

The relationship between the mathematics identities of primary school teachers and new curriculum reforms in South Africa¹

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Abstract

Based on life history accounts of two elementary school teachers in South Africa, this article examines the construction of two teachers' mathematics identities. In the article we juxtapose these identities with the identity forms that are envisaged by the policymakers and the mathematics reforms currently underway in the country. Using the data on contradictions between the reformer's visions and the teachers' accounts of their lived experiences and identities, we construct an account of why the goals of reforming mathematics in primary school classrooms in South Africa continue to elude even this latest set of reform proposals. We conclude by exploring some possibilities for bridging the divide in order to transform mathematics teaching and learning in the South African classrooms and elsewhere.

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Introduction

The educational landscape in South Africa has not been the same since the introduction of popular democracy in the country in 1994. Many of the changes in education, however, have only altered the structures of education and left intact the content of what goes on in the classrooms (DoE, 1997a; Jansen, 1998a; Jansen, 1998b; Jita, 1999). Only recently has the curriculum received sustained attention from the policymakers (DoE, 1997a; DoE, 2002) beginning with the introduction of a new curriculum, the Curriculum 2005 (C-2005) and more recently its streamlined version called the National Curriculum Statement (NCS).

The new outcomes-based C-2005 was launched in 1997 as a radical departure from the content-based and teacher-centred curriculum, laden with apartheid symbols of a past era in South Africa. The introduction of this Curriculum-2005, however, has had a troubled history and lifespan. It has on the one hand, been rejected as political rhetoric and posturing by some educational and political leaders in the country (Jansen, 1998a). On the other hand, the practical problems of its implementation at the classroom level have raised questions about its influence on teachers and their classroom practice.

Unlike its traditional predecessors, the new curriculum versions (C-2005 & NCS) are distinct and make demands on teachers in a number of ways. First, in their approach to mathematics as a "discipline that enables creative and logical reasoning about problems in the physical and social world" (DoE, 2002). Second, in their view of mathematics as a contested and changing "human activity developed over time by social interactions through both language and symbols" (DoE, 2002). Finally, in their emphasis of "mathematical process skills above the acquisition of content knowledge for its own sake" (DoE, 2002). This new focus on reasoning, problem solving, human engagement and discourse, and other process skills in mathematics represents a radical departure from the traditional curriculum in South Africa which focused more on mathematical content knowledge for its own sake. This reform agenda represents a tall order for many of the classroom teachers whose experiences of mathematics and mathematics identities have been within the traditional approaches to the school subject, which placed more emphasis on content, manipulation of symbols and operation and less on problem solving, discourse and reasoning (Ball, 1988; Ball, 1993; Cohen, 1990; Nelson, 1997; Spillane, 2000; Spillane & Zeuli, 1999). It demands of teachers to reconceptualise their own relationship to the subject matter and to their learners in order to foster the new agenda. Ideally, teachers of mathematics are expected to be facilitators of a deeper discourse about mathematics among groups of learners engaged in some real life problem solving (DoE, 1997b). As Spillane (2000) and others (see Cohen, 1990) have argued, teachers are expected to assume identities of being learners themselves and not the bearers of all the mathematical knowledge students are required to learn. This agenda, therefore, represents a fundamental shift in the mathematics teachers' identities of many teachers across the country.

However, very little seems to have changed in mathematics classrooms across the country. In this article we begin a search for explanations to this inadequate transfer of reform ideas into mathematics classrooms. Using data from a study of two primary school mathematics teachers, we develop an account of how the mathematics agenda is progressing in specific classrooms and begin to suggest an explanation for the non-reform of many similar classrooms across the country. We begin by sketching briefly our framework for looking at the teacher cases, then we detail the methodology for the study and then outline our two case studies. Each case study includes a synoptic view of what could be considered typical and common in each teacher's classroom practice. We conclude by discussing the findings and pondering their meaning and implications for the reform agenda in general.

