

Professional Development as a Process of Change: Some Reflections on Mathematics Teacher Development

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ABSTRACT This paper considers professional development from the perspective that teachers need to change and adjust to an ever-changing world. Teachers' views of mathematics influence the way in which they teach. For teachers to change they have to become aware of their teaching practices. It is argued that externally imposed professional development programmes do not make a sustainable difference. The commitment to change must come from within the teachers, and sustained by continuous reflection. The paper further argues that situated learning where teachers can be a part of a community of practitioners opens the doors for teachers to reflect on their daily classroom practices. Because change is a long and sometimes painful process, the factors that drive change are scrutinised. The paper concludes with arguments that the process in professional development of teachers should create an environment that caters for teachers to become aware of their classroom practices, to reflect on their teaching and take decisions, and to change their own beliefs about teaching and learning of mathematics.

INTRODUCTION

The term professional development lends itself best to the conception of the teacher as an educational professional. On the other hand, the concept "development" has a connotation related to evolution and continuity which goes beyond the traditional overlapping of basic and continued teacher education. Effective professional development happens in a community of learning. Just as students deepen their knowledge of science and mathematics through communication, so too do their teachers learn through formulating, sharing, and challenging what they and their colleagues think they know.

Professional Development

When reflecting on the meaning of "professional development", two issues need clarification, namely what is understood by a "professional" and what "development" means.

A professional should possess at least the following;

- ♦ Expert and specialised knowledge
- ♦ Excellent skills in his or her profession
- ♦ The ability to produce high-quality work
- ♦ A high standard of professional ethics (Coldron and Smith 1999)

Development as a concept is described as growth and/or progress. Development by de-

duction is thus associated with change and change accordingly presumes amendment and modification (Dictionary.com).

Professional development is thus the process whereby people's professionalism may be considered to be enhanced (Evans 2008). Professional development is viewed as a career-long, context-specific, continuous endeavour that is guided by standards and thus presupposes a process whereby an individual undergoes or experiences the need to change in order to achieve a particular goal.

To be a professional teacher is vastly different from being a professional in any other field. Professional teachers have to be equipped with a variety of appropriate yet different skills and knowledge from professionals in other fields if they are to function successfully in a classroom where they have to be equal to the daily demands of their duties. Ball (2008; 11) describes these differences between being a professional teacher and a professional in other fields in the Table 1.

The professional teacher has a different responsibility to that of a professional in other capacities. The demands placed on teachers in their day to day practices do not always come naturally, but they have to be aware of the different role they play in school compared to a another setting.

Table 1: Ways of being in teaching profession

Familiar/typical/Common ways of being	Ways of being in teaching
Asking questions to which you do not know the answers	Asking questions to which you often do know (at least part of) the answer
Telling and showing others, doing things for people	Listening and watching others, help others do
Assuming you know what others mean	Probing others' ideas
Correcting and smoothing over mistakes	Provoking disequilibrium and error
Assuming others experience things as you do	Not presuming shared identity; seeking to learn others' experiences and perspectives
Liking/disliking people	Seeing people more descriptively
Being "yourself"	Being in a professional role

Professional Development as Viewed by Researchers

Marcello (2009) characterises professional development as a process which takes place in specific contexts based on the school and which are connected to the daily activities carried out by teachers. He quotes several opinions of researchers with regards to their interpretations of professional development;

- ♦ "the teacher's ability to maintain the curiosity of the class; to identify significant interests in the teaching and learning processes; to value and seek dialogue with experienced colleagues as a source of support in the analysis of situations" (Rudduck 1991: 129);
- ♦ "the professional development of teachers is a broad area which includes any activity or process intent on improving dexterity, attitudes, understanding or involvement in current or future roles" (Fullan 1990: 3);
- ♦ "it is defined as the entire process that improves knowledge, dexterity or teacher attitudes" (Sparks and Loucks-Horsley 1990: 234-235);
- ♦ "it is the process by which teachers, whether alone or accompanied, review, renew and further their commitment as agents of change, with moral teaching aims" (Day 1999: 4);
- ♦ "work opportunities that encourage creative and reflective skills in the teachers, thus, enabling them to improve their practices" (Bredeson 2002: 663).

From the above opinions, it can be said that researchers view professional development, *inter alia* as improvement, reflection and commitment to change.

