

# Supporting Beginning Primary Mathematics Teachers through a 'Fellow Worker' Professional Development Model

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A large study tracked four primary teachers during their first year of teaching, with a focus on how a 'fellow worker' professional development support model influenced their pedagogical practices and beliefs concerning mathematics. The case studies used an interpretive research approach for analysis of data from interviews, observations, reflective journals, and group meetings. The findings highlight how the realities and challenges of beginning teachers' classroom experiences prompted adoption of 'traditional', teacher-centred mathematics pedagogy. Support in the form of a 'fellow worker' helped the beginning teachers survive and then begin to teach in ways consistent with current trends in mathematics education.

Current reform efforts in mathematics education have been setting ambitious goals for schools, teachers and students (e.g. Australian Education Council, 1994; Department of Employment, Education and Training, 1989; National Council of Teachers of Mathematics, 2000). In these efforts, mathematics classrooms are envisioned as places where teachers and students engage in rich discourse about important mathematical ideas while exploring problems grounded in meaningful contexts. Such views are a departure from a 'traditional' mathematics classroom in which teachers tell students how to think about concepts and how to perform particular procedures, with students then expected to practise skills and reproduce ideas. These two perspectives for mathematics classrooms are based on different assumptions and beliefs about the nature of mathematics and effective mathematics teaching and learning. Hence, to move forward with a reform agenda requires substantial learning on the part of many teachers because the new perspectives challenge teachers' mathematics knowledge, beliefs and teaching practices. Progress is unlikely to happen without the support and sensitive guidance of appropriate professional development (Borko & Puttnam, 1998).

It was the context of mathematics education reform that motivated the study upon which this report is based, while the more focused concern for appropriate professional development for teachers arose from the recognition that teachers are key in any reform agenda. Their learning needs must be accounted for if beneficial change is to occur. The overall study from which this paper arose (Sparrow, 2000) aimed to examine three main things:

- How a range of personal and contextual factors impact upon beginning primary mathematics teachers' pedagogical practices;
- How these factors impact upon beginning primary mathematics teachers' pedagogical beliefs; and
- The effectiveness of an empowerment model of professional development that incorporates a 'fellow worker' support mechanism.

The focus of this paper is upon key findings that arose from the larger study with regard to the third research area. However, since the 'fellow worker' played an influential role in

supporting the teachers as they made pedagogical decisions, the first two research foci are integrated into the discussions with further details available in Sparrow and Frid (2001a, 2001b). The research is of significance in reporting on the challenges faced by beginning primary mathematics teachers, the related choices they make, how the foci or nature of their decisions change as they develop professionally, and, most importantly, how a 'fellow worker' can play a valuable role in this development.

## The 'Fellow Worker' Professional Development Model

### *Teacher Professional Development: The General Context*

Teacher professional development, as conceived of in this study, aligns with constructivist philosophy in that learning to teach is viewed as a process of personal growth that is influenced by beliefs, commitments, and ways of operating in and interpreting one's world (von Glasersfeld, 1995). Here, teacher professional development is "that natural process of growth in which a teacher gradually acquires confidence, gains new perspectives, increases knowledge, discovers new methods, and takes on new roles" (Jaworski, 1993, pp. 10-11).

It might be expected that beginning teachers in Australia, having completed pre-service education within a mathematics reform context, would be leaders of change. Mathematics teacher education programs today, as indicated by the perspectives adopted by commonly used mathematics education textbooks (eg. Bobis, Mulligan, Lowrie, & Taplin, 1999; Klein, 2000), promote mathematics as more than a collection of facts and skills to be taught in a routine, drill-oriented fashion. They offer, instead, a view of mathematics teaching and learning that sees students engaged in inquiring, problem solving, meaning-oriented, relevant endeavours. However, earlier, *The Discipline Review of Teacher Education in Mathematics and Science* (Department of Employment, Education and Training, 1989) noted a discrepancy between what was taught in teacher education courses and what evolved later in teachers' classrooms. This finding highlighted a need to address the professional development of beginning teachers, yet, over a decade later, means by which growth can be facilitated are not fully understood and articulated within the educational literature.