Conceptual framework

We locate our account of the slow pace and non-reform generally within a framework recently advocated by Jansen (2001) and others (Sachs, 2001). In his framework Jansen (2001) argues that the relationship between policy images (in the policy texts) of what a reformed teacher should look like and the personal identities of teachers, which define the understandings that teachers hold of themselves, is problematic. That is the gap between policy and practice in many schools in South Africa and elsewhere could be explained by the disjuncture between the demands that policy makes on teachers and the personal identities of these teachers with regard to their work. We draw especially on what Jansen (2001) refers to as the "professional basis for teacher identity," which describes their "capacity to teach" and includes the teachers' subject matter competence, levels of training and preparation, and their formal qualifications. Perceptions of and beliefs about the subject and themselves as learners of mathematics also constitute an important dimension of this professional basis for teacher identity. In our analysis, therefore, we look at the interplay of these dimensions of the professional basis for teacher identity to explain the changes or lack thereof in teachers' classroom practices.

Recently there has been growing interest among researchers on the subject of teachers' identities as they relate to their work in schools (Casey, 1993; Coldron & Smith, 1999; Connelly & Clandinin, 1999; Middleton, 1993; Osler, 1997). More importantly, the work on teachers' identities has begun to grow steadily in developing countries over the past few years (Carrim, 2001; Dhunpath, 2000; Jansen, 2001; Jita, 1999; 2004; Samuels, 2001; Matheson & Harley, 2001; Olser, 1997; Soudien, 2001). A significant gap however exists in much of this literature with regard to our understanding of how these identities are shaped within specific subject matter contexts. Some work on the subject matter identities (in mathematics and science) has begun to emerge, albeit from the developed world (exemplars include Drake, Spillane & Hufferd-Ackles, 2001; Drake, 2002; Eick & Reed, 2002; Poletini, 2000; Spillane, 2000). Our work seeks to develop this subject matter focus for mathematics identities in developing countries, more in the vein of what is beginning to emerge for science teachers (see for example Jita, 1999; 2004; Volkmann & Anderson, 1998).

In the article we present an empirical study of two primary teachers of mathematics working in two former 'whites-only' schools (for English and Afrikaans-speaking white children respectively).² From their life-history accounts, we explore their mathematics identities and consider an account of how it is that the classroom practices of many primary school teachers, like these two, in South Africa have remained untouched by the recent reform agenda. We explore two teachers' constructed mathematics identities by comparing them to the ideal images proposed by policymakers in South Africa. We conclude by developing an account to explain non-reform in these two teachers' classrooms and those of others with similar features.

Methodology

We based our study on the premise that changing practice is never easy, for it involves reconceptualising one's knowledge and beliefs about a particular subject. Changing practice in the mathematics classroom involves changing one's mathematics identities. This is a difficult request for many teachers, old and new (Cohen, 1990; Spillane, 2000). Our study seeks to unpack this request for change and the assumptions embedded in it.

The research was conducted in two primary schools in a large South African city. We focused on the Grade 4 mathematics classrooms, which is the first level after the foundation

² Afrikaans is one of the eleven official languages recognized by South Africa's new constitution. In the previous dispensation, only English and Afrikaans were recognized as official languages and languages of instruction in whites-only schools.

phase (i.e. after Grades 1-3). In this article we focus on two primary school teachers and use a mix of data including classroom observations, in-depth interviews, and an analysis of key documents (learner transcripts, teacher workbooks, marking schemes, diagnostic tools, etc.). The interview protocol took the form of a semistructured interview, with a set of questions on the teachers' own experiences as learners and teachers of mathematics. Observations of teaching and assessment practices were made over a two-week period in the case of each teacher. Interviews complemented the observations and afforded teachers an opportunity to talk about their teaching and assessment practices, and to locate their teaching within the broader mathematical experiences they had as students of mathematics.

The table below presents a summary of the school profiles.