SITUATED LEARNING

As a main point of departure in this paper, it is argued that situated cognition underpins the efficacy of professional development. From a theoretical perspective, situativity locates learning as a social and cultural activity where success is not an individual cognitive attribute, but rather how these attributes interact with the real world. (Boaler 1999: 260). Theorists supporting situated cognition argue that knowing and learning are constructed through participation in the discourse in practices of the community (Lave and Wenger 1991; Greeno 2003). This also has relevance for teacher learning in a professional development setting if it is considered how practices can be recontextualised in a classroom. When teachers are afforded the opportunity to work together on improving their practices, these opportunities can be transferred to the learning opportunities in their classrooms (Borko 2004). Situative theorists argue that learning is both an individual process of coming to understand how to participate in the practice of a particular community and a community refining the norms and practices through the ways in which individuals bring ideas to the discourse (Lave and Wenger 1991). Such communities can enhance teachers' professional knowledge and improvement of practice. According to Marcelo (2009), professional development is conceived as a collaborative process, even though it is assumed that there may be room for isolated work and reflection.

Teachers' Perceptions about Mathematics

In order to understand how teachers approach their work it is necessary to understand the beliefs and principles they operate on (Richards et al. n.d.). How teachers behave and go

about their daily teaching practices depends on their view of mathematics. If a teacher sees mathematics as a number of procedures to remember, this teacher will teach in the way for learners to master the procedures. Procedural knowledge and the rote learning of rules will probably be the focus of his or her classroom practice. These practices are often textbook bound, where the teacher will explain the “new” work, and give the learners strings of exercises to practise the procedures. Learners in such classrooms often perceive that school mathematics is made up of numerous rules that had to be memorised and that mathematics is divorced from real life. It is these types of views of mathematics that need to be addressed in professional development.

If, on the other hand, a teacher believes that mathematics is a human, cultural and social construct, where meaning is formed and negotiated via discourse with peers, he or she will adjust the classroom atmosphere where learners can negotiate meaning. In such a classroom, the learners will be exposed to a variety of strategies to solve problems, will be given the opportunity to develop mathematical beliefs and practices that were more consistent with the demands of both the classroom and the real world. Situated perspectives suggest that the behaviours and practices of students in mathematical situations are not solely mathematical, nor individual, but are emergent as part of the relationships formed between learners and the people and systems of their environments (Boaler 1999: 260).

Professional development is primarily about teacher change. For a teacher to adapt to new teaching habits, he or she must become aware of their own behaviour in the classroom. Loucks-Horsley et al. (1996) emphasise that, apart from teachers’ subject knowledge, their expectations, attitudes, and beliefs about themselves and about knowledge, learning, schooling, and the community in which they live are also important and must be addressed.

Professional Development as a Response to Change

Professional development takes many forms, but true professional development, in the sense of development that results in meaningful and long-lasting qualitative change in a teacher’s thinking and approaches to educating, is an autonomous activity chosen by a teacher in search

of better ways of knowing and teaching mathematics. Castle and Aichele (1994: 3) are of the opinion that development initiatives that are externally mandated or coerced by a power hierarchy generally prove to be ineffectual because they do not result in perceptible qualitative changes in learners’ performance. Externally imposed professional development activities, although well intentioned, are generally doomed to fail. This resonates with the theory of constructivism which concurs that knowledge cannot be transferred from one person to another in a passive fashion, but that each person is actively involved in the construction of his or her own knowledge. Active involvement can bring about a dissonance of opinions which could lead to a disturbance to the status quo of somebody’s habits of being.

According to Edwards (1994), there are six factors that drive teacher change for a professional development process;

- ♦ Experiencing a perturbation
- ♦ Having a commitment to change
- ♦ Constructing a vision of what the changes might look like in the classroom
- ♦ Projecting the teacher self into that vision
- ♦ Deciding to make changes within the given context
- ♦ Being a reflective practitioner

To experience a *perturbation* means to become aware that something needs to change. Teachers are often so caught up in their daily routine that something has to happen to cause this distinct interruption or disorder that will bring with it a need or desire in the teacher to change. However, Shaw and Jakubowski (1991) argue that without this perturbation, the status quo is not upset and teachers will likely be satisfied with their current form of teaching. Regardless of the type of perturbation that prompts change, the individual teacher needs to *commit* to the change. This process can be made more successful if the teacher or a group of teachers construct a *goal* for change that provides them with something tangible towards which they can work. Once a goal has been set, the teachers elect to become part of this goal thereby *personalising* the goal. They have to project themselves in this vision of how they will change. The most difficult part of change is to actually make the changes in the classroom. Teachers are required to *decide* to change the way they think about the process of teaching as well as

their teaching practice and habits. To successfully implement the changes that were precipitated by the perturbation, teachers need to continuously *reflect* on their own growth or development which bolsters their commitment and encourages them to pursue the goals that were set. Edwards (1994) argues that reflection on practice can be seen as the force that drives the entire process of change.

