Mathematical teacher professional development incorporating an external critical friend

Pauline Rogers
La Trobe University
oonpared@bigpond.com

This paper presents some survey data from a mathematical teacher professional development initiative being conducted in a small rural school. The initiative involves an external critical friend working within a school, in mathematics classes, with teachers for week-long sessions. The initiative began with a whole staff professional development day, moving to three week-long visits throughout the year, working one-to-one with staff and their professional partners, concluding with a whole staff reflection day at the end of the project.

Teacher professional development has traditionally involved conferences, workshops, mentoring and lectures. Teaching is time demanding and so professional development needs to be relevant, useful and effective. The initiatives in this paper involve the study of teacher professional development undertaken in school time in teachers' own mathematics classes. In the United Kingdom there is the ongoing debate regarding teacher training (their term). An article posted on the New South Wales Teacher's Federation website 'Overtime cash for teachers' from the BBC online, states "The Education Secretary Estelle Morris, had angered teaching unions by saying teachers should have extra training in their own time". This is something we often expect in Australia with after school workshops, and conferences held during school holiday periods and on weekends. Estelle Morris is quoted saying "I think there are a lot of teachers who genuinely would not want their training to be disruptive to class, and be happy to be paid to do it outside school hours." While recognising that many teachers are willing to undertake voluntary professional development in their own time, this initiative involves teacher professional development undertaken in school time, in a teacher's own class, as they are teaching mathematics, over an extended period of time, making the professional development 'on the spot' and relevant to each teacher's personal situation. The initiative was developed from an Australian Government Quality Teacher Program (AGQTP). The project's focus was teacher professional development in mathematics with teachers as active learners. The implementation of the project involved an external critical friend, conducting teacher professional development and working with teachers as a whole staff, in teams or individually. This is similar to what Guskey and Sparks (1991) termed "coaching to application" (p.74). This was achieved through visiting classes, teaching model mathematics lessons and team teaching with staff. The author's role, the external critical friend, resulted from experience in maths teaching (K – Year 12), with involvement in teacher education courses at university level, as well as being one of the authors of the series of teacher and student mathematics books being used at the school.

Models of teacher professional development

Mathematics teacher education occurs at various times in different ways, and can have a variety of emphasis. The content can focus on mathematics, on teacher attitudes and beliefs, on curriculum or on pedagogy. Feiman-Nemser (2001) wrote "if we want schools to produce more powerful learning on the part of students we have to offer more powerful

learning opportunities to teachers" (p. 1014). The traditional and conventional approaches to professional development do not fit with the changing and developing learning requirements of both students and teachers. This needs to be a consideration in our current changing educational environment. To promote more powerful student learning and to aid in the transformation of the roles of teachers, professional development now calls for ongoing study and problem solving among teachers where "teachers (are) constructors of knowledge and transformers of culture" (p. 1038).

As Feiman-Nemser (2001) wrote "professional development is everybody's and nobody's responsibility" (p. 1049). Teachers need to know about many different things, including students, learning, curriculum, subject matter and pedagogy. Their knowledge cannot be discrete packets but needs to be flexible and changing as teaching and learning changes. Thus their professional development should be reflective of a coherent and connected professional curriculum. Some knowledge can be gained at university, but much teacher knowledge is gained in the context of practice. The need for continual serious and sustained professional development opportunities for teachers is clear. "Just as student learning is the desired outcome of teaching, so teacher learning is the desired outcome of teacher education" (Feiman-Nemser, 2001, 1025). Similarly, Hord (1997) identifies 'teachers are the first learners" (p. 5). It is this idea of teachers as learners which has formed the essence of the project and the professional development initiative.

