# Beginning Teachers' Professional Identity Formation in Early Science and Mathematics Teaching: What Develops?

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## Abstract

*This article is about teacher identity formation of two foundation phase level (Grade R-9) level beginning teachers in their first year of teaching early mathematics science and technology (MST) in two different schools and grade levels. The study used a phenomenological approach and the case study method to try to illuminate what factors influence how teacher identities can be narratively constructed on the basis of the lived experiences of the two teachers in different school contexts. Data was generated from different sources for the purpose of triangulation, which included visual and written narratives, teacher journals, teacher observations and interviews (open and semi-structured).The paper concludes by noting how identity formation is an ongoing process of integration of teacher's personal, and professional histories and initial teacher education and training, alongside issues of school culture and institutional (in-school) support. Those key factors emerge as strong determinants of the kinds and relative stability or otherwise of professional identities which the two teachers develop in the first year of MST teaching ,and thus the kind of reform minded teachers they become.*

## 1. Introduction

This article is based on personal histories, professional educational studies, teachers' working conditions, and interpretative analysis of interviews and classroom observations of two female South African foundation phase teachers in their first year of teaching mathematics science and technology (MST) in the early years. These two beginning teachers use narrative resources to describe and voice their lived experiences in their different school settings during the process of professional teacher identity (ies) (PTI) formation. The study reported here, which is part of a larger project on teacher professionalism sought to illuminate how teacher identities can be narratively formed and to analyse key factors that are likely to influence the ways these new teachers' professional identities are shaped and reshaped in the context of teaching mathematics science and technology (MST) at foundation phase level (pre-primary education).

Pre-primary and primary schools in South Africa have a diverse pupil body that increasingly demands of beginning teachers, to continually adapt their teaching to the different learning environments for the benefit of young children's growth. Beginning to teach as is

widely recognised, is a particular and complex stage of teacher learning and teacher identity formation (Avalos 2011; Hobson, Ashby, Malderez, & Tomlinson, 2009; OECD, 2005). The high levels of attrition surrounding beginner teachers worldwide (Avalos 2011; Cherian & Daniel, 2008) have been well documented. While existing literature suggests that teacher effectiveness improves sharply in the first few years of entering the profession, research shows that many new teachers abandon the profession prior to attaining that level of expertise in any appreciable way (Fantilli & McDougall 2009; Mitchell & Logue 2009). Teacher retention and teacher quality have thus become interlocking issues of policy for many developed and developing countries (OECD, 2005).

In the South African setting, there is a paucity of discourse and research into early childhood and Foundation-phase level teacher education. The poor historical status of this sector of the education system, particularly in respect of the comparatively few African candidates who opt for a teaching career in early childhood education and foundation phase has been of national concern (DoE, 2003). In addition, the growing body of literature surrounding the effective teaching of mathematics science and technology (MST) in the early years is void of the South African context and the beginning teacher's voice. In recent years several authors (Clements, 2001; Fuson, Grandau & Sugiyama, 2001; Saracho & Spodek, 2009) have advocated the benefits to children (and society) of early exposure to MST. Therefore, research that would investigate aspects of foundation phase teacher education provision must of necessity be seen as absolutely crucial for teaching and teacher education at that level. At the core of any such endeavours is the understanding that professional development and identity formation for the beginning South African teacher is all about transforming their knowledge into practice for effective implementation of the new reform based national curriculum statement (DoE, 2005; 2007).

In this paper, the point of departure for the analysis of the factors that are likely to impact on the two foundation phase teachers' professional identity formation is the following research questions: what identifiable factors contribute to professional teacher identity (PTI) formation in the context of teaching MST in the early years? How do these factors affect the sustainability or otherwise of their PTI in diverse school contexts? The article will argue that for these teachers, teacher identity formation is a process that starts during professional studies and is continued during the lifetime of the teacher as a practitioner (Osgood, 2006). The institutions of higher learning where teachers are educated and trained have the responsibility of instilling in the latter a sense of relevance of their own uniquely constructed possible professional teacher identities (Day, 2008; Smith, 2007; Søreide, 2006). This notion of teacher identity as multifaceted and constructed, virtually excludes the belief that teacher education programmes can provide teachers "with ready-made and universal identities which they should fit in to" (Søreide, 2006, p. 527), yet the kind of teacher envisaged by exposure to the pre-service teacher education degree programme successfully completed by these two first year teachers is best described as

