Coping with New Mathematics Teacher Roles in a Contradictory Context of Curriculum Change

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This paper is part of a broader longitudinal study that investigates, from a social practice perspective, mathematics teacher learning (within an in-service program) stimulated by rapid curriculum transformation (Graven, 2002). As a backdrop for the description of the curriculum that follows, I begin with a discussion of the socio-political context that gives rise to the new curriculum. Then I provide a sketch of the wider study of which this analysis forms part, and so situate my focus on teachers' roles within a theoretical and methodological framework. Documentary analysis allows me to describe the curriculum and the new teacher roles. I conclude with a discussion of conflicts and tensions that arise in relation to these roles in curriculum implementation.

The social and political context within which the study takes place

South Africa has been typified by large inequalities. Wilson & Ramphele (1989) note that of the 57 countries for which data is available, South Africa displayed the widest gaps between rich and poor. The system of apartheid was predicated on ensuring that these inequalities were structured along racial lines. Under apartheid four racially classified population groups were created: White (of European origin); Colored (of mixed race, mainly European, African, and Malaysian); Asian (of Asian origin); and African (of African origin). All South Africans not designated as White were denied democratic participation, and resources were allocated to groups differentially for education, health, and all other essential services. Thus, huge inequalities were created and perpetuated under apartheid, resulting in large gaps between the rich and largely white population, and the poor and largely black population.

The education system under apartheid consisted of racially segregated departments of education. Thus all government-funded schools were racially segregated. Schools were hierarchical institutions with a culture of top-down decision-making and passive acceptance of instructions by teachers. Teaching in schools primarily involved the delivery of a prescribed, centralized curriculum that was subject to inspection. Teaching was dominated by teacher-centered "chalk and talk" methods, and assessment was almost synonymous with tests and examinations (Graven, 2002).

Since the first democratic elections in 1994, South Africa has been embarking on radical educational reform. The need for a complete overhaul of the education system under apartheid has been identified as a priority for building a new democratic South Africa. Thus educational change has been stimulated by the major political changes which occurred in the country during the 1990s and which brought about the abolition of apartheid and the introduction of a democratic South Africa. The vision for education that emerged was to integrate education and training into a system of lifelong learning. Outcomes-based education (OBE) was adopted as the approach that would enable the articulation between education and training, recognition of prior learning, and thus increased mobility for learners between different vocations.

Through consultation with a range of stakeholders, including teachers, a new curriculum, *Curriculum 2005* (National Department of Education [NDE], 1997), was developed for implementation. However, the degree of teacher involvement with the project has been criticized, particularly with regard to the number of teachers who participated in the curriculum's design, the demographics of those teachers who were involved, and the extent of teachers' participation (Jansen & Christie, 1999).

Curriculum 2005 is premised on a learner-centered, outcomes-based approach to education. The key principles on which *Curriculum 2005* is based are: integration, holistic development, relevance, participation and ownership, accountability and transparency, learner-orientation, flexibility, critical and creative thinking, progression, anti-biased approach, inclusion of learners with special education needs, quality standards, and international comparability (NDE, 1997). It should be noted that these changes in education did not originate in *Curriculum 2005.* South Africa has a long history of attempts to introduce "alternative curricula," most notably the People's Education movement and the National Education Co-ordinating Committee.[1] Chisholm, et al. (2000) sum up this history: During the apartheid years the principal pedagogical alternative to

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the education system's Fundamental Pedagogics was "progressive education", a form of learner-centered education nurtured in the liberal universities and the English private schools. In the 1980s the progressive learner-centered approach was linked to an egalitarian transformative project for South African education, and the result, People's Education, was presented as the alternative to "apartheid education" (p. 26).

However, the effectiveness of these attempts was muted, and the curriculum of the apartheid state clearly dominated (Jansen, 1999). Changes in the political landscape opened the way for progressive education stakeholders to become involved in policy debates about the future of education. The main features of People's Education that were absorbed into contemporary policy were equal access for all, critical thinking, learner-centeredness, bridging the gap between theoretical and practical knowledge, teachers as curriculum developers, group work, community participation, and continuous assessment (Chisholm, et al., 2000).