The initiative in this study focuses on mathematics. As Cooney and Krainer (1996) argued "teachers need to learn mathematics as they are expected to teach it" (p. 1162). The initiative involves teachers working in their own classrooms with their own students, teaching mathematics, thus making their professional development more current, immediate and personal. Teachers learn as they teach and students see their teachers as active learners. "Teachers are concerned about improving their 'local' conditions and hence are more likely to be interested in addressing issues perceived relevant to their particular students" (Cooney & Krainer, 1996, 1159). By working within their own classrooms with an external critical friend over a number of visits throughout the year, teachers can immediately apply their own learning and experiences to their individual situations. In addition, as the visits are spread, it provides teachers with time to try new ideas and strategies suggested, and then these can be reflected upon, discussed and trialled at the next visit.

Cooney and Krainer (1996) identify "teacher education as moving toward a more process orientation in which teachers are encouraged to be reflective beings" (p. 1163). One of the main focuses of the initiative is the reflective components of the sessions. It is in these sessions with the teacher, their professional partner and the external critical friend that the most significant learning takes place. One teacher said "watching another teacher was just great. As well as learning how other people teach it felt professional to be part of this learning experience sharing with others the trickiness of teaching". This aspect of the initiative is based on Hord's (1997) model of "peers helping peers" (p. 4). This involves teachers regularly visiting each other's classes and observing, and then discussing the lesson. In this initiative, the model is taken one step further with an external critical friend being involved as a third party, adding an independent view as well as a helping hand. It is the discussion and reflection time that forms an integral part of the development of both the individual teacher and the school's teaching community as a whole. Hord (1997) reinforces the concept of teachers (as well as students) needing "an environment that values and supports hard work, the acceptance of challenging tasks, risk taking and the promotion

of growth" (p. 4). It is as we move towards this professional learning model of teachers reflecting on their own practice that teacher eductors need to provide the support, time and opportunity for the teachers' personal development. This initiative aimed to encourage constructive reflection, in a positive and encouraging environment.

The Initiative

This teacher professional development initiative is centered on an external critical friend, a 'mathematician' in residence conducting professional development, visiting classes, observing specific mathematics lessons, teaching model mathematics lessons and team teaching with staff as required. In this study mathematics was the focus, but it is clear that it could be implemented in any or all subject areas. Rather than a random and ad-hoc approach during the week, a timetable was developed and teachers were paired into professional partners. For each teacher, a half hour was spent with the external critical friend prior to each observed lesson, discussing the lesson and any other concerns or interests regarding the teaching of mathematics. Then a lesson of approximately one hour was taught, with the external critical friend and professional partner viewing and participating as appropriate. After the lesson, a half hour (or more) was spent reflecting on the lesson with the external critical friend and professional partner. Note: flexibility of time was the key, as naturally some lessons ran short and some ran longer. Flexibility was built into the timetable, ensuring no-one felt rushed or pushed for time.

The reflection time was the most valuable component of the process. As one teacher wrote "I found the debriefing discussions invaluable. I believe my teaching has changed and I strongly feel each person has grown and made changes from working in this manner." The classroom teacher was asked to comment and reflect first, then the professional partner and finally the external critical friend. As Feiman-Nemser (2001) said "Through critical and thoughtful conversations, teachers develop and refine ways to study teaching and learning" (p. 1042). This helped to keep teachers' comments open and honest, allowing them to indicate their concerns and drive the discussion. It showed staff that their ideas, feelings and comments were highly valued. The methodology of allowing teachers to speak first, ensured that the external critical friend did not dominate the conversation, or devalue teachers' concerns and highlighted the importance of listening. All issues raised were addressed in a positive manner. Allowing the teachers to speak first acted to reinforce and clarify observations made during the lessons, enabling the external critical friend the opportunity to critically analyse the feelings and coach reflective learning. It is the development of these professional conversations that led to a professional community of practice. During each visit teachers were encouraged to set their own personal goals. For the final teaching week, teachers were asked to develop a lesson goal which was reflected upon during the half hour after the lesson. Goal setting proved to be important by providing teachers with aims, direction and motivation for the project.