'reform-minded teacher'. A reform-minded teacher according to the philosophy which underpins that institution's foundation phase teacher education programme is expected to become the nucleus of reform and transformation in the learning environment in which he or she operates in implementing the new curriculum. In other words becomimng a reform-based teacher entails developing a new professional identity in context. It is assumed that the programme will have exposed them to factors –internal and external to pre-service students- that contribute or not to identity formation of beginning teachers (Devos, 2010; Harrison, Dymoke & Pell, 2006; Killeavy & Moloney 2010) that will enable them to learn to become effective reform-minded teachers in different school settings. Flores and Day (2006, p. 219) refer to the nature of this learning process as 'multi-dimensional idiosyncratic and context-specific'. The aim of this article is to show how teacher identities of the two first year foundation phase teachers were narratively constructed (cf Søreide eide 2006) through the interaction of mediating factors, internal and external to the participating teachers in teaching the new MST curriculum.

## 2.  Context

In South Africa, the new vision of the reform based national curriculum statement for early SMT teaching emphasises problem solving skills and competencies grounded in inquiry based education. It (vision) also advocates the integration of science and technology into all three learning programmes of numeracy, literacy and life skills (DoE, 2003) at foundation phase level. However this vision is still far from becoming a reality as there are very few "reform-minded' pre-primary and primary science teachers currently implementing this type of practice. For instance, recent studies  have shown that South African pre-primary level teachers and beginning foundation phase teachers often find it difficult to teach science (Bosman, 2006) and technology (Van Heerden, 2005) at that level. Within that broad recommendation of subject matter integration, the teachers remain uneasy as to how to implement the integration in practice. The upshot according to research (Bosman, 2006; Van Heerden, 2005) is that they invariably embark on a period of uncertainty and denial, questioning the place of science and technology in foundation phase level curriculum. Naturally, without this belief or conviction of inclusion, Akerson, Buzzelli, and Eastwood (2010) contend that such teachers invariably neglect or avoid teaching those two learning areas. Various studies provide empirical support (e.g. Bosman, 2006; Botha, M., Maree, J. G., & de Witt M. W., 2005; Gillard, 2008; Martin, 2001, 2003; Munn 2009; Van Heerden, 2005) for that assertion. For many teachers not least beginning teachers, implementing the new foundation phase SMT curriculum may just underscore the fact that inquiry based education demands of the teacher skills that differ considerably from 'traditional' teaching (Ermeling 2010; Timperley & Phillips, 2003). Indeed, as Furtak (2006, p 64) has noted, "it may not be sufficient for teachers to acquire the skills of inquiry; without the beliefs, the skills fall short of  full implementation"

Against this backdrop, there is clearly the need to ask why current teacher preparation

programmes are failing to prepare South African foundation phase teachers who are able and choose to implement the vision for SMT education as articulated in the nation's norms and professional standards. In order to address the question there is need for a better understanding of factors that mediate beginning teachers' identity formation in the context of implementing the new reform based early MST curriculum (Jansen, 2003; Jita & Vandeyar, 2006; Onwu, 2008).

## 3. Theoretical Approach and Central Concepts

Teacher preparation programme is essentially about developing professional teacher identity However, even when pre-service teachers have been exposed to the same programme, there remains a large measure of variability in terms of what individuals have and do in just how the curriculum is implemented in different learning environments and working conditions. As a result the learned multiple identities of the beginning teachers, and the contingencies of the classrooms have the potential to create differences in teaching and teacher decision making. These multiple identities have the potential to influence what, how much, and how well the curriculum is implemented.

Although most first year beginning teachers are idealistic and positive about their entry into the profession, they enter the new teaching situation with personal histories, attitudes, beliefs and indeed a sense of a variety of roles they feel that they have to play as teachers. This sense of 'self' as teacher has largely been shaped by previous and current history or experiences (Cieslik, 2006; Day, 2002; 2008; Day, Kington, Stobart, & Sammons, 2006; Sachs, 2001). Beginning first year teachers often feel pressured to conform to the specific requirements of a school culture. This pressure, according to recent studies (Parkison, 2008; Whitelaw, 2007), sometimes isolates the beginning teacher from the broader landscape of the school social setting, which in turn prevents him or her from perhaps developing a 'positive' professional teacher identity. Many researchers have emphasized the reality shock and conflicting emotions new teachers experience as they take on their roles as school teachers. For some, the conflicts and dilemmas arise as a result of mismatch between personal beliefs, idealistic expectations and the reality on ground (Billet & Somerville, 2004; Day, 2008; Keys, 2007; Parkison, 2008). For others, feelings of isolation and the absence of institutional support (Flores & Day 2006, Whitelaw 2007), could trigger negative emotions in the transition from student to teacher. How such dilemmas are often resolved involve trying to make sense of, and reinterpreting one's own values and experiences in light of the 'powerful socializing forces of the school culture'(Day, 1999, p. 59) and outside of school too.