A distinguishing feature of *Curriculum 2005* is its explicit political agenda. *Curriculum 2005* is a vehicle for restructuring South African society along democratic principles. This role is captured in the introduction to the *Curriculum 2005*:

> The curriculum is at the heart of the education and training system. In the past the curriculum has perpetuated race, class, gender and ethnic divisions and has emphasised separateness, rather than common citizenship and nationhood. It is therefore imperative that the curriculum be restructured to reflect the values and principles of our new democratic society (NDE, 1997).

These underlying goals of *Curriculum 2005* have taken shape in the new mathematics curriculum and in its demands for new teacher roles. Before describing these changes, I discuss briefly the broader study from which this paper is drawn and why an analysis of curriculum change from the perspective of teacher roles and identity is important.

The empirical field of the study

The context of curriculum change implies an important role for in-service work with teachers. The Programme for Leader Educators in Senior-phase Mathematics Education (PLESME) was developed in order to create leader teachers in mathematics with the capacity to interpret, critique, and implement current curriculum innovations in mathematics education in South Africa. Other major aims included:

- enabling and fostering collegial and co-operative ways of working with other mathematics teachers within schools and between schools;
- fostering co-operative ways of working with departmental mathematics subject advisors and district offices to assist in implementing and reviewing mathematics curriculum innovations;
- developing necessary skills and knowledge for running workshops with groups of teachers on a range of mathematics topics related to current curriculum innovations.

Assessment was portfolio-based. Portfolios included, for example, teacher conference presentations, materials and booklets designed by teachers, teachers' input into the Report of the Review Committee on *Curriculum 2005* (Chisholm, et al., 2000), workshops teachers organized and conducted, classroom videos, and teachers' written reflections on lessons, etc. PLESME worked with teachers from schools in Soweto and Eldorado Park (both urban townships outside Johannesburg) over a two-year period. This in-service teacher education program provided the empirical field for my study.

In PLESME I wore two hats. First, I was the coordinator of PLESME, my full time vocation from October 1998 until June 2001. I raised funds for it; designed it; set up a steering committee; and negotiated with schools, districts and teachers as to the nature of the project. I was accountable to my organization, the university, the steering committee, donors, teachers, and schools for the value and "success" of the project. At the same time, I was a researcher in the process of conducting research on the nature of mathematics teacher learning in relation to an in-service teacher education within the context of rapid curriculum change.

I was expecting some tension to emerge in relation to my role as an in-service education coordinator and my role as researcher, primarily because I had struggled to distinguish these roles clearly in the research proposal. However, I discovered that no such tension emerged in practice; the tension remained primarily theoretical. Instead I discovered a powerful praxis in the duality of performing both roles. It enhanced and enabled a form of action-reflection practice that I had been unable to achieve with success in previous in-service teacher education projects. For example, reflecting on interviews, lessons, and other data helped me to develop research ideas and refine my research objectives. This reflection led to asking specific questions in interviews and questionnaires that related to my research interest in understanding the nature of teacher learning. However, such reflection on data also led to the re-planning of PLESME activities and the design of additional activities that enhanced teacher participation and teacher learning. For example, interviews became discussions that formed a necessary part of praxis and were also geared towards

gathering data necessary to assist me in answering my research questions. Similarly, my ongoing reflection in the form of journal entries (relating both to PLESME and my work as a researcher) and the readings I was engaged with helped me reflect on how to improve PLESME.

Teacher learning, roles and identity

The study explored mathematics teacher learning in relation to how teachers participate in and make use of a community of practice, stimulated by PLESME in the context of curriculum change. The study is broadly located in social practice theory. Within this field, Lave & Wenger's (1991) notion of participation in communities of practice is becoming increasingly popular to explain learning. According to their model, learning is located in the process of co-participation, the increased access of learners to participation, and in an interactive process in which learners simultaneously perform several roles. Participation in this sense is the process of "being active participants in the practices of social communities and constructing identities in relation to these communities" (Wenger, 1998, p. 4). Learning and a sense of identity are aspects of the same phenomenon (Lave & Wenger, 1991). Previous research conducted by Graven (1998) indicated that teacher education should involve bringing teachers into supportive communities where reflection-in-practice is enabled. Lave and Wenger's model of learning supported this conclusion and provided some useful insights for analysis of the broader study.

