Professional Development of Mathematics Teachers in Low Socio-Economic Secondary Schools in New Zealand

Barbara Kensington-Miller
The University of Auckland
<bmiller@math.auckland.ac.nz>

This paper reports on a study, which seeks to understand mathematics teacher development in low socio-economic schools. It initially aimed to evaluate the effectiveness of four strategies: professional development meetings; peer observations; mentoring teachers in their own classrooms; and providing readable literature. However, it quickly became apparent that implementing these strategies was problematic, and consequently the focus shifted to investigate what was happening and to find an explanation. There existed a contradiction between teachers' espoused desire for exactly these types of professional development and their lack of participation when it was made available and supported. The study indicated that many of the problems with implementing professional development were not with individual teachers but systemic throughout the schools. The obstacles related to teachers' time commitments, energy demands, and their working environment.

The need for teacher development is vital in an environment where educational goals for schools, teachers and students are high. Teachers are expected to help students become critical, constructive thinkers who have developed thorough conceptual understandings (Borko & Putnam, 1998). Students are required to synthesise information, solve problems, invent new ideas, create models, and explain themselves with confidence and proficiency. Classrooms are viewed as places where rich discourse should take place as students engage in their work and explore problems with meaningful contexts.

The traditional approach to teaching is a long-established style and is especially prevalent in schools amongst older teachers who were taught, and have long been teaching, in this manner (Goos, 1999; Sakonidis, Tzekaki & Kaldrimidou, 2001; Thompson, 1992). It consists of the mastery of concepts and procedures as the ultimate goal of instruction and places little emphasis on the processes of mathematics, or on the knowledge that comes out of mathematical problem situations. There is therefore a strong contemporary need for teacher development.

Modern curricula and new theory also indicate that a move is necessary from the over-reliance of teaching practices where exposition and individual seatwork exist, towards activities that promote students' involvement in constructing, applying, and evaluating mathematical ideas. This move is especially important for low socio-economic schools where there is a special need for teaching to include more mathematical reasoning and problem solving, more communication, and more connections between the mathematical ideas and applications.

In New Zealand, senior classes in these low socio-economic areas are commonly small. There will often be one class at senior level, so teachers are alone and isolated from others to discuss and compare results. By comparison in higher socio-economic schools of similar size, there may be three or four senior classes. The teaching in low socio-economic areas is difficult and demanding as student achievement and participation is poor, extra-curricula expectations place a premium on their time, and necessary support in the classroom is often lacking or unavailable.

The contemporary approach is premised on constructivism, in which learning is directly focused on the construction of knowledge, and not the traditional transfer of it

from the teacher to the student (Even, Tirosh & Markovits, 1996). However, this constructivist approach often takes teachers far beyond their traditional and familiar roles and practices, requiring changes in epistemological perspectives and knowledge of how students learn mathematics. In addition, they also require changes in classroom practices.

In order to give teachers the opportunity to develop and make changes, with support, professional development is necessary. In particular, there is a need for professional development to cater for teachers working in low socio-economic schools. The common view that each teacher must find their own style, as related by Ball (1996), maintains this individualism and isolation of teaching. Common standards are difficult to develop, and disagreements are masked. The struggles a teacher may be having in their practice, especially in low socio-economic schools, are often hidden because of the isolation. It is therefore hoped that by offering the teachers good opportunities for learning, they are then able to critique and challenge alternative practices, with real and helpful debate, facilitating growth.

Four different professional development strategies were used in this research. The MEP team together with the teachers of the schools involved planned these. The first strategy consisted of organising meetings with teachers and the second was organising mutual peer observations and reflection of each other's teaching styles. These two strategies both align with literature (Darling-Hammond, 1998; Desimone, Porter, Garet, Suk Yoon & Birman, 2001: Loucks-Horsley & Matsumoto, 1999) which state that professional development that immerses teachers in mathematics, fostering both basic knowledge and advanced thinking and problem solving skills, will improve teaching practice. They also stress that to be effective it must be grounded in the curriculum, connected to assessment, and extended over time. Britt, Irwin & Ritchie (2001) and Leikin & Winicki-Landman (2001) broaden this view by stating that if teachers are given opportunity to deepen their content knowledge they are then provided with new ways to explore visualising mathematics and presenting it.

The third strategy was mentoring teachers in their own classroom on a one-to-one basis. This strategy, as well as the first two, examines practice. Begg (1994) and Britt et al. (2001) state that if teachers are encouraged to examine their practice and reflect on their beliefs about how the teaching and learning of mathematics occurs then valued teaching outcomes will be established.