Table 1: Profiles of schools

School name	Broadwater	Silverstream
Type of school	English, well-resourced school, former white	Afrikaans public school
Situated	Middle to upper class predominantly white suburb	Low to middle-class white suburb
Medium of instruction	English	Dual medium (English and Afrikaans).
Established	Early 1900	1906
Pre-1994 population:	White English-speaking learners	White Afrikaans-speaking learners.
Post-1994 Student population	800 (60% white, 33% African, 4% Indian and 3% Coloured)	535 (52% African, 43% Indian, 3% white and 2% Coloured)
Staff component	33 (all white), Afrikaans-speaking	19 teachers (17 white, 1 Indian and 1 Coloured) 17 white teachers were all Afrikaans-speaking and had to make adjustments both culturally and pedagogically to meet the challenges of change
Distribution of learners by population groups	59% white; 33% African; 4.7% Indian and 3.3% Coloured	59% African; 34% Indian; 5% White and 2% Coloured. ¹
Learners in Grade 4 class	28 (20 white, 7 African, 1 Indian)	39 (24 African, 13 Indian, 1 White, 1 Coloured). Some African learners have limited English proficiency
Teacher	White Afrikaans/English-speaking female, 17 years primary school experience	White Afrikaans-speaking female, 30 years primary school experience(Endnotes)

Understanding mathematics identities in the classroom: Case study one

Life history and mathematics identity

Marieta is a veteran teacher at Silverstream and has been teaching primary classes since the early 70s. She began her teaching career soon after she had left the prestigious Afrikaans college in the Cape in 1970. Prior to that she had spent much of her early education experiences in farm or rural Afrikaans-medium schools where multi-age grading was the norm. Although Marieta speaks positively of her schooling experiences generally, she was unable to identify or remember specific incidents or experiences that contributed to these positive feelings of her own schooling. When pressed to talk about her experiences as a student in specific subject areas at primary and secondary school, aspects of her mathematics identity began to emerge in powerful ways we could not have expected. In response to a question to "talk about learning mathematics" for example, here's what she said:

I hate it. I don't think I have very good insight about it. I could deal with the basics ... but the moment there's a problem; problem solving was a problem for me. I hated that. In Standard 8 (Grade 10), I stopped studying mathematics.

Although the first three words in this quote are very powerful in revealing Marieta's disposition towards mathematics in general or mathematics learning in particular, what is even more interesting is her confession of lack of confidence in tackling what many reformers consider to be at the heart of mathematics literacy, *viz.* problem solving. Her negative experiences with mathematics or mathematics learning are not uncommon among many teachers of mathematics (Drake, Spillane & Hufferd-Ackles, 2001). However, what is uncommon is the fact that it is not the repetitive, superficial algorithmic aspects of mathematics that became a turn-off for her, but the very essence of what mathematics is about – problem solving. Problem solving is at the very heart of what it means to do mathematics in schools and outside them (Thompson, 1992; NCTM, 1989). Pushed further to explain this turn-off towards mathematics, Marieta noted that it's probably because

we are different, I think that is why. We are different. I don't think I'm a mathematics kind of person. I really love other things ... I liked history, Afrikaans and English ...

From this quote, and throughout our conversations, it became clear to us that Marieta located her inadequacies as a mathematics learner solely within herself. She was not terribly dissatisfied with the mathematics instruction she received from her teachers in the 1960s (although many of the curriculum reformers would have expected her to be critical of the traditional mathematics curriculum that dominated South African schools until this latest major reform in mathematics). In fact, the closest she got to a critical review of the mathematics instruction she received was when she talked about her teacher education experiences.

To tell you the truth, I think they could have done much more, in those days. I don't know what happens now, but in those days you learned how to be a teacher by taking a bit of psychology and all the other subjects. I think they could have done more to teach you how to help children learn the basic things. Say for instance, maths and then they teach you, they didn't really teach you how to do it and why and how to help the child and all that.

In the foregoing discussion, Marieta begins to recognise some of the possible shortcomings in the kinds of mathematics experiences she received while preparing to be a teacher. Most of her criticism however, seems to be centred around what Shulman (1987) calls pedagogical content knowledge – the knowledge of how to translate mathematics content for a particular group of learners.

Marieta's grounding in mathematics is inadequate. Academically, she went only as far as Grade 10 mathematics, which is basically foundational in the South Africa context. Professionally, her preparation for teaching mathematics was by her own admission very lacklustre. Her confidence and capacity as a mathematics learner herself is very low. To use Jansen's (2001) phrase, the "professional basis for her identity" as a mathematics teacher is therefore weak. That is her subject matter competence, her academic grounding in mathematics, her professional preparation as a mathematics teacher, and her beliefs and perspectives of herself as a learner and teacher of the subject are not as strong either. With this weak basis for her identity, she is however called upon to implement a new and challenging mathematics curriculum for her Grade 4 learners. The reformers' request is therefore an impossible demand for Marieta. In the next section we explore her classroom practices and our conversations with her about the challenges for change.