My assumption was that the implementation of the new curriculum would not simply involve following a set of curriculum instructions or replacing "old" practice with "new" practice. Rather, implementation is a process of fashioning the curriculum in such a way that it becomes part of the teacher's "way of being." In fashioning the curriculum in this way, teachers will change themselves and modify the curriculum. My assumption was that this learning would take place within the context of participation within the PLESME practice, which included practice within schools. These assumptions were not evident to me at the start of the research study but rather developed over time through observing teachers make sense of the new curriculum and reflect on their learning process. In interviews with teachers about their learning within the context of PLESME, it became evident that teachers themselves saw their learning as a process of developing a different way of being. The following quotes from teacher interviews support this statement.

Beatrice,[2] a grade 7 primary school teacher, said, "You know before I always used to introduce myself as the music teacher, now I introduce myself as the maths teacher" (Beatrice, personal communication, July 20, 1999). Through learning and being part of a mathematics community, this teacher's identity as a mathematics teacher was strengthened.

Elaine, another teacher in the study, said "It [PLESME] has broadened my horizons very much…For myself, if I open a newspaper I think what can I use in my class, or think this is another way of drawing a graph... Like the example we did on holiday, I start to realise how much they (advertisements) are bluffing you. I use it in everyday life…" (Elaine, personal communication, June 22, 1999). For Elaine, participation in PLESME practices led to a new mathematical approach to the world around her—she became a critical mathematical thinker in her life outside of the mathematics classroom.

Two key notions I draw upon are teacher roles (designed by the NDE) and teacher identities (which form in uneven ways in relation to change). The object of the broader study is to elaborate on the relationship between these notions. I believe that analysis of curriculum change from the perspective of teacher roles and identities is original and has much to contribute to understanding curriculum in practice.

The study uses ethnography as its research methodology, in which I work as a participant observer. Because teacher learning is analysed within the context of radical curriculum change, a major part of the study has involved thorough documentary analysis of the new curriculum and related literature. This part of the study is the focus of this paper. For a more detailed analysis see Graven (2001). I have drawn on the work of Bernstein (1982, 1996) for tools for curriculum analysis. In this paper I draw on Bernstein's (1996) differentiation between performance- and competence-based pedagogic models. According to Bernstein, performance models serve primarily economic goals and are considered instrumental. They emphasize specialized skills necessary for the production of specific outputs. In contrast, competence models foreground the cognitive and the social, and acquirers apparently have a greater measure of control over selection, sequence, and pace. I also draw on Bernstein's concept of *Official Projected Identities,* which refers to the identity projected by an institution (in this case, the NDE).

Changes in the mathematics curriculum and teacher roles

In this section I describe the changes found in mathematics curriculum documentation and unpack the new roles for teachers. First, in *Curriculum 2005* the subject *Mathematics* has been replaced with the broader Learning Area *Mathematical Literacy*,

Mathematics and Mathematical Sciences (MLMMS). This learning area represents a major shift in the philosophy of mathematics and mathematics education. Three main philosophical shifts can be identified. They relate to the approach to mathematics teaching, the nature and contents of mathematics, and the role of mathematics education. I will address each of these changes briefly.

Within the learning area MLMMS, the NDE defines mathematics as:

> the construction of knowledge that deals with qualitative and quantitative relationships of space and time. It is a human activity that deals with patterns, problem-solving, logical thinking etc., in an attempt to understand the world and make use of that understanding. This understanding is expressed, developed and contested through language, symbols and social interaction (1997, p. 2).

This definition places an emphasis on more social constructivist, learner-centered, and integrated approaches to mathematics teaching and learning. This emphasis indicates a move away from the previous performance-based approach towards a more competence-based approach. Furthermore this definition indicates a shift away from the "absolutist paradigm," which views mathematics as a body of infallible objective truth that has little to do with the affairs of humanity (Ernest, 1991). The *Rationale* for MLMMS further states that mathematics should empower learners to "understand the contested nature of mathematical knowledge" (NDE, 1997, p. 1). MLMMS focuses its attention on constructing mathematical meaning in order to understand the world and make use of that understanding. Mathematical learning is to be relational, flexible, transferable, and integrated with everyday life and other learning areas. The specific outcomes for MLMMS indicate changes in the content of school mathematics. The importance of data, space, and shape (not simply Euclidean geometry); history of mathematics; and cultural, social, and political applications of mathematics are all new. For example, Specific Outcome 4 is: "Critically analyze how mathematical relationships are used in social, political and economic relations" (p. 3).

