adopt recent assessment practices when they taught in classrooms, both during their school practicum and in their initial school postings as beginning teachers.

The design of the authentic multimedia environment was based on the theory of *situated learning* (Brown, Collins & Duguid, 1989; Collins, Brown & Newman, 1989; Lave & Wenger, 1991). Situated learning places learning in the context in which it will later be applied. One of the principal effects claimed for the theory is that it facilitates transfer of learning to new situations. Park and Hannafin (1993) cite the improvement of transfer as *the* distinguishing feature of situated learning as a theory in their analysis of new learning theories in relation to the design of interactive multimedia.

Multimedia Program on Assessment

Nine critical characteristics of situated learning environments have been defined to inform the instructional design of new learning environments (described in detail in Herrington & Oliver, 2000): provide an authentic context and task; provide access to expert performances; provide multiple roles and perspectives; support the collaborative construction of knowledge; provide coaching and scaffolding; promote reflection, and articulation to enable tacit knowledge to be made explicit; and provide for integrated assessment of learning.

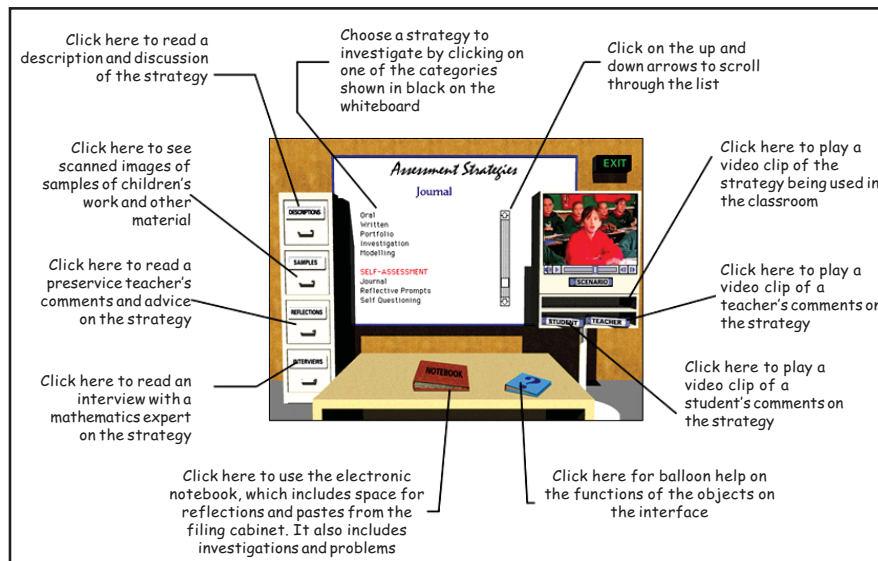
A multimedia program entitled *Investigating Assessment Strategies in Mathematics Classrooms* was developed in light of these characteristics to enable teachers and pre-service teachers of mathematics to explore issues of assess-

ment (Herrington, Sparrow, Herrington, & Oliver, 1997). Twenty-three assessment strategies suitable for K-12 classrooms were identified and grouped in the following categories: *Questioning*, *Interviewing*, *Testing*, *Problem-solving*, *Reporting* and *Self-assessment*, 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. For example, in one task, students respond to a letter to the school from a parent requesting that her child be assessed without formal tests due to the stress this caused in the family. In response to this dilemma, the students need to prepare an alternative assessment approach for the whole mathematics department. To do this, they can access the wealth of resources provided in the multimedia program (listed below), and to further add to the authenticity, they must deliver their report in a "staff meeting." The interface of the program (see Figure 1) simulates the front part of a classroom with the resources represented by appropriate metaphors (such as video cassettes, filing cabinet drawers, folders on the desk) giving direct access to the following:

- Video clips of teachers using various assessment techniques
- Video clips of teachers' comments on 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 pre-service teachers to provide practical advice
- Text descriptions of each assessment category
- Teachers' resources and children's 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

Using a design research approach (Brown, 1992; Collins, 1992; Reeves, 2000), two studies were conducted over a five-year period to investigate the transfer effect of the multimedia program on the extent of use of alternative assessment strategies. The first study investigated these effects in pre-service teachers' teaching practicum, and four years later, the second study examined the effects when the same students were in their second year of teaching.

Figure 1. Annotated interface of the multimedia program



Transfer to School Practicum

In the first study, pre-service teachers explored a variety of assessment strategies appropriate to K-12 mathematics classrooms using the multimedia assessment program. The students spent three weeks of the semester examining strategies within the context of a complex and sustained authentic activity, where in small collaborative groups, they prepared and presented a report on a new assessment plan for mathematics in a school. In order to do this, they were asked to consult with experts, look at what was happening in classrooms, talk to teachers, talk to students and so on — all of which could be done “virtually” from the CD-ROM.