The Context

The initiative was conducted at a small rural school in the northern part of Victoria, Australia. There were ten teaching staff, including the principal, who were all involved in the initiative. There were three 2nd and 3rd year graduates, some very experienced staff, with the rest falling in between. All classes were structured as composite classes (i.e., Year 5/6) except for the Prep (K) class. The Prep class was team taught by two teachers during

the year. The focus of the project was mathematics, and the results are provided in this context.

The idea for the project was developed in conjunction with the principal and the external critical friend, and the focus was numeracy and mathematics in the context of teacher learning. Teacher learning was the priority and it was felt this would naturally filter to student learning. The external critical friend provided the support in class to teachers wanting to change and improve mathematics teaching practices. There was opportunity to work with the teachers and students in their own environment. Teachers also spent time outside the classes talking, discussing and reflecting on lessons and ideas.

The results presented in this paper only examine a small part of the much larger initiative. In this case three specific questions are examined.

- To what extent does working with an external critical friend have an impact on students' willingness to discuss their thinking in mathematics?
- To what extent does the presence of an external critical friend allow teachers to be more flexible in their teaching of mathematics?
- To what extent can an external critical friend foster more discussion about mathematics and teaching at staff meetings?

The Survey

As part of the data collection associated with the initiative, teachers completed a survey prior to the commencement of the first visit week in February and the same survey was implemented at the end of the initiative in October. It was conducted in February to provide some baseline data for the initiative as well as to give the external critical friend insights into the experiences and thinking of the teachers. The methodology for the overall initiative was design research. Teachers were asked to bring their responses to the first meeting, so in a sense they acted as an 'ice-breaker'. The results were shared informally with staff during the initiative, and all staff identifiers were kept anonymous. The survey was implemented again at the end of the initiative at the beginning of the 'reflection' day, before staff verbally shared their own reflections written for the session. It was again collected and kept anonymous. The survey was designed so that the statements were unambiguous, and in language that staff could understand, based on work they had already been doing at the school. Three items from the survey were selected and are reported here to illustrate the impact of the initiative. The items were selected to show a 'snap shot' of teacher's ratings of three different aspects of the project. The first item is student focused, the second teacher focused and the third is school focused.

The survey consisted of twenty-five statements adapted from Barrell (2003) and teachers were asked to respond with the subject of mathematics in mind. Teachers ranked each of the statements on a Likert scale with 1 representing hardly ever, 2 seldom, 3 sometimes, 4 often, and 5 very often. The three statements examined in this paper are:

Statement 16: Students confidently and willingly discuss their thinking in maths.

Statement 21: I am flexible in my lessons; I allow students' questions to divert my teaching from the planned lesson.

Statement 24: We discuss teaching strategies at unit or staff meetings.

Results

Figure 1 presents the responses of the teachers, in both February and October in response to *Statement 16*: *Students confidently and willingly discuss their thinking in maths.* This item was linked to one of the main focus areas of the teaching curriculum for the year, students discussing their thinking. In responding to the statement, staff focussed on students talking about their thinking and how this related to their learning of the topic/concept being taught.
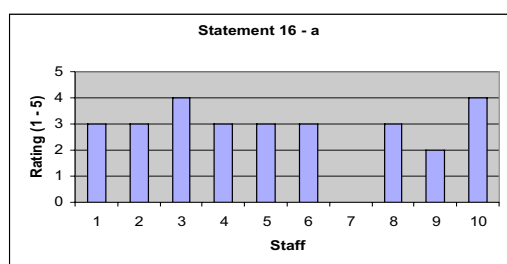
Statement 16 - a

Statement 16 - b

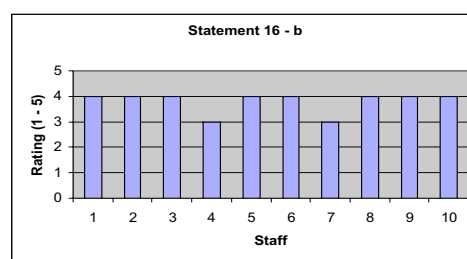Figure 1.a Teacher responses to Statement 16 (Feb) — Figure 1.b Teacher responses to Statement 16 (Oct)