### *The 'Fellow Worker' Model*

An intent of this study was to design a professional development model specifically aimed at supporting beginning primary mathematics teachers to develop skills and confidence to acquire knowledge and competence in their teaching as needs arise. Extensive examination of the research literature related to teacher professional development indicated several factors that would need to be incorporated into the professional development model, including: (i) fostering teachers' development as reflective practitioners (Clarke, 1994; Clarke & Peter, 1993; Prawat, 1991; Pultorak, 1996), (ii) empowering teachers to be decision makers and take actions (Begg, 1996; Clarke, 1994), (iii) the nature and role of adult learning (Knowles, 1984; Feiman-Nemser, 1992), and (iv) the need for support from a more experienced colleague (Feiman-Nemser, 1992, Speck, 1996). The 'fellow worker' professional development model was therefore designed as empowerment via *reflection* and *experimentation*. More specifically, it was designed to use the researcher as a more experienced colleague (a fellow worker) who would support the beginning teachers in the process of reflection, consideration of options

related to teaching practices, and small-scale experimentation with options. This role meant the fellow worker was a hybrid of a critical friend, colleague, listener, mentor, resource person, and supportive, interested person. His role was also as a catalyst by which the beginning teachers could reason about and learn from their own teaching experiences. In this context it was recognised that, as Easen (1985) noted:

You cannot change other people, nor can they change you; people can only change themselves. The best anyone can do is to provide a structure, which helps others to change, if that is what they want to do. (p. 71)

Consequently, the fellow worker had to be more concerned with choice than with change, and be wary of reinforcing his self-image of mathematics teaching irrespective of the needs and wishes of the beginning teachers. At the same time, as a professional, he could not be too 'laissez-faire' and allow an 'anything-will-do' attitude. Key features of the structure that framed the fellow worker professional development model are outlined in Figure 1 along with the literature sources from which these principles were developed.

- The fellow worker will be an experienced teacher (Clarke, 1994; Feiman-Nemser, 1992; Speck, 1996);
- The beginning teacher is empowered to decide which problem or issue will be the focus of attention (Begg, 1996; Clarke, 1994; Knowles, 1984);
- The beginning teacher is empowered to decide what will happen in the classroom or elsewhere to address the problem or issue (Clarke, 1994; Knowles, 1984; Speck, 1996);
- Options for action will be decided between the fellow worker and beginning teacher, but the beginning teacher will choose which option to put in to action (Feiman-Nemser, 1992; Knowles, 1984);
- Reflection on practice and beliefs of the beginning teacher will be emphasised (Clarke, 1994; Clarke & Peter, 1993; Eason, 1985; Prawat, 1991; Pultorak, 1996; Speck, 1996);
- Beliefs and assumptions about mathematics and mathematics teaching and learning will be examined (Thompson, 1984);
- Experimentation in the classroom will be encouraged to provide data and evidence for reflection (Clarke, 1994; Clarke & Peter, 1993);
- Meetings with other beginning teachers will be established (Barnett, 1992; Clarke, 1994).

(Adapted from Sparrow, 2000, p. 72)

*Figure 1.* Key features of the fellow worker professional development model.

## Method

Since its aim was to understand the nature of a professional development learning environment and the ways beginning teachers interacted with it, this study was designed as a naturalistic, interpretive inquiry. Hence, qualitative methods, with their capacity to emphasise contexts, meanings, and individuals' interpretations, were adopted.