In addition the second and third strategies involve working collaboratively. Borko & Putnam (1998) argue that teachers who work alongside other teachers become reflective professionals, and will learn and change in thoughtful ways that are sustained. Britt et al. (2001) document that professional conversations can play an important role in helping teachers decide what is needing to be changed and then doing it.

The final strategy was providing 'readable' literature from research digests, and to evaluate whether teachers would read them and be able to discuss them at meetings. Although this was a professional development strategy chosen by the teachers in these schools that they wanted to receive there was no research found documenting this as an effective, or ineffective, method. The teachers commented that they had very little opportunity to find, select and read about current research by mathematics educators, and would value the opportunity to receive some. It was decided to pursue this and articles were therefore selected that would be topical and then rewritten to be easily 'readable' by the teachers.

The Study

Participants

A team from the University of Auckland has set up a Mathematics Enhancement Project (MEP) for students and teachers in four low socio-economic schools. The aim of the project is to improve the participation and achievement of the senior mathematics students. All of these schools have a high percentage of Maori and Pacific Island students and are situated in the Manukau region of South Auckland. The design, the theoretical basis, and preliminary results of the Pilot Phase in 2001/2002 were reported in Alangui, Autagavaia, Barton, Kensington-Miller, Lane, Paterson, Poleki & Van Den Heuvel (2002).

This study (Kensington-Miller, B.A., 2002), which is a part of the MEP, involved ten teachers of senior mathematics classes in four low socio-economic secondary schools over one year. Of this group, only one was female, which is fairly typical of the distribution of senior mathematics teachers in these schools. There were two European New Zealanders, four Indian, three Pasifika and one Iranian, again very typical of the demographics of teachers in these schools at this time.

Procedure

The study was specifically focused on teacher development. This included reporting on the existing state of teachers' well-being and attitudes, and included factors in the school environment, which affected their teaching. The MEP team planned professional development with the teachers of those schools. The specific aim was to compare and evaluate the effectiveness of the four different strategies (written above) with respect to ease of delivery, teacher reception, student response, and classroom atmosphere.

The research began by examining what professional development was useful for this particular group and appreciated by them. However, early in the pilot year, considerable difficulties implementing the professional development strategies arose, which then grew and compounded. As a result, the emphasis of the study shifted to investigate these and find reasons why. This paper will not include the evaluations of the different strategies but will report on and document the difficulties encountered.

The research design involved documenting the implementation, the attitudes towards, and the effects of the four professional development strategies. It also included documenting and analysing the many difficulties and restrictions encountered. The evidence gathered included journals by the university team, observation sheets of classroom lessons, and questionnaires and interviews with the teachers.

The MEP team throughout the year recorded comments about the teachers and their teaching, the work ethic and behaviour of students, and any problems in general that arose, in journals. Observation sheets for classrooms were designed as an instrument to measure change. These evaluated on-task time, mathematical richness of the tasks and classroom relationships. Three questionnaires were also given during the year. The first evaluated teacher's attitudes and preferences for professional development. The second examined teacher's attitudes and beliefs about the nature and teaching of mathematics. The third evaluated the different professional development strategies. Finally, structured interviews were held with the teachers that had been mentored.

The professional development meetings were held in the teachers' own time. These meetings were an opportunity to discuss their own experiences, and a chance to listen to some guest speakers on topics of their choice. Peer visiting involved the MEP team supervising classes while the teachers carried out mutual peer observations. Mentoring

involved an MEP team member working with a teacher in ways that were helpful such as working with individual students, or taking the lesson. They would also support and encourage the teacher. Interesting articles from the existing research literature were rewritten to be 'readable', without the academic language or the long length. These were then distributed.

Results

The research was divided into different focal areas in which the results would be collected, analysed and summarised. Only two of the focal areas are related to this paper, on the problems of implementation, and will be considered.

1. Usefulness of professional development

The data gathered from the ten teachers using questionnaires, interviews and the researchers' journals gave strong indications of whether the professional development strategies offered were useful, or not. The timing of professional development was regarded as very important but it was difficult to select from the responses the most suitable time. Local or school-based venues were also regarded as important as this meant easy access, and could focus on the needs in that school, such as language issues. Six out of ten believed that professional development should challenge their assumptions, whereas all ten believed it should help them try new ideas or experiments with their classes. Nine believed that they should be encouraged to critique their own teaching and two felt there was pressure to change. Five believed that professional development should be offered to at least two teachers in a department at a time, to provide support as well as good feedback to the department.