Marieta begins her lesson on problem solving in this way:

T: Let's see what we did yesterday (pauses to think); first count in 3s up to 30
 SS: Count in 3s to 30 and back. (some learners just mumble along).
 T: Then count in 4s

The counting continues in 4s and backwards, in 5s and backwards, in 6s and backwards. The teacher then intervenes and assists the learners with the 6s table as they begin to struggle (she writes the 6s table on the chalkboard for them to read it out).

After this memory work on the tables, which lasted about 10 minutes, the teacher then assigned students several sets of calculations to do. The first set of tasks involved computing an answer from a given set of three numbers, e.g.

3; 9; 4 (=10).

The students were to use the three numbers to compute the answer 10.

Many of the learners had no problems with this computation task and even slower ones began to catch up on what was happening after the second or third tasks. However almost all the students began to have problems with the tasks that required some multiplication and division prompting the teacher to stop and explain to the whole class.

In the last segment of the lesson (about 5-7 minutes), the teacher introduces another set of computations that require understanding of the concept of a place value. She began this work the previous day and had assigned it as homework.

T: Some of you still have problems ... let me explain this again. Some of you went home and had problems.

S1 (one Afrikaans girl) *Ek het myself gehelp* (I helped myself to do the sums).

T: (ignores the comment and proceeds) there's your sum or problem [writing on the board the numbers the students are required to add 567, 159 using the "expanded method"].

S11: 500 + 60 + 7

S3: 100 + 50 + 9

T: Yes (Writes on the board as the learners say the numbers) ... boys and girls you will learn about place value, listen, can you see I put them in their places.

SS: Yes

T: What do we do now?

SS: Add

T: (writes the answer)
$$\begin{array}{r} 600 + 110 + 16 \end{array}$$

T: Can you see we have a mixed salad...and we must now sort it out. [she then proceeds to sort it out herself on the chalkboard with her back facing the learners as she explains what she is doing]...who does not see what I did?

SS: Silence (... The bell signalling the end of the period rings at this time).

T: This whole morning you are solving problems in numbers but sometimes problems are a little story but you will work in groups of two to do the stories. The teacher assigns the worksheet with story problems which learners are to do as homework. The following day she goes over the homework but abandons it as it turns out to be too complicated for the children; reverting back to the familiar computation practices.

This segment of Marieta's classroom practice was typical of all the mathematics lessons we observed in her classroom over the period of our observations. Several features stand out in this, and other lessons by Marieta. First, the fact that she almost always begins her lessons with some memory work on the multiplication tables. Her goal is to have students "master their tables" to enable them to have the basics for working out the computations. Although this is a fairly noble goal for mathematics learners to pursue, the decontextualised approach to its teaching is problematic for the mathematics reformers (NCTM, 1989). Throughout the lessons there was no effort to make the learners see the integration of this knowledge with their overall mathematics problem-solving activities. In fact, even when learners had problems approaching the three number computations that required the use of multiplication and division, there was no explicit attempt to link this to what they already knew about multiplication tables. The second major feature of Marieta's lessons is that computations tended to dominate the real world of problem solving. In fact, her emphasis was on these computations as problem solving with only peripheral and limited exposure to what the learners would likely experience as problems in the real world. For example, her approach to the word problems was very brief and cut short at the first experience of a challenge by the learners. Her approach to the word problems was almost reluctant and regulated. Evidently, the very aspect of mathematics that gave her problems as a learner in primary school was the one her own learners were being short-circuited on in her own classroom. Problem solving had indeed become a problem in her teaching and learning of mathematics. This is not to suggest that Marieta was at all a bad teacher overall, but that aspects of her mathematics teaching were constrained by her own constructions of an identity around mathematics, an identity based on a deficit notion of herself as a mathematics learner and teacher.