One such distinct intrusion or perturbation in a teacher's life world is educational policy change – a change not brought on by the teacher's choice, but by ministerial obligation. The disruption that educational policy change brings about – in the case of the South African scenario – affects not only what is taught but how also how the process of teaching and learning is conceptualised and effected.

Taking these sentiments into consideration, one could suggest that what is needed in South Africa is teacher professional development that is linked to the expectations and requirements of mathematics teacher as presented in the current curriculum. Teachers need to understand that some of the former methods and perceptions of the role of the mathematics teacher are not applicable to the current expectations of mathematics teaching and learning pedagogy. The emphasis of professional development initiatives should earnestly be on helping teachers understand the need for change and to empower them to meet the need for learner-centred and constructivist-based instruction. This would advance learners' problem-solving, meaning-making and conceptual understanding abilities rather than rote memorisation of facts that characterised the approach to education in the previous dispensation.

Professional Development as Commitment to Change

Policy implementation is brought about by the teachers, and it consequently becomes necessary to promote amongst teachers a commitment to make the change happen since new curricula generally entail new approaches to teaching and learning (a changed instructional methodology) and a new perspective on what should be included in the curriculum (content modifications). Teachers in South Africa have gone through several curriculum changes since 1994, the latest of which is the introduction of the

Curriculum Assessment Policy Statement (fully implemented in all school grades by the end of 2013), which forms part of the National Curriculum Statement.

Because teachers play a fundamental role in all formal instructional systems (Borko 2004) they are regarded as a cornerstone in innovations to education (Driel et al. 2001) and consequently any innovation to education will require a particular professional development programme to support teachers to facilitate the change. However, before teachers will change their traditional or previously instilled views of learning mathematics, their prevailing opinions need to come into conflict with "new" ideas.

Professional Development as Changing Teachers' Views of Teaching and Seeking Alternatives

As mentioned earlier, teachers' views of the nature of mathematics influences the way in which they teach mathematics (Ernest 1998) and furthermore, teachers' conceptions of what constitutes "good mathematics teaching" are deeply rooted and consequently there is generally a tendency to resist change to teaching strategies mainly because their perceptions have been firmly reinforced through extensive experience (Martins in Pekhonen and Törner 1999). It could be suggested that teachers will only commit to change if they believe that alternative ways of teaching and learning mathematics are imperative and will improve learning outcomes. Once teachers have committed to bringing about change, they will need to critically examine their own views of mathematics as a discipline and be made aware of alternative perspectives about the nature of mathematics and how it can be taught with greater effectiveness (Beckum et al. 1989: 438).

Teachers might also have a limited vision of their own needs in terms of instructional innovation. Thus, before change can be effected, teachers must first become aware of their own day-to-day actions in their classrooms in order for them to know and accept the changes that will be required and to commit to these changes. Commitment is an act of binding or dedicating oneself to a course of action. Since commitment is a mindful decision taken by an individual, it is a personal issue. A teacher's commitment to the teaching profession is a highly personal way of

viewing the self and the relationship to education. While teacher commitment can be seen as a commitment to external factors (such as learners), teacher commitment links significantly to personal zeal based on the individual's ideology, values and beliefs about the process of teaching and the subject field. This commitment can be a result of teachers seeking a deeper understanding of, and reflecting on their own behaviour.

Professional Development as a Reflective Practice

Reflection is a deliberate, purposeful act, and not a spontaneous or subconscious act. As teachers become more aware of reflection, they will develop the skills to enable them to reflect. As their repertoire of suggestions, experiences of problem situations, hypotheses, reasoning and testing skills increase, their ability to reflect during teaching is enhanced. This pedagogical skill can become something that resembles reflection-in-action. But then they must experience reflection as part of their own learning about learning and teaching (Loughran 1996). Kaune (1999) specifies "reflection" as "comparing and scrutinising cogitation, thinking, and examination, directed to the matter at hand, which is characterised through differentiation, detachment, and deepening". Reflection is used to describe a particular kind of high-level cognitive thinking process.