As can be seen in Figure 1.a, many of the teachers thought the students were sometimes confidently and willingly discussing their thinking in maths. One teacher did not respond, and in later discussions this was because she felt that it was too early in the year, and with younger students, they were still getting a handle on the 'being at school' situation. Interestingly two teachers, 3 and 1, felt their students often discussed their thinking in maths. At the end of the initiative all teachers' responses had either increased or remained the same. All staff felt that students were now willing to discuss their thinking in maths either sometimes or often.

Figure 2 presents the teachers responses to *Statement 21*: *I am flexible in my lessons; I allow students' questions to divert me from my planned lessons.* This item could be seen as a positive as students' questions are guiding the teacher's lessons; it could also be seen as a negative that the students easily divert the teacher with perhaps interesting, although inappropriate questions. How a teacher handles students' questioning to carefully select and drive the teaching program is a very important consideration.
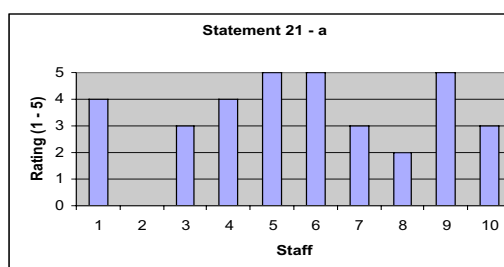
Statement 21 - a

Statement 21 - b

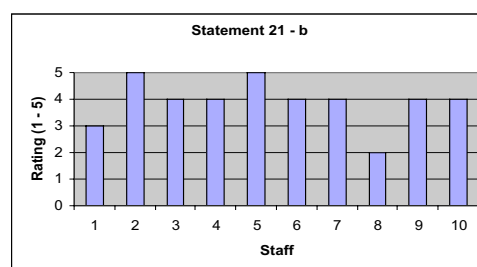Figure 2. a Teacher responses to Statement 21 (Feb) — Figure 2. b Teacher responses to Statement 21 (Oct)

Most teachers' responses varied greatly prior to the start of the project, as can be seen in Figure 2.a. One teacher, teacher 2, opted not to rank this question, and it was found in later discussions that this was due to being early in the year, and she found it difficult to provide a rating as her class was not established, and the routine for maths lessons not fully

developed. Initially only two teachers, teachers 5 and 6 felt that they were flexible in their lessons with student's diverting them from their planned lessons very often. Only teachers 4 and 8 responses remained the same at the end of the initiative, and teachers' 1, 6 and 9 responses decreased indicating that the teacher's weren't feeling as flexible in their lessons as they perhaps liked. The rest of the responses increased indicating that the teachers felt they were becoming more flexible in their teaching, allowing the students' questions to drive the lessons more. Discussions throughout the initiative indicted that this was a priority for many teachers, and some just needed the 'OK' to have permission to divert from their set plans.

Figure 3 presents teachers responses to *Statement 24: We discuss teaching strategies at unit or staff meetings.* At the school, staff meetings were held once a week, with a fortnightly focus on professional development. Unit meetings were held once a week, generally on Tuesdays for the infant (Prep – Year 2 teachers) department and Thursdays for the senior (Years 3 – 6 teachers) department.
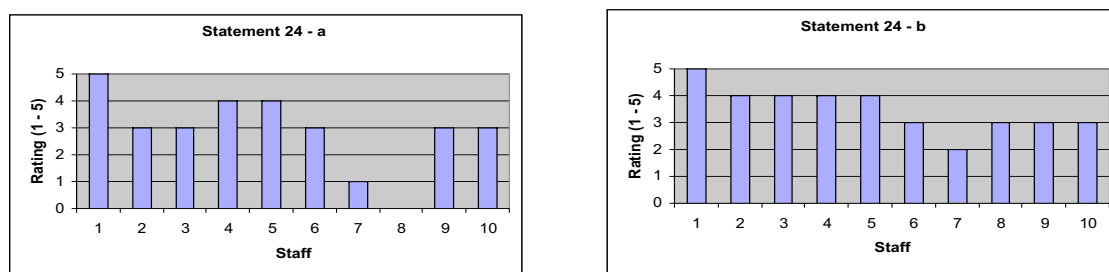