The mathematics in her classroom is somewhat problematic. The definition of what constitutes mathematics in her classroom contrasts sharply with the ideas contained in the reform documents and statements by mathematics reformers in South Africa and elsewhere. Her instruction and account of that instruction is mediated through her use of the deficit concepts she developed for constructing her own identity around mathematics. Her mathematics identity is both a strength and a liability. This implies that she uses her own experiences to understand the learners who experience problems with mathematics and their need for more assistance while at the same time constructing a rationale that could condemn them to a similar fate as hers regarding mathematics learning. Although she begins to develop a vocabulary to explain what is different between the new curriculum reforms and the traditional approaches to mathematics learning and teaching, her grasp of this vocabulary appears shaky and its consequences for her teaching are almost invisible. Although she tried hard to find some good in the new language of reform, Marieta's construction of her identity stands in the way.

I'm an old teacher, so it's not easy for me to say 'I'm going to drop everything' ... I say to my children, I'm going to do what I think is best, I take the other (new) things, and I do the other (old) things. If a child doesn't know how to do plus, how on earth can he do something? So I do the basics and then they carry on. OBE is difficult, it is something quite different. It's difficult to work in groups ... so it's difficult for us, I really think so, because you work with different kinds of children, from different backgrounds.

In this rather frank discussion, Marieta explores with us some of her problems with the mathematics reform curriculum. Much like the failing (foreclosed) teachers described by Drake *et al.* (2001), her construction of her identity (as a master of the "basics") foreclosed her from seeing the opportunities for learning and teaching mathematics in new ways. For example, her declared mastery of the "basics," which she was good at from her primary school days, led her to construct her mathematics lessons around the "basics." She challenged the reformers' approach to learning the basics in the context of doing mathematics, e.g. solving problems, as inappropriate for her particular group of learners. As noted in the vignette, her teaching of

problem solving centred on the 'basics' of addition and subtraction and ground to a halt at the point of introduction of problem solving.

Consider Sharon, another Grade 4 teacher at the second English-medium school, and the mathematics identities she constructed.

Case study two

Sharon grew up mostly in the Cape. Her family moved around the country because of her father's postings as a member of the Defence Force. Despite the difficulty of coping with different systems of education in the various provinces of South Africa, Sharon describes her schooling experiences in positive terms. Her definitions of what it means to become a mathematics teacher, were constructed from some of these positive experiences of schooling. In our conversations she credits her mathematics teacher, who had a "pleasant approach" for her decision to continue with mathematics beyond Grade 10 through to the end of high school:

I was a borderline case and then the motivation from him ... , we enjoyed his classes so he motivated you to carry on. I think (he had) a very relaxed way of teaching.

Although she did not have the best of experiences with mathematics at primary and secondary school, her mathematics identity was not constructed in negative or deficit terms. In fact, she understood mathematics as something that learners can work on and master.

I won't say I had an aptitude for numbers ... but I don't battle that much with it. Mathematics was difficult, it was a struggle. It was, and suddenly I think in Standard 9 (Grade 11), going over to matric (Grade 12), I learned that it's something that you learn like any other subject. You do it and then you do it again, and you look at examination papers and you see the numbers change but there's the same method that comes out of all of them. And then at matriculation it was, funny enough, a bit easier than it was up there (in earlier grade levels).

Her emphasis on mathematics as a subject whose difficulty can be overcome through hard work and learning is critical to our understanding of her constructed identity as a learner and teacher of mathematics. Furthermore, it is evident from the quote that Sharon saw herself not as a master but as a continuous (lifelong) learner of mathematics. This construction of her expertise in mathematics as unfolding is a very powerful one for someone confronted by a radically new and changing curriculum in South Africa. It comes out again when she talks about how she has been able to sustain her desire to learn more about the new reforms in mathematics and how to improve her "creativity" in teaching by "finding new ways to understand and present the subject matter" to her learners. For example, she talks about the challenge to reform in spite of the conflicting demands of the new curriculum.

It has been very challenging to change your whole approach, we are only in the second year of doing it. And I think there is some confusion about what OBE is and then we already hear that they need to change things (through the NCS). So in that way it's making it very difficult for us as well. But I can't really say that I'm the type to shy away from a challenge.