Three pairs of students were interviewed and observed as they used the multimedia program. An analysis of their conversation revealed that students used a substantial amount of higher-order thinking as they worked with the assessment program (reported in Herrington & Oliver, 1999). A study of the transfer of a variety of assessment strategies to classroom practice was conducted with the students as they completed two weeks of professional practice in schools approximately five weeks after the completion of their work on the assessment program (reported in Herrington, Herrington, & Sparrow, 2000). All the students were required to teach mathematics classes in this teaching practice, and it was expected that they would have the opportunity to implement some of the assessment strategies they had investigated in the

multimedia program. Students and their supervising teachers in the schools were interviewed and the comments were transcribed and analysed. Transfer was thought to have occurred if firstly, students using the interactive multimedia program on assessment had demonstrated a good understanding of the diversity of assessment approaches in the mathematics classroom and were able to articulate this understanding; and secondly, if 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). Analysis of the data showed that all the students could speak knowledgeably and confidently about assessment, and all the students used a variety of techniques to assess children's understanding. All pre-service teachers were influenced strongly by the supervising teacher in the schools, many of whom had planned assessment strategies in advance of the students' arrival. However, pre-service teachers still incorporated some informal assessment techniques — such as checklists, anecdotal records and open interviews — without the contribution or agreement of the supervising teacher. Five of the six students attributed their use of alternative assessment techniques directly to the interactive multimedia program. These findings were qualified by two mitigating factors: the brevity of a two-week professional practice and the substantial influence of the supervising teacher. In the words of one student: “I'm not the qualified teacher. I'm in their situation, in their room, conforming to their rules. So I can't just suddenly say: Hey, let's do some oral assessment.”

Many of the students in the first study were inhibited in the choice of assessment strategies by the influence and authority of their supervising teachers, in a way that may not have been an issue if the students were practising teachers with their own classes. In order to investigate this issue further, a follow-up study of those same students who had gained employment as teachers was carried out when the students were in the second year of teaching, four years after the first study.

Transfer to School Practice

Four students from the original study had gained employment as teachers, and all were in their second year of teaching. Three students (two female, one male) were teaching mathematics in private schools in the metropolitan area of Perth, Western Australia, and one (female) was teaching in a remote outback government school in the north of the state.

In addition to providing informal information about their teaching approaches, participants were interviewed at their schools, for approximately 90 to 120

minutes each, using an interview schedule described by Denzin (1989) as *Non-scheduled standardised interview*. Students were questioned about: their beliefs about assessment; their knowledge and use of assessment strategies in mathematics; the influence of factors such as school policy, colleagues, and national guidelines, on their assessment practices; and the influence of their teacher training on their current practices. Interviews and notes were transcribed and analysed using a qualitative data analysis program.

The longitudinal nature of the study, incorporating interviews with the same people over a four-year period of immense growth and change, provided a unique opportunity to observe the development of these teachers. Our initial impression of the pre-service teachers was that they were enthusiastic, idealistic and positioning themselves as agents of change in classrooms where they believed they could do better than the teachers they had observed. But as teachers, they seemed to have lost much of their enthusiasm, and were struggling to deal with a range of factors that appeared to have compromised their ideals. For example, Zoe (pseudonyms used) commenting on her practicum supervising teacher's use of assessment strategies in 1996, appeared to have a range of alternative strategies in mind which failed to be used in her teaching practice in 2000:

Interview with Zoe (1996) as a pre-service teacher:

[The multimedia program on assessment] 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 (2000) as a practising teacher:

Testing. That's the main approach. With years 8, 9 and 10 mainly topic testing, and then at the end of their year we do an exam to get them ready for Year 11 and 12 ... If you put it on a piece of paper, you know if they can interpret it. I don't think that sort of testing is fantastic for every student [because] some kids can't read very well ... It's hard for them, so it's got its weaknesses, but I can't think of another really appropriate assessment task.

Similarly, the enthusiasm Evie had in 1996 to try a range of assessment strategies in her own classes, by 2000 had been overwhelmed by significant social and cultural problems:

Interview with Evie (1996) as a pre-service teacher:

There were only limited types of assessment that I could use [on teaching practicum], 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 (2000) as a practising teacher:

I'd like to vary a lot of things, such as I'd like to do a lot more collaborative work with the kids, group work. And probably even presentation type stuff, where kids can actually demonstrate or explain their findings, whether it be an investigation or even project work ... I just find that all these fantastic ideas that I come up with, they usually seem to backfire when I use them in the classroom. I don't see myself as being a really boring teacher, I just think the kids — I'm not blaming it on the kids — but they just lack any self-motivation. And it's not just me, it's across the curricula. All the learning areas are having the same problems with the same kids. You can just tell when you don't have kids coming to school. I think the problem is they don't see the importance of education ... there is a high rate of kids dropping out, and girls falling pregnant at a young age which is really sad.