The specific outcomes support the important role charged to MLMMS for helping to build a new democratic, equitable, non-racist, non-sexist South Africa. Political aims are also clear in the *Rationale* for MLMMS, which states that MLMMS must empower people to:

- work towards the reconstruction and development of South African society;
- develop equal opportunities and choice;
- contribute towards the widest development of the society's cultures;
- participate in their communities and in the South African society as a whole in a democratic, non-racist and non-sexist manner etc.

In sum, MLMMS demands major philosophical shifts of teachers and learners. These shifts affect teacher roles and hence the development of mathematics teacher identities. As is well documented (Thompson, 1992), bringing about change in teachers' conceptions of mathematics is a difficult and long-term process. Therefore it is important not to underestimate the enormity of these demands.

Further analysis of MLMMS shows four different orientations of mathematics.

1. Mathematics is to be learned for critical democratic citizenship. It empowers learners to critique mathematical applications in various social, political, and economic contexts.
2. Mathematics is relevant and practical. It has utilitarian value and can be applied to many aspects of everyday life.
3. Mathematics inducts learners into what it means to be a mathematician, to think mathematically, and to view the world through a mathematical lens.
4. Mathematics involves conventions, skills, and algorithms that must be learned. Many will not be used in everyday life but are important for further studies.

An understanding of school mathematics, in terms of the four orientations, demands that mathematics teachers develop related "roles" in relation to their teaching practice. Four related mathematics teacher roles are thus identified:

1. The teacher's role is to prepare learners for critical democratic citizenship. The teacher becomes a critical analyzer of the way mathematics is used socially, politically, and economically, and supports learners to do the same.
2. The teacher's role is a local curriculum developer and an applier of math in everyday life. The teacher brings math from "outside" into the class.
3. The teacher's role is to be an exemplar mathematician or someone who has an interest in pursuing mathematics for its own sake. The teacher apprentices learners into ways of investigating mathematics.
4. The teacher's role is as a custodian of mathematical knowledge or a deliverer of mathematical conventions, algorithms, etc., which are important for MLMMS in general and will enable success in the Further Education and Training band (grades 10-12). The teacher is a conveyor of the practices of the broader community of mathematics teachers.

In this vision for change, it's important to ask whether these roles are realizable. Is it possible for teachers to perform each of these mathematical roles? Is it reasonable to expect teachers to integrate across these roles? Engaging in a theoretical discussion about these issues is beyond the scope of this paper. Instead I examine some of the tensions that emerge in relation to these roles in the implementation of the new curriculum.

Some tensions in working with the mathematics orientations and teacher roles

The separate presentation of the four orientations and related roles should not indicate a lack of connection between them; these orientations should work together in support of each other. While the assumption in MLMMS is that these orientations can and do co-exist, they are not presented to teachers this way in practice. Rather than presenting a view of mathematics that integrates all four of these orientations and roles, emphasizing variation, curriculum support presents conflicting messages as to which orientation is "best," and often sends a message that there is one best orientation a teacher should adopt. Official support for primary school mathematics teachers at district level tends to focus on the first and second orientations while viewing the fourth orientation, the one most familiar to teachers, as "old." On the other hand, support provided to teachers that is aimed at improving performance in mathematics examination results emphasizes the fourth orientation at the expense of the other three. Let me elaborate with two examples.