More specifically, the research involved case studies of four beginning primary teachers with the researcher (author 1) in the role of 'participant-as-observer' by serving as the fellow worker of the professional development model. The beginning teachers were volunteers for the research and they all had recently completed a one-year Graduate

Diploma in Education in Western Australia after prior completion of a three-year Bachelor's degree. The sample consisted of two males (Harry and Gaz) and two females (Stephanie and Tiffany). This was not typical of the overall enrolment in the diploma course, where generally males are in the minority. However, proximity to the university and the need for the researcher to visit the teachers on a regular basis governed selection of participants. All four teachers were assigned to multi-aged classes for their first teaching position. Stephanie had a Years 5/6 class, Harry had a Years 5/6/7 class, and Tiffany and Gaz each had Years 2/3.

Data were collected from interviews, teacher and researcher journals, group meetings, and classroom observations. Interviews occurred at least twice each term, while group meetings took place at the end of Terms 1, 2, and 3. Interview transcripts were the initial data analysed, with the other data sources used to substantiate and expand themes identified in the interview data. Hence, data analyses proceeded inductively, with NUD\*IST as a data handling tool (Qualitative Solutions & Research, 1997). Initial nodes for use in NUD\*IST were selected from factors identified from the literature as relevant influences upon pedagogy.

## Findings

The following discussion considers the two fundamental features of the model of empowerment: *reflection* and *experimentation*. These overviews are followed by consideration of the overall effectiveness of the model for supporting the beginning teachers and engendering change. The case of Stephanie is used as an exemplar of the overall findings that were in common amongst the four beginning teachers. This provides a complete, coherent, and authentic account of one teacher's experiences without fragmenting the common findings amongst more than one teacher. The discrepancies that arose between the four teachers are touched upon in the section on the study's implications.

### *Reflection*

The beginning teachers found it was difficult to find time to reflect on what was happening in their classrooms. The fact a fellow worker visit had been organised meant a time was actually committed and the reflection process could begin. Without the catalyst of the professional development model it appeared unlikely that time for reflection would have been found, as noted by Stephanie:

There's so much time just getting through day-to-day, and to do in the day, that you don't have time to really sort of plot and think a lot about what you are doing. (Stephanie)

Initially the fellow worker prompted reflection by asking the teachers to describe successes and failures they had experienced in their mathematics teaching. Questions were sometimes specific to the situation, inviting the beginning teacher to reflect on what had happened since a previous conversation concerning specific teaching endeavours. When possible, the fellow worker asked questions designed to encourage teacher reflection in a way that would remind the teacher that she had prior valuable knowledge related to children and how they learn, or guidelines and ideas in mathematics curriculum documents. In this way, features of changed or developing practice were highlighted to help the beginning teacher realise that she was actually developing into a different teacher.

For Stephanie, this approach helped her to see and articulate the journey she was undertaking. Hence, as a result of the meetings and related reflections, teaching successes

and weaknesses were considered. From these considerations positive features were noticed and later built upon. For example, in the following interview excerpt, Stephanie notes how trying a group work activity with her students led to valuable learning for her students:

And it was quite interesting using paper. I think we had three sessions. Like they started off really well and there were four groups and they did all different things. One group began cutting out triangles and then one group traced around them, and one group actually worked out that one triangle was double the next one, and was double the next one. And did it like that and did it very quickly.

Talking incidents through with another person appeared to clarify aspects of what had happened and provided Stephanie with insights into children's thinking and understandings, as well as the complexity of the task of teaching. For example, the following transcript related to students exploring the concept of area reveals how Stephanie was enabled through the reflection process to 'see' the children in a different way, as individuals rather than as a homogeneous mass:

Stephanie (S): ... but one girl actually worked out that she had gaps and she knew you couldn't have, you couldn't have gaps. You couldn't work out gaps and she actually came up with using plasticine. 'And have you got any plasticine I can use to fill in the gaps?'

Fellow Worker (FW): What? So she squished the plasticine up?

S: Yeah, ... then she realised she could not measure how much plasticine she'd used. And so she actually made her plasticine into two centimetre little worm things. ... And she was the only one who explicitly came out and said, 'But there's gaps. And like, no I can't have those. What shall I do about it?' And that was quite good thinking. A pleasant surprise I suppose.