García et al. (2007) distinguish between the notions of 'reflection-in-action' and 'reflection-on-action' which underline the importance of the teacher's interpretative process. These notions are immersed in a broad theoretical perspective that has been denominated 'reflective practice'. From a general point of view, the notion of reflection on-action can be thought of as a person's posterior analysis of his/her own actions. In such reflection, the individual, free of the restrictions and demands of the specific situation, can systematically apply his/her conceptual tools and analytical strategies to understanding and assessing his/her past actions. Reflection-on-action is an essential component of the learning process that constitutes professional training. Mathematics teachers' reflection on teaching situations is an important process providing information that contributes to the understanding of their professional knowledge.

Marcelo (2009) also views a teacher as a reflective practitioner, someone who is in possession of former knowledge when entering a profession and who continues to acquire more knowledge through reflection on his/her own experience. He further examines the role that professional identity plays in professional development and in the processes involving the change and improvement of the teaching profession. He considers reflection as necessary, since it is through our identity that we perceive ourselves, see ourselves and wish to be seen by others. Professional identity is how teachers define themselves and others. It is a construction of the professional I, which evolves over the course of the teaching career and can be influenced by the school, reforms and political contexts. Lasky (2005) states that personal identity is shaped by a personal commitment, availability to learn and teach, beliefs, values, knowledge on the subjects being taught and how they teach them, past experiences, as well as professional vulnerability itself.

Professional Development Settings Which Foster Change

If it is the belief that professional development is about changing teachers in an environment where they can freely discuss teaching issues with other teachers, then such opportunities should be secured within a community of practice. The question: "How can teacher educators help teachers to address the multiple challenges they face in the mathematics classroom and school life?" is not an easy one to answer. Traditional forms of professional development are quite common, but they are widely criticized as being ineffective in providing teachers with sufficient time, activities, and content necessary for increasing teacher's knowledge and fostering meaningful changes in their classroom practice (Loucks-Horsley et al. 1998). It has been mentioned earlier that change *imposed* upon teachers does not work; at best it promotes momentary base subservience. On the other hand, changes that emerge from within the individual teacher are authentic. The person who has invested in the change is intrinsic to the situation, committed to both the change and making it work. Changes emanating from teachers themselves persist as long as they are committed to the idea, which is usually as long as the idea is

productive for both the practitioner and students (Barth 1980: 146-147). If a teacher can be placed in a situation where they can stand back and become aware of their actions during a lesson, it can provoke reflection on their behaviour.

Conversations where teachers can critically examine their teaching practices must occur if teachers are collectively exploring ways to improve their teaching and support each other as they work to transform their practice. Professional development settings, such as Lesson Study where teachers participate in planning lessons, teach the lesson, observe the lesson, and reflect on the learning that took place in the classroom, set the scene for teachers to become aware of their actions in the classroom. Garet et al. (2001) point out that by locating opportunities for professional development within a teacher's regular work day, reform types of professional development may be more likely than traditional forms to make connections with classroom teaching, and they may be easier to sustain over time.

Research shows that intellectual and pedagogical change requires professional development activities to be of sufficient duration, including both span of time over which the activity is spread (for example, one day or one semester) and the number of hours spent on the activity (Supovitz and Turner 2000; Cohen and Hill 2001). Loucks-Horsley (1995: 267) states that "professional development that is confined to short, discrete events is usually a wasted effort. Professional development takes time. It requires teachers to be reflective about their practice."

Papastamatis et al. (2009) argue that it is imperative for educational authorities to make staff development so worthwhile, so exciting, so effective, and so clearly adjusted to the growth needs of teaching professionals that every single one of them will demand to be part of the programme.

This paper reflects and is informed by research done on professional development, particularly in the field of Mathematics Education. For teachers to change their way of teaching, they need to change their way of thinking about mathematics. The commitment to change and the effort to implement these changes in the classroom is a deliberate act on the part of the teacher. This is a long and slow process, which must be nurtured and supported in a community of practice.

CONCLUSION

In an ever changing society, the needs of people change continuously and new demands that are placed on teachers in the teaching of mathematics. Professional development must also adjust to these demands. Teachers' beliefs about mathematics, the curriculum, how students learn are influenced by how they experience professional development. Therefore professional development programmes, where teachers are challenged to reflect on their beliefs about the purposes of education, to their professional identity are proposed. This paper thus argues that an environment that caters for teachers to become aware of their classroom practices, where they are exposed to reflect on their teaching and where they can take decisions within a group where they feel nurtured and safe to change their own beliefs about teaching and learning, can be a powerful process in the professional development of teachers.

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