Figure 3. a Teacher responses to Statement 24 (Feb)   Figure 3. b Teacher responses to Statement 24 (Oct)

Most of the staff felt that teaching strategies were discussed either sometimes or often at the meetings. Only one teacher felt that the staff discussed teaching strategies at the meetings very often, whereas one teacher felt that teaching strategies were discussed hardly ever and one teacher did not respond prior to the start of the initiative. As can be seen in Figure 3. b, by the end of the initiative the majority of teachers felt that teaching strategies were either discussed often, very often or sometimes at the meetings, and teacher 7's response had also increased. Given that the initial question was asking if the discussion of teaching strategies had increased at unit or staff meetings with the presence of a critical friend, in the context of mathematics the survey showed that the project had given the teaching strategies of mathematics a focus across the school.

Discussion

The data presented above is three statements of a much larger survey of 25 statements. The points drawn from these three items are compatible with general observations and other data collected with the teachers and school as a whole. Overall the results show that teachers were beginning to think critically about their own mathematics teaching, with either responses changing to higher or lower ratings between the two surveys. A move in one direction might indicate growth and development in the teacher's learning and a greater understanding of the statements in the context of mathematics. Whereas a move in the other direction might indicate a more critical analysis of one's teaching practices, a gain in confidence of one's mathematics teaching abilities or even a greater understanding of the statements in the context of mathematics. As it is felt that significant changes would not

happen immediately, it is proposed that the survey could be conducted again in a year's time and the results compared.

Changes of attitudes towards discussing thinking have come through the teachers' own willingness to share their learning and thinking during the initiative. As one teacher wrote "I have learnt that I am not that bad at the teaching of maths and my ideas and approaches to teaching the subject are actually pretty good". The presence of an external critical friend has provided staff with an external person with whom they can discuss their ideas, thinking and concerns in confidence, through the establishment of a professional relationship. From classroom observations the observer felt that this willingness to share learning by staff, was also starting to filter to the students as they are viewing their teachers modelling learning. A Year 3 student said in reflection of a lesson on space "I learnt to draw bird's eye views. I thought it would be easy but it wasn't. It was hard trying to think you were up above looking down". Through discussions it is clear that working with an external critical friend has had an impact on teachers' willingness to discuss their thinking. One teacher said "I have learnt in this form of professional development there is no room to hide; you have to step up to the mark." Through the survey, teachers felt this willingness to share was also developing in students.

It is pleasing to see that teachers felt that they were becoming more flexible in their teaching, arising from an increase in confidence in some cases, and in other cases it was just about getting the 'OK' to move away from a structured model. In the discussions with staff and in the reflection sessions, teachers were experimenting more with their teaching and with the curriculum. One teacher said "I have learnt to relax and not be so worried that I am not following the Early Years Model to the book as it does not always work for every grade". They took the opportunity of working with other staff and the external critical friend to try new ideas and strategies, and they allowed the students and their interests to drive the classes more. The presence of an external critical friend gave many staff the support and encouragement they needed to become more flexible in their teaching and this is supported with the survey results, the reflective writings of the staff and through observations.

It can be interpreted from the data that the presence of an external critical friend fostered more discussion about mathematics and teaching at staff meetings, as there was a positive move in the data. Teachers were contributing more at meetings and one teacher said "I feel that I have learnt more about how children learn maths and how to teach maths".