FW: So going back and thinking, and I think our initial conversation was you actually wanted to know where to start with kids, and what they knew. Do you think something like this ... do you think something like that is helpful?

S: Yeah, because there were some kids who had that kind of understanding and some kids who didn't. Some kids just put the round counters and then counted how many counters and didn't care if there was bits left over. Yeah, like I would probably say, yes that kid knows space and that kid doesn't. Maybe use two groups in the classroom, [rather] than have one lot.

Stephanie's last comment about the possibility of using two distinct learning groups in the classroom shows how reflection led her to consider other ways of teaching mathematics beyond having all the class complete the same task in the same way. This capacity to see alternatives did not arise until Term 3 of the school the year, as outlined in the next section, but once it did emerge it led to changes in her teaching.

### *Experimentation*

Insights into pedagogical practice and the possibilities of other, maybe more effective, ways became apparent as Stephanie's reflective talk continued into the second half of the year. She began to consider differences in children's achievements, while also considering how she might change her teaching methods to develop other aspects of their learning. For example, she wanted to develop more talk amongst students when they were working in groups, so she thought about how that might be facilitated by the way she designed the task:

S: ... even though they were in small groups they were actually, it was, 'How big is my foot?' Not how big is one [person's] foot, you know, even though they were working in groups. They were still

all actually measuring [on their own], so maybe if they were, you know, all told to pick one person out of the four and find out how big their foot was, they might have to sort of do more talking to each other, and that might have made [their] writing easier, and the marking easier.

Another of the earlier successes in Stephanie's teaching, which in turn led to a gradual change in her teaching style, was associated with mental mathematics. In the first term and part of the second term, mental mathematics was a 'traditional' exercise of recall and speed. A simple and small option, changing from asking for the answer to supplying the answer and asking for a possible sum, provided a catalyst for further experimentation. For example, she used questions such as: "The answer is 12, What is the sum?" After getting a positive response from the children in relation to their learning she endeavoured to ask more questions aimed at requiring the students to think.

As Stephanie's confidence with her ability to control the class and her success with a teaching style other than teacher-directed and procedural continued to grow, she began to try other ideas. She did this even when she was not convinced they would actually work. This risk taking led to some success, and in turn this prompted her to question her beliefs about mathematics teaching and what the children could achieve:

S: That lesson on the types of multiplying, I was just blown away. I was just like, 'There's no way they're going to be able to make that connection between the squares and the digits.' But they said, 'Oh yeah, that's this and that's that.' All very easy. Probably that made me see that doing something like that constantly first really does actually get it. ... you always knew the theory of it, but having actually seen it like clearly ..."

### *Aspects of Change and the Role of Support in the First Year of Teaching Mathematics*

Initially, Stephanie's teaching style was directed to the whole class with everyone doing exactly the same activity and with the same learning objectives (also see Sparrow & Frid, 2001a, 2001b). Later, through the support of the fellow worker and related reflection and experimentation, Stephanie changed her practice. She began to use group work with the children, and at times each group had a different task to complete. There was also a change of emphasis. The children were now sometimes required to think and solve simple problems. This was in contrast to her earlier teaching in which the children merely followed instructions. Talk by children, as part of learning mathematics, also gradually became a feature of her pedagogy over her beginning year. Initially, children worked "on their own" and generally worked in silence. Stephanie had used that initial time to establish control of the children, what they were doing, and what they were (supposedly) learning.

The development towards group work and children discussing mathematics was not an easy transition. Not only did she have to believe it was worthwhile and that the children would learn something from it, she also had to teach the children how to socialise and cooperate with their peers:

S: Towards the end of that first session they began almost breaking up and making little pairs and things rather than working as a whole group. And so by the next session they were also sort of off and kept going off and working in two's and three's and fighting and arguing and things.