While the first study revealed constraints for the participants as pre-service teachers on professional practice (limited time and the influence of the supervising teacher), as teachers they were also faced with cultural and practical constraints. Constraints include the requirements of the mathematics department in the school, National Curriculum guidelines, issues of practical classroom management, personal issues (such as the amount of time that can be devoted to planning), and convictions about the suitability of certain types of assessment for certain students. Ensor (2001) found that beginning mathematics teachers in South Africa experienced similar constraints. As such, the teachers' pedagogical beliefs do not always translate to classroom practice.

These findings do not suggest the teachers' approaches to assessment will remain static. When prompted with various assessment strategies, all teachers indicated that they would be willing to try these techniques in the future. One teacher indicated that she would try journals as an assessment strategy when she could develop strategies to help students write them. Further research with the same teachers in 2-3 years' time might reveal more self-assured and confident classroom managers, by then willing and capable of using a variety of assessment strategies in appropriate ways in their mathematics classrooms.

A Way Forward

It is clear from this study that these teachers face challenges in their implementation of new assessment techniques learned during their pre-service teaching experiences. One confounding variable in this situation is teaching experience. Teachers may start to overcome constraints in their teaching once they establish themselves in schools and gain confidence. Unfortunately, the statistics on teacher retention suggests that this strategy might be self-defeating. In the USA, a national study by Ingersoll (2001) indicated that 39% of beginning teachers leave the profession in their first five years of teaching. A similar statistic of 30% was found in a UK national study (Adams, 2003). While no national studies have occurred in Australia, it is estimated that up to 25% of beginning teachers leave the profession in their first five years (DEST, 2003).

In an effort to overcome stagnation, pre-service educators and administrators need to develop strategies to help beginning teachers transfer innovative ideas into practice. The need for effective induction programs appears to hold merit, particularly where they involve mentoring programs. Such programs have generally evolved from individual school initiatives to district, state and national systemic approaches. Their success, however, appears to depend to a large extent on the individual school culture and the support provided by the principal (DEST, 2002). For those beginning teachers who enter schools where such support does not exist, then other strategies need to be available, such as participation in collegial groups outside of the school walls.

In recent years, a number of online sites have become available to provide support and professional development for beginning teachers (e.g., Ontario Teachers' Federation's *Survive and Thrive Virtual Conference for Beginning Teachers*; Indiana University's *Novice Teacher Support Project*). Typically these Web sites provide resources linked to the appropriate educational system, and importantly provide a system of mentoring and support that enables novice teachers to seek advice from content and issues experts. These sites may also provide connections to other beginning teachers where a virtual *community of practice* (Wenger, 1998; Wenger, McDermott & Snyder, 2002) develops. In such a way, the problems faced by beginning teachers can often be resolved in a collaborative and authentic way. These sites hold much promise, although effective strategies for design, implementation, and sustainability of these online communities has not been clearly defined. In addition, further research is needed to explore the impact these online communities have on teacher retention and transfer of pedagogical knowledge and practice (Herrington, Herrington, Lockyer, & Brown, 2004).

Conclusion

The notion of transfer implies a situation where people have the choice to apply the knowledge they have learnt. Unapplied knowledge suggests the learning environment may be inadequate for transfer, and modifications may be necessary in order to promote transfer. As Bransford, Brown and Cocking (2000) indicated, transfer involves a number of factors: a threshold of initial learning must be achieved; thoughtful and meaningful learning must occur; knowledge needs to be learnt in a variety of contexts; transfer involves knowing *how* as well as *when* to use knowledge; transfer effects subsequent learning; and, all learning involves transfer (p. 235). Even if all of these conditions are met, evidence of transfer may exist within teachers' changed beliefs but not in practice, simply because of external constraints. Removing those constraints, or providing novice teachers with professional experiences to deal more effectively with them, might enable the vision of modern theories of education to transfer to practice early in a teacher's career, rather than later.

To paraphrase Eisner's earlier quote: it's what novice teachers do with what they learn *when they can do what they want to do* that is the real measure of teacher education. Establishing communities of practice where beginning teachers are supported by their peers and experienced teachers, may well provide an "authentic community" in which beginning teachers feel secure to transfer the pedagogical knowledge encountered in their teacher education courses.

