A Situated Perspective on Learning to Teach Secondary Mathematics

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This paper applies a situated perspective on learning to investigate the process of becoming a secondary mathematics teacher. We followed a group of beginning teachers into their early teaching careers. Each participant was interviewed on three separate occasions during their university studies in order to examine how they interpreted their practicum experiences. In the following year, we again interviewed some of the participants to investigate their sense of self as mathematics teachers and to document the issues which they identified as significant in shaping their classroom practices. The beginning teachers saw the culture of the school and pedagogies of more experienced colleagues as the most important factors affecting their professional growth and ability to implement Working Mathematically in the classroom.

Introduction

Calls to reform the learning and teaching of secondary mathematics have been around for over a decade and their message is quite consistent. They call for a seismic shift away from a view of mathematics as the accumulation of rules and formulae which are drilled and practised to one where mathematics is a sense-making activity and learners are actively engaged in their lessons. However, despite a growing tradition of reform-oriented documents and syllabuses, research suggests that little has changed (e.g., Hollingsworth, Lokan, & McCrae, 2003). There is, in many mathematics classrooms, a reliance on a "shallow teaching syndrome" (Stacey, 2003) where students complete a large number of repetitive, low complexity problems often by blindly copying procedures at the direction of their teachers.

How then can the message of the reform movement start to take root in schools and begin to bring about the reformist vision? One possibility often proposed is through the work of beginning teachers who are trained according to constructivist principles in their university studies and encouraged to experiment with student-centred approaches in their school-based practica. In doing so, it is hoped that these novice teachers might act as agents of change who can carry the message of reform into schools and provide an example of constructivist pedagogy for their more experienced counterparts. Yet this too can be a problematic path due to the ever-present influence of the school culture and the likely impact it may have in shaping how beginning teachers learn their craft.

This paper examines the experiences of a group of secondary mathematics teachers in their first year of employment in schools. Our research is underpinned by a socio-cultural framework which interprets the process of becoming a teacher from a "situated perspective" (Greeno, 1998) as we investigate the extent to which the school culture influences the ideas and practices of beginning teachers.

Situated Learning

Fullan and Hargreaves (1996, p. 37) define the school culture as "the guiding beliefs and expectations evident in the way a school operates particularly in reference to how people relate (or fail to relate) to each other. In simple terms, culture is the way we do things and relate to each other".

Cognitive learning theories consider the acquisition of knowledge as a change in conceptual structures within the mind of an individual. As such, what is learned is largely independent of the context in which the learning takes place. From a cognitive perspective, knowledge is viewed as an entity which is acquired in one setting and can be readily transferred to other situations. Situated theories, on the other hand, regard learning as located in particular forms of experience and not simply in the mind. From a situated perspective, the learner and what is being learned are always situated in activities, processes and contexts. Situated paradigms therefore focus primarily on how individuals interact in socially organised activities or practices that are oriented towards specific goals and are always contextualised because the nature of what is learned is shaped and influenced by the environment in which learning takes place.

Learning is distributed across the individual, interactions with others, and different kinds of artifacts such as language, symbols and tools (Wenger, 1998). So, while cognitive approaches focus on knowledge, situated perspectives view learning as authentic participation in the discourse and practices of a community i.e. within the culture of the school. Learning is therefore regarded as a social activity that involves individuals making sense of their experiences as they increase the range and level of participation in the norms and practices of a community (Lave & Wenger, 1998).

Participation is described in terms of negotiating new meanings through the accumulation of experiences that arise from active engagement in "communities of practice" (Wenger, 1998). Communities are critical because they help to shape the knowledge and skills that are learned and how this learning occurs (Franke & Kazemi, 2001). At the same time, the practices of the community are themselves always evolving since individuals both participate in and contribute to the development of the practices of their community based on their prior experiences and the unique perspectives which they bring with them (Rogoff, 1995). There is merit, therefore, in analysing not only the practices of the community but also the diversity of each individual's mode of participation within it (Cobb & Bowers, 1999).

An important aspect of situated theories of learning concerns the consistency of patterns of participation across different settings and the extent to which engagement in one context can facilitate successful participation in another. Ensor (2001) refers to the notion of "recontextualizing" as a "process of disembedding, reembedding and change" (p. 297) to describe how resources, tools and discourses can be transformed across contexts. These ideas are useful in the present study which seeks to understand whether or not the practices learned by pre-service teachers in the practicum are recontextualised in their first year of teaching and the extent to which immersion in the practice of teaching can sometimes create a barrier for beginning teachers who wish to implement a reform agenda.