She persevered with group work and children talking because she wished to incorporate aspects of children's writing about mathematics. She saw the use of talk as a necessary rehearsal for writing. This reflected a change in her beliefs about teaching and learning mathematics in that teaching mathematics now involved children talking and using their

own ideas. She also developed skill with assessing their level of understanding by listening to their talk and observing what they did:

S: The assessing, I tried to include some different ways. ... First and second term it was mostly just a test at the end of the unit, and I did a little bit of speed maths. ... I've done a lot more observation things ... 'Yes, they've got this, ... no, they haven't,' ... checklist sort of thing. I've also tried to include some kind of a practical component as well, so I take things like the measuring perhaps, I get them to read off the container rather than saying, 'Here's a picture of a container.'

Understanding the children's achievement levels and identifying what they knew had been the first issue or problem for investigation identified by Stephanie at the first meeting, but it took her much of the year to reach a point where she successfully implemented changes in her pedagogical style to accommodate her earlier concerns. The empowerment format of the teacher's identification of a need and the fellow worker being able to respond helped to change professional practice in Stephanie's classroom. Stephanie saw the support model, with its built-in need for reflection, as a positive and useful thing for her as a beginning teacher:

It has certainly got me thinking about what I do, which is good. ... Quite often I think, 'I don't know what I was doing or why I was doing it that way.' ... and that [reflection] has led me to think then ... 'I'll try doing something else.'

## Conclusions and Implications

During her beginning year, there was a change in Stephanie's pedagogical practice in mathematics. She changed from a traditionally-oriented teacher to one who was experimenting with a variety of teaching and assessment styles, and who paid explicit attention to the abilities and needs of the individual children in her classroom. Her work in mathematics teaching was approaching more closely the recommendations of recent documents in mathematics education. Whether this development can be attributed solely to the fellow worker professional development model is debatable. However, there is evidence to suggest that it was influential in that with the assistance of the fellow worker instances of 'good' practice were supported and further developed. This did not occur to the same degree or at the same rate for the other three teachers. Tiffany, similarly to Stephanie, became more adept at reflection, and then giving her own suggestions and acting upon them. Gaz also experimented with different teaching strategies as a result of both his principal and the fellow worker acting as support persons and option-providers. In comparison, the professional development model did not appear to influence Harry's teaching practices until very late in the year. For Harry, *very* strongly held 'traditional' beliefs about mathematics and how it should be taught, along with extreme home pressures and many school pressures, formed a situation where reflection was highly restricted.

These findings suggest three main things concerning mathematics teacher education and related research:

- More mentoring or other forms of support are needed by beginning teachers as they 'survive' their initial teaching experiences and the many challenges they face in their classroom management, curriculum planning, teaching and assessment practices, and personal and professional identities.
- The impact of pre-service teacher education programs needs to be examined, particularly with regard to how to bridge the gaps between what is promoted in mathematics education studies and what are the realities of schools and classrooms.



- In pre-service education, teachers need to further develop their skills and confidence as reflective practitioners who can examine the inherent complexities and conflicts of teaching alongside a wide array of potential resolutions and how they might be put into practice.

### Practical Implications

The findings of this study point to a strong need to break the cycle of tradition of placing beginning teachers in a 'sink or swim' situation. The beginning teachers faced situations that for them were extremely challenging and demanding upon their professional knowledge, skills, and self-esteem, particularly in relation to their mathematics teaching. They saw their experiences very much as that of 'survival'. Even when they expressed concerns early in the year about aspects of their teaching, they were not able to give them much more than a casual thought. It was only after sustained, longer-term interactions with the fellow worker that the beginning teachers reached a point where they were able to engage in reflection that led to consideration of options and experimentation with different teaching practices.