Illustrative Learning Programmes (ILPs) were designed by the Gauteng Department of Education and the Gauteng Institute for Curriculum Development to support teachers in developing theme-based and integrated learning materials (1999). The first ILP for MLMMS, grade 7, was "Farming and Growth." Analysis of this 50-page document reveals that only approximately one quarter of the activities relates to mathematics and that most of these mathematics activities simply "apply" mathematics skills that are assumed to be available to learners. The mathematics in this ILP works with the second orientation at the expense of the other three orientations. This ILP has been heavily criticized by mathematics teachers and educators. Minutes of the Primary Mathematics Working Group Session of the Association of Mathematics Education of South Africa (2000) reflect that teachers feel that there is not enough mathematics in this ILP. Chisolm, et al. (2000) note that the ILP shows that the emphasis on integration has compromised coherent mathematical development and that the mathematical content is obscured.

On the other hand, official support aimed at the improvement of performance emphasizes the fourth orientation by stressing algorithms, procedures, and definitions. At the start of my work with the PLESME teachers I was invited to a district level workshop for primary school teachers from Soweto. These teachers were invited to a previously white primary school for the workshop. At this workshop the white teachers from this school provided the black teachers from Soweto with photocopies of their mathematics schemes of work. These schemes of work did not reflect any current curriculum developments and only focused on the fourth orientation of mathematics. The common assessments given to the teachers from Soweto schools were based on this scheme of work and did not reflect any of the other three orientations. For example, the exam asked learners to define various mathematics terms and excluded geometry because according to the scheme of work, this mathematical topic is only dealt with in the final term. The justification for the insistence of the use of these schemes of work and assessments is that they are derived from a so-called "top performing" school in the district. This judgment of top-performance was based on the grade 12 external exit assessment of learners in the high school that this primary school fed into (Researcher's journal entry, February, 1999).

Recall that under apartheid white schools were provided far greater resources than black schools. As a result, performance on grade 12 examinations for white schools was far better than for black schools. Clearly the district advisor who organized the workshop (himself an former teacher from Soweto) assumed that good results in grade 12 meant that "good" teaching must have occurred at the primary school level. Therefore he assumed that black teachers (in Soweto) should learn from the white teachers irrespective of whether or not they embraced the new curriculum and its socio-political aims.

Such actions by the part of district workers will affect the morale of teachers, undermining teachers' attempts to implement new curriculum ideas and excluding teachers from making decisions related to the teaching and assessment of their learning area. Furthermore, they will prevent, rather than support, teachers from developing new roles that resonate with MLMMS and broader curriculum changes. In a context of a post-apartheid South Africa, the racial undertones of such an incident which imply that learning between teachers of different race groups is a one-way process from "previously advantaged Whites" to "previously disadvantaged Blacks," are particularly problematic and worrying.

Thus two contradictory official identities are being projected, that of the incoming curriculum and that of the outgoing curriculum. The Official Projected Identity (Bernstein, 1996) of MLMMS, the incoming curriculum, emphasizes the first and second orientation (the third and fourth orientations are included but are, in practice, less emphasized). However, the Official Projected Identity related to the outgoing (but still predominantly implemented) curriculum emphasizes the fourth orientation. Since there are currently two curricula existing within the school system, the incoming competence-based model and the outgoing performance based-model, provincial departments and district workers are in the difficult position of having to work out when it is appropriate to work with which Official Projected Identity. Furthermore, though *Curriculum 2005* applies to all bands of education, including Early Child Development, General Education and Training (GET, grades 1-9) and Further Education and Training (FET, grades 10-12), currently details of the curriculum are only available in the GET band. Since the curriculum has not yet been designed for the FET band, the credibility of the first and second orientations is undermined. The alternating official emphases on the two different curricula create a swinging pendulum in which teachers receive contradictory messages. I believe that these inconsistent emphases are problematic and that all four orientations are needed for learners to become competent in MLMMS.

I have argued that analysis of curriculum documentation for MLMMS reveals a radical shift in the philosophy of mathematics. Furthermore, during the phasing-in period of *Curriculum 2005*, two contradictory education models "officially" co-exist. This duality creates dilemmas for teachers who are expected to implement new learner-centered and locally relevant curricula while their schools continue to be judged on the performance of national examination results. I believe that this tension is reflective of broader tensions between the local and global. *Curriculum 2005* attempts to satisfy both local and global demands in its drive to create mathematical meaning in local contexts while simultaneously competing internationally.