The second important issue in the construction of her mathematics identity from her school experiences, has to do with the messages she received of what it means to do mathematics. Her description of mathematics as a repetition of letters where only the numbers change is very revealing. As a high school learner, she began to construct this view of mathematics as an application of "methods" or tricks in some repetitive exercises and tasks where the symbols or "letters" as she put it, remained constant but only the numbers changed. This is a very decontextualised understanding of what it means to do mathematics. There is not a sense of mathematics being a tool through which to interact with the real world. Hers is an understanding of mathematics as routine 'problem solving.'

These two aspects of her mathematics identity – *viz.* the view of herself as a continuous learner who is trying to develop expertise in the subject and its teaching, together with her view of the subject as static and routine are crucial to our understanding of the observed practices in her mathematics classroom. This implies that these two aspects of her identity help to explain how it is that despite her weak grounding and expertise in mathematics from her early experiences at school, Sharon is able to craft a somewhat reformed and demanding classroom practice for her mathematics learners.

Consider a vignette of Sharon's class at a time when she was also exploring problem solving with her learners:

Her lesson begins with a Lord's prayer and some housekeeping announcements, opening windows etc. The learners then finish some work in their 'write and wipe' booklets.

T: we'll start by counting, first in 6s...do it S8 (pointing to a young white girl)

S8: (looking at her chart with the table of numbers) 6, 12, 18, 24,

T: carry on S3

S3: 24, 30, 36, 40

T: can you hear all? ... is she right?

SS: [as the chosen learners count, all others also follow from their (books with) tables of numbers].
No...

T: [the teacher corrects a mistake by the learner who was reading and then asks her to continue]
....

T: count in 6s backwards, S15 ...

S15: [obliges and reads the table backwards this time around]

T: all of you now count in 6s.

After this brief segment, of about 5-10 minutes, the teacher asks the learners to create the 6s table in their 'busy books' which the students do with a good degree of familiarity. Once this exercise is over, the teacher introduces the word problems:

T: we are going to do word problems, where I don't tell you to add this and that but I give you a problem (switches on the OHP to view a transparency with one example of a problem) ... you recognise this eh (with some excitement), what did you do in Grade 3, when you got a problem like this? How many steps are there? S1?

S1: you have to plan, build and think

T: right, who learned that in Grade 3? (asking almost rhetorically as the learners seemed to know these steps and could read them off one of her charts over the chalkboard ... what does planning involve? S11?)

S11: when we write the sum and not just write the answer

T: yes. In other words you have to think about how you are going to solve it first...what are the possibilities? How can you solve this one (pointing to the OHP)? You can do four operations, what are they? S2?

S2: plus, minus, times and divide

T: yes, very good ... the most important thing to do in solving word problems, you have to READ (emphasises by lowering her tone), that's step number one. Michael, once I have done that I write the open number sentence. If you look up there (pointing to the chart with the three steps for solving word problems) you will see a reminder of the steps...(reads off the steps with some emphasis). Now we are going to work together, I want you to work in pairs. On your own, read that problem, but don't write anything, just read and think ... [after about 2 minutes] David, read the problem for us

S20: mom picks some flowers, she used 26 in an arrangement and has 18 left over. How many flowers did she pick up?

T: Work in pairs ... decide what operations to use, then write the open number sentence. E.g. $7 + 5 = ?$

SS: [begin to work in pairs, reading and discussing the problem]

S12: are we just planning or should we do the problem?

T: I want you to write down your step number 1 only. I don't want any answers ... [the teachers goes around checking on how the groups are working, congratulating some as she passes by].

After this whole exercise at understanding the problem and translating it from words into mathematical symbols and concepts, the teacher selected a group to present its approach and solution to their peers on the chalkboard. There was vibrant discussion as the teacher asked another group that had disagreements with the first group to present its own operation. The whole class engaged in a guided discussion on how to approach this problem [with the teacher making some calculated interventions during the free-flowing discussion]. The lesson continued with more problems of a similar nature, and with the teacher gradually reducing the amount of help she gave to the learners as a whole group [e.g. each group began to read the problem by themselves with no reference to how other groups read and understood the problems].