The perceived usefulness by these teachers of the different professional development strategies provided some interesting results. The first strategy, professional development meetings, was considered very useful to provide helpful examples for their own teaching from 'real life' as well as broadening the teacher's own thinking. Peer visiting was well received as this reassured them they were not alone; they could plan to do similar activities; share resources; compare notes; and discuss problems and solutions. Mentoring was evaluated as extremely useful for the students, encouraging and motivating them, and assisting them in their work. The teachers used it as a time for revision so that they had extra help in the classroom for the students or used it as a time to try different things. The teachers considered 'readable' literature of great value. The articles were useful to reinforce things the teachers were already doing, or to provide new ideas that were working in other places.

2. Documentation and analysis of implementation problems

Collecting data from the teachers and working with them was a logistical challenge despite their enthusiasm and commitment to the project. Communication by email, the preferred choice by these teachers, was regularly not answered. Telephone messages left on answer phones, or with office staff, were regularly not received or validated. It became frustrating and wearisome, and as a result information frequently had to be personally delivered to ensure the teacher received it with continual reminders to respond.

Professional development meetings became difficult to organise and timetable everyone for the same date and time and venue because of extra demands on teachers by the school. These were a result of schools having different times for exams, reports written, ERO (Educational Review Office) visits, and so forth, leaving very limited time for teachers to relinquish and attend meetings. Rescheduling was done but difficulties arose rebooking speakers to talk. Added to this, teacher strikes caused more problems with very

tight time restrictions. Teachers that were able to attend did enjoy the camaraderie, as well as the lectures presented. They were very positive about these meetings, but time constraints from the unions meant they were unable to share adequately. Added to this, different teachers were absent from different meetings resulting in inconsistencies and some teachers found it difficult to find the venue and left in frustration.

Peer visiting had many problems with implementation, especially with the coordination of the visits. The researcher attempted to resolve this by sorting and organising the different timetables and matching up peer visits. However, some teachers still missed out on peer visits as their email messages were not read often enough, or they did not respond promptly enough with offers to teach their classes releasing them to visit.

In general, mentoring once a week was well received by the teachers but they commented on the pressure that they felt to do different things. Some teachers reported that they made more effort in their teaching only on days when the mentor visited. As well, they had mixed feelings about whether to have someone from inside the school, or outside, with valid reasons for each. There was concern that a mentor's presence was threatening to them as teachers, that their confidence with the course might not be as high as expected. As well, they were concerned with any poor behaviour of students or if a student was not 100% on task, that this would reflect on them personally as teachers.

The process of mentoring teachers was not straight forward as originally expected. Many felt that different factors affected the type of teaching they did and were very sensitive to justifying their style of teaching. Students with English as a second language made explanations difficult for the teacher. Academic levels of students varied widely with many constantly requiring intense revision of the previous years work. Basic activities were only suitable, with classroom behaviour monitoring what, if any, would be done. However, mentoring was still highly valued and considered worth pursuing by the teachers because of the many diverse problems that they faced in the low socio-economic schools.

The 'readable' literature was well received even though evaluations were to the contrary. Seven could not recall what the articles were about despite a plea for more. They considered articles would be useful to reinforce things they were already doing, or to provide some new ideas. None of the teachers were able to name anything they had done that was directly related to reading these articles. Reading for some was an onerous chore, while others read only if they had to, if someone was deliberately checking it. There was a general lack of confidence as to whether the literature would be of any value for these students, and uncertainty as to how to implement any ideas read.

Discussion

The literature (Britt et al., 2001; Garet, Porter, Desimone, Birman & Yoon, 2001) reveals that professional development meetings provide learning communities that have unique knowledge and beliefs. They provide an opportunity for teachers to develop mathematical knowledge and pedagogy, and to be reflective about their teaching practice. The results from this study support this, but many difficulties with meetings occurred. Some teachers could not find time from heavy demands at their school to attend meetings, some found the venue difficult to find and did not make it, and another decided that the mathematics lecture was of no interest and did not attend. Added to this, teacher strikes restricted time and rescheduling was often necessary. Synchronising the venue with rebooking the speaker and finding a suitable day for all teachers was not an easy task.

In the literature Boero, Dapueto & Parenti (1996) explain that the more mathematics a teacher has then their competence increases and their teaching will improve. Britt et al.

(2001) further add that bringing teachers together for professional conversations will encourage listening, discussing, gleaning ideas, support, and validation which are major factors in helping teachers to reflect and change. Leikin & Winicki-Landman (2001) also add that exposing teachers to different learning experiences enhances their knowledge and will develop their mathematical pedagogy. However, Loucks-Horsley & Matsumoto (1999) and CSMTP (2000) dispute the significance of all this. They maintain that unless it is connected to practice in the classroom it is ineffective. This raises concerns about meetings outside the classroom, different venues, and unrelated topics.