Situated perspectives can offer a useful means of analysing the professional growth of teachers (Lerman, 2000) because they focus on schools where beginning teachers work with their more experienced counterparts (Putnam & Borko, 2000). Situated approaches consider classroom social practices and examine patterns of classroom discourse and the kinds of activities in which teachers and students are engaged. Learning to teach is therefore viewed as a process in which beginning teachers increase their participation in the activity of teaching and, through this participation, gain knowledge and insights about the practices of teachers (Adler, 1998). In other words, beginning teachers learn to teach by interacting directly with their colleagues in schools, by talking with them, and by taking part in specific activities associated with teaching. They become part of the culture of the school by adopting its norms and practices and by observing other teachers as they work (Stein & Brown, 1997) and they often learn what is valued and practised by their colleagues (Stein, Silver, & Smith, 1998).

Peressini, Borko, Romagnano, Knuth and Willis (2004) identified a focus on individuals and their contexts of practice as a promising way forward for developing ideas about the process of learning to teach secondary mathematics. In this paper we investigate how the context of the school of employment (Year Two of the study) affects beginning teachers' perceptions of themselves as teachers and their classroom practices. The study took place during implementation of a new secondary mathematics syllabus which emphasised Working Mathematically, so we were particularly interested in the participants' reports on how they were implementing the Working Mathematically strand of the syllabus and the aspects which they identified as influencing their decisions. For a discussion of the pre-service teachers' practicum experience (Year One of the study), see Cavanagh and Prescott (2007).

Method

Participants

The participants in Year One of this study were ten pre-service secondary mathematics teachers who were enrolled in one-year Graduate Diploma of Education courses taught by the authors in two universities. The beginning teachers who obtained full-time employment in metropolitan schools were invited to participate in Year Two of the project. Four teachers agreed to take part and this paper reports on Year Two.

Data Collection

The four first-year teachers were interviewed individually for approximately 30 minutes in the middle of the school year. All of the interviews were semi-structured and designed to probe the participants' views of themselves as developing teachers and the particular impact of the school culture in their schools of employment.

Data Analysis

The analysis was conducted by firstly reading the interview transcripts and noting common responses. From this initial reading, three broad categories were identified in terms of the likely impact of the school culture: self-perception, implementation of working mathematically, and general classroom practices. Specific themes began to emerge as recurring phrases and sub-categories were identified within each of these broad research foci. The presentation of the findings of the research is organised according to these three key components.

Results

Self Perceptions

Many studies (e.g., Adams & Krockover, 1998; Kardos & Johnson, 2007) have found that beginning teachers find their first year of teaching stressful, chaotic, a roller coaster ride, and emotionally draining as they find themselves in a situation where they move from one 'crisis' to the next. The school culture can increase or minimise the acculturation shock felt by so many beginning teachers.

It was very easy for the beginning teacher to obsess about the relatively small number of difficult students they dealt with and lose sight of their achievements.

> Low points. Every day, one out of 60 kids doesn't do it. Or, you know, has been rude or whatever and I was concentrating more on that one person than the whole lot. It took me a while to sort of think: You know, there were 60 today and just one was out of whack. But it was very draining. [Neroli]

Beginning teachers are torn between wanting others to perceive them as effective teachers and wanting support – far more than the other teachers around them. Teaching is one of the few professions that 'throws' new practitioners in at the deep end, allowing them to function in the classroom on their own in exactly the same way as experienced teachers. This can be a very solitary experience and may even be a terrifying prospect if the beginning teachers perceive they are without support (Kardos & Johnson, 2007). In an attempt to fit in, or at least not stand out as a new teacher, beginning teachers believe that 'toeing the line' will help them show the other teachers that they are competent. To this end they find it hard to ask for help because they do not want to appear to be floundering and besides, the other teachers all look so busy. Unfortunately, many experienced teachers believe that beginning teachers are not assisted in their development as teachers by being mollycoddled with too much help.