References

- Adams, C. (2003). *Address to the North of England Education Conference*. Retrieved June 2004, from <http://www.gtce.org.uk/news/newsDetail.asp?NewsId=480>
- Ball, D. (1990). The mathematical understandings that prospective teachers bring to teacher education. *The Elementary School Journal*, 10(2), 17-24.
- Brown, A.L. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *The Journal of the Learning Sciences*, 2(2), 141-178.
- Brown, C.A., & Borko, H. (1992). Becoming a mathematics teacher. In D.A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 209-239). New York: Macmillan.

- Brown, J.S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18(1), 32-42.
- Cognition and Technology Group at Vanderbilt. (1993). Anchored instruction and situated cognition revisited. *Educational Technology*, 33(3), 52-70.
- Collins, A. (1992). Towards a design science of education. In E. Scanlon & T. O'Shea (Eds.), *New directions in educational technology* (pp. 15-22). Berlin: Springer-Verlag.
- Collins, A., Brown, J.S., & Newman, S.E. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In L.B. Resnick (Ed.), *Knowing, learning and instruction: Essays in honour of Robert Glaser* (pp. 453-494). Hillsdale, NJ: LEA.
- Comiti, C., & Ball, D. (1996). Preparing teachers to teach mathematics: A comparative perspective. In A.J. Bishop, K. Clements, C. Keitel, J. Kilpatrick & C. Laborde (Eds.), *International handbook of mathematics education* (pp. 1123-1153). Dordrecht: Kluwer.
- Denzin, N.K. (1989). *The research act: A theoretical introduction to sociological methods* (3rd ed.). Englewood Cliffs, NJ: Prentice Hall.
- Department of Education Science and Training. (2002). *An ethic of care: Effective programmes for beginning teachers*. Canberra, AGPS.
- Department of Education Science and Training. (2003). *Australia's teachers: Australia's future: Advancing innovation, science, technology and mathematics*. Canberra: AGPS.
- Ensor, P. (2001). From preservice mathematics teacher education to beginning teaching: A study in recontextualizing. *Journal for Research in Mathematics Education*, 32(3), 296-320.
- Herrington, A., Herrington, J., Lockyer, L., & Brown, I. (2004). Beginning teacher network: The design of an online community of practice for beginning teachers in Australia. In L. Cantoni & C. McLoughlin, (Eds.), *Proceedings of EdMedia 2004: World Conference on Educational Multimedia, Hypermedia & Telecommunications* (pp. 3251-3257). Norfolk, VA: AACE.
- Herrington, A.J., Sparrow, R.L., Herrington, J., & Oliver, R.G. (1997). *Investigating assessment strategies in mathematics classrooms* [Book and CD-ROM]. Perth: MASTEC, Edith Cowan University.
- Herrington, J., & Oliver, R. (1999). Using situated learning and multimedia to investigate higher-order thinking. *Journal of Interactive Learning Research*, 10(1), 3-24.

- Herrington, J., & Oliver, R. (2000). An instructional design framework for authentic learning environments. *Educational Technology Research and Development*, 48(3), 23-48.
- Herrington, J., Herrington, A., & Sparrow, L. (2000). Assessment strategies: Using multimedia to promote transfer to classroom practice. In J. Bana & A. Chapman (Eds.), *Mathematics Education Beyond 2000: Proceedings of the 23rd Annual Conference of the Mathematics Education Research Group of Australasia* (pp. 307-315). Perth: MERGA.
- Ingersoll, R.M. (2001). *Teacher turnover, teacher shortages, and the organization of schools*. Washington: University of Washington, Center for the Study of Teaching and Policy.
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University.
- Novice teacher support network*. Retrieved September 17, 2004, from <http://ntsp.ed.uiuc.edu/>
- Park, I., & Hannafin, M. J. (1993). Empirically-based guidelines for the design of interactive multimedia. *Educational Technology Research and Development*, 41(3), 63-85.
- Reeves, T. C. (2000). Socially responsible educational research. *Educational Technology*, 40(6), 19-28.
- Resnick, L. (1987). Learning in school and out. *Educational Researcher*, 16(9), 13-20.
- Survive and thrive virtual conference for beginning teachers*. Retrieved September 17, 2004, from <http://www.survivethrive.on.ca/>
- Wenger, E. (1998). *Communities of practice: Learning, meaning and identity*. Cambridge: Cambridge University.
- Wenger, E., McDermott, R., & Snyder, W. M. (2002). *Cultivating communities of practice: A guide to managing knowledge*. Boston: Harvard Business School.
- Whitehead, A. N. (1932). *The aims of education and other essays*. London: Ernest Benn.