Difficulties implementing peer visiting occurred with structuring it. It proved to be very complex and needs more discussion to make it achievable. It also appeared that struggling schools had nothing in place to foster this. Darling-Hammond (1998) describes the learning when teachers participate in professional development such as teacher networks, or teacher teams, as powerful as they provide opportunities that are connected to the teachers' own work and linked with tasks of teaching. Although these teachers stated a preference for peer visiting, especially as the teachers of senior students in these schools are isolated, making contact vital, they made no effort to organise it, nor did they respond to offers of supervision for their classes so they could be released. Desimone et al. (2001) and Garet et al. (2001) state that professional development must be well organised for the teacher, and not the teacher organising their own, for it to be effective.

CSMTP (2000) and Loucks-Horsley & Matsumoto (1999) report difficulties with professional development that is conducted by outside facilitators, as they may know little about the educational needs of these teachers or the problems they face in teaching. Ball (1996) also discusses the problem of teachers who expect a 'formula' from the professional development. Borko & Putnam (1998) strongly support collaborative relationships between teachers, as over time they argue these teachers will become reflective professionals, who can learn and change while simultaneously being sustained in practice. Likewise, Britt et al. (2001) inform us that professional conversations with other teachers play a vital role.

These are important factors when establishing mentors and may account for the difficulties that the teachers had in regarding their university mentor. It is questionable whether university mentors, although teachers themselves make good mentors. They are not at the location consistently on a daily basis, and are therefore unable to listen, discuss, glean ideas, encourage, and validate the teachers when needed. However, they are able to take a more critical and reflective stance that is research-based, which complements the teacher who has the craft knowledge.

'Readable' literature, the final strategy, is supported by Britt et al. (2001) and Darling-Hammond (1998) who state that teachers can be informed by research, either written or video, but require ongoing support to sustain any changes in teaching practice and must have regular opportunities to reflect. Begg (1994) and Ball (1996) also state that when teachers are encouraged to reflect, and critique and inquiry are fostered, valued teaching outcomes are established.

In contrast to this and what the teachers believed, their actions contradicted this. Although many acknowledged reading the articles, they could not remember what they read, and there was no evidence of anything being done differently in their practice because of the literature. The difficulty may have been the lack of follow-up or no emphasis placed on reading the articles. Begg (1994) and Loucks-Horsley & Matsumoto (1999) state ongoing support is critical for changes to occur and be sustained. Furthermore, professional development characterised as 'quick fix' remedies providing good ideas and

materials to be implemented immediately, are unlikely to have meaningful change or long-term impact.

In conclusion, the results indicated that all these teachers believed professional development was important and should encourage them to critique their own teaching, challenge their assumptions, and try out new ideas. In reality, the evidence was contrary to these beliefs. All the professional development strategies proved difficult to implement, and there was no indication that any of them were of significant use in the short term, as no teaching was being critiqued or challenged. Some new ideas were assimilated into the lessons, but as an addend rather than as substantial changes in the teaching.

The results highlighted the enormity of implementing professional development and the problems associated. It would appear that struggling schools in low socio-economic areas have nothing in place to foster professional development. The evidence indicated that even if professional development is implemented it is of no benefit to these teachers unless some crucial issues are first acknowledged and resolved. These issues were systemic in all the schools involved in the MEP project. Firstly, communication was a continual challenge. As well, the conditions these teachers work under were difficult with enormous time constraints placed on them, large energy demands expected of them, and an environment not sympathetic to change. The study revealed that these problems were not with individual teachers as previously thought but were pervasive throughout all the schools.

Throughout low socio-economic schools, many students have a history of poor achievement and are struggling to cope for a variety of reasons. In addition, attendance is poor and class time is often reduced due to sporting and cultural events or absenteeism, in comparison to high socio-economic schools. These barriers to student learning highlight further pressures on teaching and reduce the desire and opportunity to experiment with change.

The implications for further research are evident and to establish what other systemic factors may exist. It is vital to understand how the difficulties can be ameliorated and to provide support in order to empower the mathematics teacher to take risks and try new ideas in their practice. It is also important to not apportion ‘blame’ to the teachers but to focus on what the wider problems and issues are throughout low socio-economic schools.

The evidence showed that the teachers of these schools were willing to engage in professional development, but implementation difficulties need to be overcome before significant progress is to be made and teacher change promoted. In particular, teacher’s time commitments need to be addressed and time allowed for the community to develop. Teachers in low socio-economic schools are committed to the process but the difficulties and conditions, which they work under, must be acknowledged. Finally, there must be some pay-off for these teachers in particular to recognise their dedication and hard work.

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