> I guess one thing would be good if the mentor came in and observed my lessons … Not necessarily to grade me but to say I can see some difficulties, here are some things you can do. [Stephen]

The beginning teachers' perceptions of themselves as teachers were also coloured by the feeling that they never had a spare moment. The administrative details of their job and activities such as playground duty took them away from their work as teachers. They were keen to produce excellent lessons but spent so much time on details outside the classroom that the idea of being a reflective teacher could not happen.

> I've got about eighteen lessons a week but in addition to that I've got things like sports… so that's time I can't use for anything else. I've got assembly … pastoral care, those kind of other things. [John]

Implementing Working Mathematically

The study also sought to determine the ability of the beginning teachers to implement the Working Mathematically strand in the classroom. The emphasis in the syllabus requires a less textbook oriented approach to teaching mathematics and the emphasis in the university courses supports this. However, many teachers are predominantly textbook oriented and so the culture of the school does not support the beginning

teachers as they seek to incorporate a working mathematically approach to their teaching. Beginning teachers also see 'fitting in' as conforming to the style of teaching exhibited by their more experienced colleagues so working mathematically becomes problematic (Boomer & Torr, 1987; Schuck, Brady, & Griffin, 2005).

The beginning teachers recognised the need for a balance between the traditional textbook approach and the working mathematically approach to mathematics teaching but were also sure they were not yet getting the balance right. There is an unresolved tension in that the beginning teachers saw the value of working mathematically but were fearful that teaching that way would take longer and probably create classroom management issues. They said they would postpone working mathematically until they felt more confident in the classroom.

> I know [less able students] need [working mathematically] the most but I just fear that if I do this that they won't listen or they'll muck up. [Stephen]

> Once I establish a good relationship and ... good communications with them ... then I'll be popping up interesting questions. [John]

Many of the beginning teachers found resources were limited to textbooks. Of course, if experienced teachers see little point in spending money on resources, the textbook will dominate the classroom. One school used the textbook rather than the syllabus as its programming document making anything but a textbook oriented approach much harder.

Because the beginning teachers were on probation, they felt they had to keep a tight rein on their students and they felt that a textbook oriented style of mathematics teaching made this easier. They were fearful of trying something new in case it did not work, especially as the students were not used to working mathematically.

> You're on probation and you've got a teaching certificate to get so you don't want to be taking too many risks. The teachers often walk past my classroom so you want to keep the class reasonably quiet. [Stephen]

The beginning teachers' lack of experience in the classroom and (perceived) lack of support in the staffroom also led to a belief that the textbook would help their students because the examples were all pitched at the right level. It allowed them to concentrate on their explanations and classroom management.

> I have the support of the textbooks so I'll be focussing on my ability to explain things, try and keep the right level, use the right words etc. [John]

One of the beginning teachers was keen to undertake working mathematically in the classroom. During the practicum his supervising teacher made it very clear that he must prepare textbook oriented lessons but now he felt he had support from the school and the freedom of his own classes and was enjoying the experience. The support had come from the availability of resources and from a variety of people, including a mentor, the head of department and the principal.

> I guess I had a number of philosophical differences with my supervising teacher [last year in the practicum]; just, totally different approach. So [this year] I was finally able to do what I wanted to do. I didn't have to worry so much, you know, I could, if I wanted to do a lesson and have a discussion for the most of, you know, most of it or whatever then that was my decision to do, and I didn't feel like I was having to please somebody else. [Peter]

Despite the encouragement of his mentors, this beginning teacher was still using the more traditional approach because he saw this as more closely conforming to the culture of the school.

The beginning teachers also felt pressure from their colleagues to keep up with parallel classes so that all material had been covered in time for the examinations. While they knew that pushing students through the work in this way was not effective teaching practice, showing their colleagues that they were competent teachers had much greater impact on their teaching.

> You've got to try to teach the material so that they can have some opportunity to do well in the exam … I'm trying to push them through the work so at least they've seen it. … So long as you've taught it, that's OK. But whether they've learned it or not is immaterial. [Stephen]

It was not a case of making sure the students understood the work, rather it was a case of 'covering' the material in class so you could sign off the register. The beginning teachers also knew that the examination questions were usually procedural and that they would be unlikely to test conceptual understanding (despite working mathematically being central to the syllabus).