The vignette presents a typical lesson from Sharon's mathematics classroom. Her lessons always contained aspects of the new reforms in mathematics alongside the traditional and routine aspects of the subject. For example in one lesson she would require students to recite and write down the multiplication tables forward and backwards, while asking them a few minutes later, to read off numbers from the multiplication table chart (when and if they need them) to develop a solution to a real world problem simulation. In one sense therefore, hers was not always routine memory work on tables, but was calculated to "familiarise" the learners with this mathematical tool (multiplication tables) to the point of the learners having to construct the tables themselves in their booklets and to use these for problem solving. In the context of problem solving, her emphasis was on challenging the students to think and reason mathematically rather than to worry about remembering the tables (which they could read off their charts). However, Sharon is caught in the dilemma partly created by the contradictory aspects of her mathematics identities. This contradiction (which probably is not experienced as a contradiction by her) in her identity is one powerful way to explain how she could sit comfortably within the policy of her school not to change its traditional approach to the teaching of mathematics in favour of the new reforms, while exemplifying in practice much of what the reformers ask of classroom teachers in that same reform.

Sharon's mathematics knowledge and beliefs, and her mathematics identity in general was not challenged in any significant way by her college experiences. These experiences provided a basis for further experiencing and learning (Dewey, 1938). This underscores, once again, her constructed identity as a lifelong learner of teaching practice in general, and of mathematics practice in particular.

Sharon finds within her own mathematics identity a rationale for keeping mathematics structured while still grappling with new ways of enriching the mathematics experiences of her learners. That is, inasmuch as some aspects of her lessons remained very structured and traditional, the same could not be said of other aspects. She was very deliberate about enriching the mathematics experiences of her learners. She went out to workshops, brought in new ideas and new approaches to teaching familiar mathematics concepts, shared with the colleagues in her cohort (as the group leader for the Grade 4 teachers) and was generally wonderful at engaging students with deeper ideas of doing mathematics. However, the structure and routines remained intact.

When OBE started, we said there's no way we are going full over with mathematics. We are going to try and keep it apart from OBE ... we keep mathematics more structured ... but the whole thing is that we feel maths is a very sensitive area, a very serious area. It's something you don't play around with. You don't experiment to such an extent. You want good results, you stick with what works. I just want to emphasise that it does not mean that we are closed to any other one's (ideas), so if I find a new method that I can try, I do. But we found that these little stories and little things and the children haven't yet been taught a method but they must go shopping and apply it without having been taught the mechanics, does not work.

As Sharon argues, teaching the mechanics is a prerequisite for doing real mathematics and this is part of the dichotomy that is exhibited in her classroom practice. Indeed, her classroom is a far cry from the traditional mathematics classrooms that dominate many primary school classrooms. She explores children's ideas and engages them in tasks that simulate real life problems and challenges. Hers is not a total rejection of the reform ideas, but an honest attempt to construct a mathematics identity that cuts across two contradictory but almost equally powerful discourses about what it means to practice mathematically.

Sharon's journey to the "discovery" (or more appropriately the construction) of her mathematics identity, indeed, continues almost in tandem with that of her Grade 4 learners of mathematics.

Discussion and conclusion

As with Drake *et al.* (2001), we found that the two primary school teachers in our study do tell coherent stories about their mathematics identities, with themes and plots that range across their learning and teaching experiences. The stories of the two teachers have interesting points of commonality, but they also differ in some important respects.

To begin with, our account suggests that these teachers' knowledge and beliefs about mathematics, mathematics teaching and mathematics learning were shaped significantly by their previous experiences as students and early experiences as teachers in different schools (Ball, 1997; Jita, 1999; Poletini, 2000; Schifter, 1996). In the case of one teacher, Marieta, her experiences of the subject were rather brief and negative. That is, she engaged with mathematics only up to Grade 10, enough for her to see herself as an outsider in the community of mathematics learners. Her belief that people are different as far as learning the school subjects is concerned, with some more capable and able to master the content of mathematics while others not so gifted, arose out of these experiences of failure and later became central to her construction of her mathematics identity. The second teacher, Sharon, who also had less than ideal schooling experiences in the mathematics classrooms pursued the subject and developed further even during her early teaching experiences. She ended up with a radically different picture of herself around mathematics – that of being a lifelong learner of the subject.