To develop, form and sustain meaningful or relevant teacher professional identity entails as Maclure (1993, p.313) indicated a 'continuing site of struggle'. Thus professional teacher identity is not necessarily what one has but as we said earlier something that is continually developing, and is used to make sense of one's own values; personal history and experiences.

As defined here, in the context of this study, teacher professional identity is viewed as an amalgam of 'technical' knowledge (subject matter content, pedagogy and pedagogical content knowledge), beliefs and views about the nature of early SMT, and the teaching and learning of SMT at foundation phase, the curriculum goals and how all of those mediate classroom practice in a given school culture or context. The notion of amalgam implies that each of those components can stand on their own or in unison to constitute teacher identity.

The upshot is that teacher identity is influenced by personal, professional and social response. Many of the studies that have been carried out on professional teacher identity have emphasised more the 'personal' and tended to underestimate the contextual side that plays a crucial role in identity formation (Coldrom & Smith 1999; Dymoke & Harrison, 2006; Flores & Day, 2006; Forde, Jurasaite-Harbison & Rex 2010; Whitelaw, 2007). The teachers' workplace as Reynolds (1996) noted is clearly a 'landscape' which can be very persuasive, very demanding and in most cases very restrictive and constrained. It embraces various relationships such as teacher-learner relationships, the curriculum, the classroom community, the school administration and management (Flores & Day, 2006). Because such institutional relationships involve many areas of control, authority or power they are able to shape a person's identity and practice. Indeed various researchers (e.g., Beijaard, Meijer & Verloop, 2004; Melville & Wallace 2007; Whitelaw 2007) have investigated how the social setting is likely to affect a person's professional identity as a teacher. The review on teacher professional development by Avalos (2011) highlights the fact that professional development that incorporates all-school inquiry can either be hindered by the school's organisational context, or on the contrary , under certain conditions can contribute towards cooperation and attainment of common goals in school. These studies serve to illustrate how types of institutional arrangements, and traditions can impact on teacher professional development. Having said that there are  hardly any reported studies in the South African context that have highlighted the interaction if any, between teacher personal histories and contextual influences in teacher identity formation in the early years of teaching a reform based curriculum. The knowledge and beliefs about teaching and learning which are determined by personal histories, professional studies and school context are conceived of among others, as important constituents of teacher professional identity formation.

## 4.  Objective of the Study

The objective of the study was to investigate how beginning first year teachers who had been exposed to a B.Ed early childhood and foundation phase teacher education programme at a specific institution in South Africa form their teacher identities in the context of teaching mathematics science and technology in different school contexts.

## 5.  The Study's Conceptual Framework.

The study used a learning identity framework to collect and analyse data. The learning identity framework is premised on the assumption that professional identity formation and the process of learning are closely linked (Billett & Somerville, 2004; Cieslik, 2006). As a process, a learning identity framework is influenced by both internal and external factors, which it is assumed the new first year teachers use to construct and reconstruct their professional teacher identity formation ( Billett & Somerville, 2004; Day, 2008; Egan, 2004; Smith, 2007; Watson, 2006). The interactive factors which a review of the literature suggests are likely to influence teacher identity formation include  those external to the new teacher such as existing curriculum, educational reform publications, public expectations, school culture (traditions, beliefs); and those internal to the teacher, which include personal background history and experiences, pre-teaching identity, educational background as well as beliefs and values of what it means to be a MST teacher. This view of identity formation stems from a socio-cultural perspective in which a person's identity is shaped and negotiated through everyday activities.