It should be noted that one of the concerns was that teachers appeared to be addressing their own and the project goals, to meet the aims of the initiative, but it was sensed that as teachers were actively involved and contributing to the reflection sessions, as well as seeking help outside the allocated timetable, and between visits via e-mail that teachers were being honest and faithful in their responses. Some of the limitations of the initiative which will affect the ability to collect comparison data include the movement of staff between year levels at the end of the year, two staff have left the school and the structure of the classes have changed i.e. there will be straight Year 1 and 2 classes this year instead of composites. Although there is also a curriculum change this year, the school is committed to this model of professional development and will be expanding it into other areas of the curriculum as well as continuing it in mathematics. Coupled with the other collected data of observations, video footage and the collection of teacher's self reflections

at the end of the project, steady growth is already observed.

Conclusion

As Shaha, Lewis, O'Donnell, & Brown (2004) said "Bottom line, the purpose of professional development is to help teachers become better teachers" (p. 1). Traditional professional development models include conferences, workshops, mentoring and lectures. The model presented in this paper differs by being on-going professional development within a school, with teachers in their own mathematics classes. It is working with professional partners and allowing teachers to identify and address their personal needs in mathematics, and all staff were involved. There was also the underlying focus of the initiative of teachers as learners and allowing students to see their teachers actively involved in learning. The external critical friend acted as a facilitator, and coach offering advice, sourcing resources, presenting new ideas and teaching model lessons. This maintained the teachers as the focus of the project and the learning. As one of the experienced teachers wrote:

The mathematician in residence program was totally tailored to the needs of my students and myself, it was ongoing, it provided constructive feedback by an expert and my peers, it enabled me to see other teachers in their classrooms, it allowed me to see an expert model lessons at my level and other levels and most important of all it pushed me to improve my teaching and achieve my goals. My own maths teaching is changing in that I try to make activities more real, I involve the students more often in composing and assessing the tasks, I try to include games on a regular basis, I am trying to set more open tasks that students of all levels can tackle and I am becoming more of a facilitator rather than a stand out the front teacher.

References

Ball. D. L., & Cohen, D. K. (1999). Developing practice, developing practitioners: Toward a practice-based theory of professional education. In G. Skyes & L. Darling- Hammond (Eds.), *Teaching as the learning profession: Handbook of Policy and Practice* (pp. 3-32). San Francisco: Jossey-Bass

Barell, J. (2003). *Developing more curious minds*, Association for Supervision and Curriculum Development. Virginia.

Cooney, T. J., and Krainer, K. (1996) Inservice mathematics teacher education: The importance of listening. *International Handbook of Mathematics Education*, (pp. 1155 – 1185). Netherlands: Kluwer Academic Publishers.

Feiman-Nemser, S. (2001). From preparation to practice: designing a continuum to strengthen and sustain teaching. *Teachers College Record, 103* (*6*), 1013 – 1055.

Guskey, T.R., & Sparks, D. (1991). What to consider when evaluating staff development. Educational Leadership, 49 (3), (pp. 73 - 76).

Hord, S. M. (1997). Professional learning communities: what are they and why are they important? *Southwest Educational Development Laboratory, Issues… about change*, Vol 6, No 1. Retrieved 22 June 2005 from the World Wide Web: http://www.sedl.org/change/issues/issues61, 5/05/05

New South Wales Teachers Federation Website, (2006). Overtime cash for teachers. *BBC Online* Retrieved 12 January 2006 from the World Wide Web: www.nswtf.org.au/world/200010616_overtime.html

Shaha, S. H., Lewis, V. K., O'Donnell, T. J., & Brown, D. H. (2004). Evaluating professional development: an approach to verifying program impact on teachers and students. *National Development Council* (NSDC). Retrieved 5 April 2005 from the World Wide Web: http://www.nsdc.org/library/publications/research/index.cfm, 5/05/05