Thus, if beginning mathematics teachers are to be able to develop professionally they must have a 'mentor' of some sort who supports them in an ongoing way for the full first year of their teaching, if not longer. The successes and weaknesses of implementation of the fellow worker model highlight the following practical implications regarding the form of mentorship or support needed by beginning mathematics teachers:

- A fellow worker needs to be provided for each beginning teacher so that the uniqueness of individual teaching situations are effectively examined and acted upon. The group meetings with all the beginning teachers did not serve to foster depth and breadth in reflection. They were valuable at a more emotional level, but did not engender reflection that led to experimentation and subsequent pedagogical changes. Hence, the traditional form of group professional development 'workshops' are not recommended as means by which to effectively assist beginning teachers. To grow as teachers the beginning teachers needed individual, personally and professionally context-specific support. It was not a case of 'one size fits all' professional development.
- The fellow worker needs to be independent of any form of evaluation of the beginning teacher's 'performance'. That is, he cannot serve as someone who assesses the teacher for school or Education Department records. The freedom to express concerns over personal weaknesses, a key feature of the fellow worker model, would not have been present within the context of performance evaluation pressures. A similar statement can be made for concerns about the school's expectations or ways of doing things. Reflection, which proved to be a prime ingredient in the recipe for professional growth and change, would not have been fostered without the impartial concern of the fellow worker. Hence, to engender success for the fellow worker model, the fellow worker should be someone external to the school.
- Formalised meetings need to be scheduled between the fellow worker and beginning teacher. It was clear that if it had been left to the beginning teacher to contact the fellow worker 'if needed', as is often the case when a teacher at the school is assigned as a support person, then the sessions and reflections would not



have happened. The beginning teachers had opportunity make use of school personnel and resources, but opted not to do so because they did not want to "bother busy people" and did not want to show any weaknesses.

- It is vital that the fellow worker be an 'option-provider' rather than a 'solution-provider'. The beginning teachers' professional growth was dependent upon their engagement with the particular challenges, problems and dilemmas of their teaching contexts. This engagement, or solving of problems, was part of the professional development process. It would not have been successful if it had been a process of merely reproducing the fellow worker's ideas and strategies for mathematics teaching.

The implications of these points for stakeholders in the education of mathematics teachers include:

- Education Departments and other employing authorities need to develop policies that do not abandon beginning teachers. They need to establish 'fellow workers' for at least the first full year of a beginning teacher's employment. Employment of experienced educators as fellow workers, who have professional skills related to particular learning areas (e.g. mathematics) as well as skills in working in mentorship roles, is recommended. The employment contract should also consider, in conjunction with individual school input, how a beginning teacher can have 'time' made available by which to regularly meet with the fellow worker and then follow up with planning for experimentation with new ideas.
- All schools need to make sure they have formal mechanisms in place so that they too do not abandon beginning teachers. Assigning a 'mentor' that does not have a structured role or is merely a contact person is not sufficient. In addition to an external person as a fellow worker, we recommend that all schools develop specific strategies to assist beginning teachers to endeavour to experiment and engage in professional problem solving, perhaps by team teaching activities, group action research endeavours, or regularly scheduled peer-sharing sessions.
- Faculties of Education need to focus more on the major issues identified as in need of attention concerning the gaps between what is promoted in mathematics education studies and the realities of classrooms. Students need more opportunities to examine the inherent complexities and conflicts of mathematics teaching alongside a wide array of resolutions and their related advantages and disadvantages. The beginning teachers in this study did not appear to have much breadth in their professional repertoires for implementing alternatives to teacher-centred mathematics teaching. Instead, they opting for a teacher directed approach that ensured they could control students' behaviours and learning. Hence, pre-service mathematics education needs to include more of a case study, problem-solving approach to mathematics teaching. Alongside basic mathematics teaching knowledge and skills, pre-service teachers need to develop capacities to reflect upon practices and consider options. Only then will the 'cycle of tradition' be broken so that mathematics is not taught in a procedural, replication mode.

The form of mentorship developed for this study, the fellow worker, is a model that has demonstrated it can effectively support beginning teachers in reflection, experimentation, and change in mathematics pedagogical beliefs and practices.

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