In this study we have chosen to view teacher identity formation as a process of narratives (written, visual and spoken), classroom practice (activity) and interpretation of lived experiences of the two teachers in a particular school setting and work environment. It is helpful to assume that the teachers identities can be narratively constructed and understood (Soreide, 2006), precisely because it facilitates and opens up an understanding of teachers as active change agents in their own lived experiences and in identity construction (Davis & Harre 2001).

## 6.  The Methodology

The study used essentially a qualitative research approach involving phenomenology and the case study method. The identified personal, contextual and professional factors were operationally defined and used to develop the instruments. Data was generated from a combination of sources for triangulation. These sources varied from teacher visual and written narratives, open–ended and semi-structured interviews, to specific classroom observations. Teachers' portfolios, a formal teaching document which teachers have to compile and their reflective journal-which provided for reflections upon their experiences were also used as data source. A wealth of data was generated from the reports, observations and interviews. The discussion of all the results is beyond the scope of this article so a selection of data is made on which to focus. The selected data on identity formation in MST teaching were analysed for emerging themes using phenomenological procedures within an interpretive paradigm. The case study can best be characterised as small-scale and in-depth. Both beginning teachers successfully completed their BEd teacher education programme in 2009. The B.Ed degree programme containing theoretical modules as well as an 18 week internship (teaching practice) period, prepared them to teach early MST. The BEd programme aside from providing them with

technical knowledge and pedagogical skills also equipped them with creative problem solving and negotiating skills. The classroom based action-research project that each student teacher is required to undertake during their study is designed to help them to apply their teaching philosophy, reflective skills, teaching skills, and decision-making in a classroom situation.. The two teachers started teaching in January 2010, and the study was carried over a period of 10 months.

# 7. Results

The main results are presented in brief narratives according to the identified main influences that impact on the two teachers' professional identity formation namely; (i) background or prior experiences in MST; (ii) initial teacher education programme; (iii) school context experience (iv) curriculum interpretation and implementation; (v) teaching MST; (vi) institutional support; (v) classroom practice as a first year MST teacher.

Acronyms used for data sources: Narrative reflection 1 (NR1); Narrative reflection 2 (NR2); Interview 1 (In1); Interview 1 (In2); Observational reflection (OR). Teachers voices are in quotes and in italics.

The teachers are identified by pseudonyms and treated as cases.

*Case study one: Nontombi*

Nontombi teaches a grade one class of 42 learners in the local mother tongue, Tswana. Most children come from single parent households where parental support and involvement are low. There is high unemployment and the school implements a feeding scheme. Learner absenteeism is rife.

*Background experience:* Nontombi entered university with negative attitudes, limited knowledge and uninformed beliefs about MST that had been shaped by previous experiences. She says that she *"did science and maths in matric, I did not enjoy the subjects at school" (In1).*

*Teacher education programme:* Nontombi described her process of becoming a foundation phase MST teacher in terms of a person whose *"emotions went from feeling like I was thrown into the deep end ... and that I had to sink or swim....." toward "feeling more confident ..."* (In 1) and positive. She attributed this transformation to her university education experiences, which according to her played important role in the way she began to construct her identity: shaping in some instances the way in which she responded to MST teaching. Those learning experiences were instrumental in helping her *"... changed the way I (she) used to think about maths, science and technology ... During my years at university I realised that maths can be made interesting and can be learnt and taught in a different way"* (In1).

*"At university I learned that science can be approached in different ways ... teacher can use lots of different environments as areas for discovery and for exploring and investigating and thinking in scientific terms—the teacher has to allow children to think and allow time to discover*

*and explore*" (In1). Her thinking about the nature of science and technology also changed from when she commenced her studies to where she is now, explaining that "*I used to think that science is about test tubes and such, but science is all around us. technology is the same*" (In1). She wants her learners to discover things on their own because "*science at foundation phase level is about investigating and that is our primary focus in this phase*" (NR1).

Furthermore pre-service teacher education seemed to have had a relatively strong impact on the way she approaches her teaching. She explains that she uses the content and pedagogical knowledge, skills and resources she acquired during her teacher education programme as a "*... form of referral to remind you (me) of strategies to use when teaching a certain aspect – using what was learned as a basis for more reflective teaching*" (NR1).