Wenger (1998) raises an important issue for teacher education in this respect. While national education departments can design roles, they cannot design the (local) identities of teachers. The broader research study analyzes teacher learning in terms of the relationship between the new mathematics roles, the generic roles for educators as outlined in the *Norms and Standards Document for Educators* (NDE, 2000), and developing teacher identities. In this paper I have outlined the socio-political context that has led to the design of new teacher roles that in turn have resulted in contradictory messages for teachers. I have used evidence from the larger study as examples of these contradictions.

In conclusion, I concur with Harley and Parker (1999) that teacher development in this context of change is far more complex than simply retraining teachers. Ways must be found to support teachers in developing new professional identities. They conclude that to implement these changes "teachers may well need first to shift their own identities, their understanding of who they are and how they relate to others" (p. 197).

REFERENCES

Association of Mathematics Education of South Africa. (2000). *Minutes of the Primary Mathematics Working Group Session.* Bloemfontein, South Africa.

Bernstein, B. (1996). *Pedagogy, symbolic control and identity: Theory, research, critique*. London: Taylor and Frances.

Bernstein, B. (1982). On the classification and framing of educational knowledge. In T. Horton & P. Raggatt (Eds.), *Challenge and change in the curriculum.* Milton Keynes, UK: The Open University.

Chisholm, L., Volmink, J., Ndhlovu, T., Potenza, E., Mahomed, H., Muller, J., Lubisi, C., Vinjevold, P., Ngozi, L., Malan, B., & Mphahlele, L. (31, May, 2000). *A South African curriculum for the twenty-first century.* (Report of the review committee on Curriculum 2005). Pretoria: South Africa.

Ernest, P. (1991). *The philosophy of mathematics education: Studies in mathematics education*. London: The Falmer Press.

Gauteng Department of Education (GDE) & Gauteng Institute for Curriculum Development (GICD). (1999). *MLMMS grade 7 module 1: Farming and growth, learner's material.* Johannesburg: GICD.

Graven, M. (1998). Are mathematics high school teachers ready for Curriculum 2005? In *Proceedings of the 6th Annual Meeting of the Southern African Association For Research in Mathematics and Science Education, Vol. 1* (pp. 172-178). Pretoria, South Africa.

Graven, M. (2001). Understanding the context of South African curriculum change. In *Proceedings of the 9th Annual Meeting of the Southern African Association for Research in Mathematics and Science Education, Vol. 1* (pp. 327-35). Maputo, Mozambique.

Graven, M. (2002). *Mathematics teacher learning, communities of practice and the centrality of confidence.* Unpublished doctoral dissertation, University of the Witwatersrand, Johannesburg South Africa.

Harley, K., & Parker, B. (1999). Integrating differences: Implications of an outcomes-based national qualifications framework for the roles and competencies of teachers. In J. Jansen & P. Christie (Eds.), *Changing curriculum: Studies on outcomes-based education in South Africa* (pp. 181-200). Kenwyn, South Africa: Juta & Co.

Jansen, J. (1999). Why outcomes-based education will fail: An elaboration. In J. Jansen & P. Christie (Eds.), *Changing*

curriculum: Studies on outcomes-based education in South Africa. (pp. 145-156). Kenwyn, South Africa: Juta & Co.

Jansen, J., & Christie, P. (Eds.). (1999). *Changing curriculum: Studies on outcomes-based education in South Africa*. Kenwyn, South Africa: Juta & Co.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation.* New York: Cambridge University Press.

National Department of Education. (1997). *Curriculum 2005: Lifelong learning for the 21st century*. Pretoria: NDE.

National Department of Education. (4 February 2000). *Norms and standards for educators* (Government Gazette, Vol. 415, No. 20844). Republic of South Africa: NDE.

Thompson, A. G. (1992). Teachers' beliefs and conceptions: A synthesis of the research. In D. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 127-146). New York: Macmillan.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. New York: Cambridge University Press.

Wilson, F., & Ramphele, M. (1989). *Uprooting poverty: The South African challenge.* Cape Town, South Africa: David Phillip Publishers.

[1] The NECC was an alliance of progressive education and labor stakeholders. In 1992 its Curriculum Research Group produced a National Education Policy Investigation report on curriculum on which much of the current curriculum is based.

[2] All names used are pseudonyms.