Many students' experience of mathematics teaching was almost exclusively instrumentalist so they were used to being told how to do their mathematics by a rule and then practice. A working mathematically approach to teaching requires more from the students and so there was conflict between beginning teachers who wanted to develop conceptual understanding and students who just wanted to know how to do the examination questions. The resistance from students discouraged the beginning teachers from pursuing anything but a traditional lesson, and those who tried and felt their lessons were poor were fearful of trying again.

> They said why are we doing this? We don't need this. They rebelled. [John]

Classroom Practices

The beginning teachers' ideas about being effective in the classroom were limited to being able to deal with classroom management issues and being a good communicator so that explanations were clear. The problem for them was that they saw the discipline issues as emanating from their inability to cater for the range of abilities in their classes. They saw the main problems as adapting to the needs of different classes and determining the amount of work to be covered in each class. Added to this, the full teaching load made lesson preparation and reflection a luxury rather than an essential component of good teaching practice.

Classroom management problems meant that many hours were needed to follow up recalcitrant students and in dealing with students who needed extra help. The inability to deal with the various levels of ability in the classroom meant that lunchtimes were used for helping students to catch up with their work and to improve understanding.

> I see a lot of students benefiting from individual attention which I can't give them during a normal lesson and I tell them 'Look you have to come for a lunchtime because I want to cover this area in detail with you' [John].

To the beginning teacher, experienced teachers appear to prepare lessons with little time and energy (particularly if it is straight from the textbook). This ability to prepare lessons at will only served to emphasise the time pressure experienced by the beginning teachers. This meant that the time-consuming creation of worksheets and development of activities gave the beginning teachers the idea that they were always catching up rather than working as competent teachers.

> I often don't have time to reflect on what worked and what didn't. I do sometimes but not half as much as I would like to … it's basically trying to survive to the next lesson. [John]

Discussion and Conclusion

We investigated the beginning teachers' sense of themselves as teachers, and the issues that they saw as influencing their classroom practice, particularly their implementation of working mathematically. The situated learning framework allowed us to interpret the comments made by the beginning teachers about their classroom practice and identify the factors that they regarded as impinging on their ability to become more effective practitioners.

While we separated the results into three discrete categories because we saw them as common themes in the interviews, in reality many of the discussions showed links across the three domains of self-perception, implementing working mathematically and classroom management. In other words, the beginning teachers did not always see these as separate issues, so the examples they used and the stories they told during the interviews demonstrated an interconnectedness between them.

The beginning teachers sometimes found themselves receiving mixed messages about what constituted being an effective teacher. On the one hand, more senior colleagues encouraged them to experiment with student-centred activities in their lessons, but the culture of the school and the example of other teachers was very traditional and did not appear to support a working mathematically approach because the textbook was the

dominant resource. The beginning teachers were not confident in their pedagogy and chose to resolve this dilemma by conforming to the dominant practices of the school in the hope of being seen as effective in the classroom. Clearly the culture of the school was a powerful influence on their decision-making, counteracting ideas they professed during their university year (Prescott & Cavanagh, 2006).

The beginning teachers were also confronted by the relative ease with which their more experienced colleagues prepared and delivered traditional style lessons which appeared to be successful – success being predominantly measured by the school in terms of quiet classrooms and acceptable scores on common tests. The contrast between the relative calm of other teachers and their own highly anxious state forced the beginning teachers to acknowledge the impact of the daily struggles in learning to teach. Faced with this situation, they chose to adopt the style of their colleagues in the hope that their lessons would become easier to prepare, classroom management would improve and their students would see them in a positive light. Again, we see the culture of the school as a dominant force in shaping the practices of beginning teachers.

Woods and Weasmer (2004) suggest that there are reciprocal benefits when experienced teachers and beginning teachers share their ideas with each other – including a clearer understanding of the school culture and a stronger sense of what is expected. Only then is it possible that beginning teachers might be agents of change within the school.

Our work indicates the pervasiveness of the context in which teachers work. Mathematics teacher educators, and colleagues and mentors of beginning teachers should all be aware of this influence and provide beginning teachers with the skills necessary to identify and deal with the impact of the culture of the school. The participants in our study claimed that they would adopt a more working mathematically approach when they saw themselves as competent teachers who had earned the respect of their colleagues and their students. Further research could be undertaken to test this assertion and determine whether the culture of the school maintains its influence as the teachers become more experienced.

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