In general both teachers describe a less than ideal set of experiences around mathematics learning and teaching in their early experiences. The common feature in their descriptions is the conception of mathematics as routine and algorithmic. Very little in their own learning experiences challenged the commonplace notions of what it means to do mathematics in school. The professional basis for teacher identity (Jansen, 2001), which includes their subject matter competence, levels of training and preparation and formal qualifications was generally weak for both teachers. Both teachers did very little mathematics beyond the high school level, especially in their teacher preparation programs, with one of the teachers even opting out (of secondary school mathematics) much earlier in high school.

The teachers in our study hesitated to implement many of the ideas of the new mathematics reforms in South Africa. Despite being hesitant about the mathematics reform in general, however, Sharon's practice incorporated many of the reform ideas albeit in tandem with the traditional notions or the "mechanics" of mathematics. As we have illustrated, her classroom practice had shifted significantly towards the reform ideas relative to Marieta's. How this could be was an important aspect of our investigation.

Despite the two primary school teachers having had comparable experiences of learning mathematics in their own schooling, which were generally weak and traditional, they constructed radically different classroom practices for their learners of mathematics. What accounts for the differences, was for us, revealed in their construction of their mathematics identities. The two teachers constructed fairly different identities from their early and somewhat similar experiences. While Marieta constructed her mathematics identity in more deficit terms, her counterpart, Sharon constructed herself as someone who was a learner of mathematics and who was engaged constantly in learning about how to improve her teaching of the subject. How she constructed her identity around mathematics was important for Sharon to overcome some of the limitations of her early experiences with mathematics. It appears as if the reform agenda provided Sharon with a fresh opportunity to learn and interrogate mathematics that she had missed out on during her time as a primary and secondary school student.

Constructing an identity as a learner enabled her to perceive the reforms differently from her colleague(s). Despite her school's policy to go slow on the reform agenda, she was able to see the reform ideas as opportunities to explore and experiment in her mathematics classroom more like the reform-oriented teachers in the Drake *et al.* (2001) study. However, for Sharon the

distinction between learning from the reforms about the mathematics content or about the pedagogical or process knowledge was less clear. Although she talks about bringing new approaches to the teaching of mathematics from the workshops, many of the new approaches she brought into her classrooms were premised on and communicated a different understanding of what it means to do mathematics.

These findings from the study of the two primary school teachers of mathematics raise two important issues for policy in South Africa. First, there is the issue of policy disjuncture from reality. What Jansen (2001, 242) characterises as the relationship (or should we say lack thereof) between "policy images" and "personal identities" of teachers. The reform documents make certain assumptions about the kind of teachers who will implement the reforms. For example, the mathematics reform agenda is premised on a more sophisticated and deeper understanding of what it means to learn and do mathematics in school. Our findings suggest that this may not be the experience of many (primary) teachers in the country. Most teachers who completed their studies prior to the 90s reforms would most likely have gone through one version or the other of the traditional curriculum with little exposure to the debates and discussions currently underway in the subject reforms. As a result, teachers will continue to struggle with the reform ideas and this is a real and significant issue for the reformers to plan for in the reform agenda.

Second, we have developed an account of how teachers construct and use their identities as a filter for the reform ideas in mathematics. An important aspect of teaching concerning the reforms therefore should include opportunities for teachers to experience and engage with the mathematics as learners in similar ways as they would be expected to teach in their own classrooms. Such experiences and opportunity to engage differently are critical elements in the construction of a mathematics professional identity and developing a new vocabulary for reflecting on one's own experiences in the subject. Changing classroom practice eventually depends on the teachers' ability to construct a counter-identity around mathematics, and to incorporate the new (reform) vocabulary within their own systems of thought and practice.

Based on the evidence and issues we raise in the case studies, we conclude by drawing attention to three critical ingredients for the success of the current wave of reforms in South Africa: Firstly, the need for policymakers and other reformers to take the necessary time to **uncover teachers' prior experiences** with mathematics which act as filters through which the reform ideas are interpreted. Secondly, to provide **opportunities for them to learn and unlearn** in the context of the new reform ideas which may be fundamentally different from their (the teachers') own. Finally, the need to provide **time** for such learning and experimentation, for teachers with varied sets of experiences and backgrounds in mathematics, to occur without the pressures to perform and reform overnight.

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