Becoming a professional foundation MST teacher is for Nontombi a process of interaction between personal perceptions and specific aspects of one's professional training in a particular context. This implies a process of growing stimulated by awareness of the theories (knowledge) learned at university and the application of such theories to manage the complex and demanding reality of the classroom. The process also involved engaging in dialogue with her colleagues. As will be noted later there are issues of disagreement (see Teaching MST) with colleagues which lead to both inner and practical tensions but culminate in growth in resourcefulness and negotiating skills.

***School context:*** During her first year of teaching Nontombi felt that moving from being a university student teacher to the reality of her own classroom was a shock "*My emotions went from feeling like I was thrown into the deep end ... towards working hard to make schooling a meaningful experience for each learner*" (In1).

She teaches in a school that challenges her adaptive and decision making capabilities because of the poor conditions that characterise the school's physical facilities and learning environment. The school is located in an area of high unemployment and the many children's learning difficulties she observes are further exacerbated by a high rate of absenteeism. "*Learners are from a poor socio-economic background. They sometimes miss a few days of school. This influences their progress. So the learner ends up not knowing the subject. That is a huge problem for us*" (In2).

All of those factors and conditions pose veritable obstacles to effective teaching and learning, which in turn makes her to feel at first unprepared to handle the role required of a teacher.

***Curriculum interpretation and implementation:*** Nontombi initially found the new curriculum difficult to follow, especially with regard to the recommended protocols (of integration) and procedures specified in the 'Foundations for Learning' document. She found the documents unhelpful. "*We have been using The Foundations for Learning Campaign files as directed by the DoE and this I found very confusing*" (NR1) because "*The curriculum changes every year. This is disconcerting. You find something that works and the next year you are made*

*to readjust because of something else"* (In2). Nontombi's resistance to the change reflects in a way a loss of a sense of herself as a teacher-does not seem to be on top of things-because curriculum change results in new ways-other than what she is used to- to live by. The reluctance to use the documents or to entertain the curriculum changes may also reflect the effort that she needs to apply to start up a new direction contrary to what she had been exposed to at the university. It requires an effort to maintain a story to justify herself as a teacher.

***Teaching MST:*** Mathematics is regarded as the foundational subject at the school and has a prominent place in the curriculum. *"Maths is a priority subject."* (In1) and *"Maths is important every day"* (In2). She is positive about teaching mathematics to her children and enjoys their reaction: *"I think my children love mathematics because they see I love it"* (In1).

Her personal experience of viewing mathematics as important and fun seemed to be relevant in the ways she views or understands herself as a MST teacher. While mathematical knowledge and skills are regarded as the main focus of teaching in her school, the school curriculum does not make provision for science and technology. For her this is unacceptable. There is a certain disenchantment in the way science is taught or not taught in the school. She insists that *"Learners should know science and I wish I could do more. Maybe I should plan better to include science on Fridays"* (In2).

*"We (other staff members) plan the subjects together and science is not a priority subject because it does not count for marks"* (In1) *"...so there is very little time to teach science..... But we could plan a science project like a discovery table..."* (NR2) she posits.

She identifies factors that inhibit her from fulfilling her role as a MST teacher. *"The factors that caused me not to teach science and technology are..... of lack of time"* (In2) and *"Very little science and technology, if any, is taught in the foundation phase at the school. I don't see science and technology"* (In1). Science and technology at that level are ignored or avoided in the school because they *"don't count for marks"*.

Nontombi's uneasiness about the school's (and her colleagues') position on science & technology teaching has its positive side, for it does lead to strategic resolution of the situation. She insists on integrating science and technology into her other learning area lessons. Indeed, the approach is consistent with the intentions of the foundation phase curriculum. She explains that *"Science and technology are now taught integrated with life skills and language"* (In2). When the national teachers' strike interrupted her teaching over an extended period she felt frustrated because *"Our science observations (about plant growth) had to be postponed and there was very little time left in the end to make a really good observation and measurement of the processes"* *(OR)*. She had intended to start a science corner that would foster this integration because she would *"... want to include science into all my teaching,... maybe a discovery table"* (NR1). Technology is somewhat silent. But Nontombi does not find the integration of mathematics, science and technology into the other lessons or programme easy at all. With mathematics it seems to be a little more straight forward: *"You do the maths, and you do on its own...but have to*

*integrate the science through other subjects… this is difficult"* (In 2). What motivates Nontombi in her MST teaching is clearly a love for mathematics science and technology and dedication to her job. Her personal commitment and desire to being an effective and reform minded MST teacher however, appears to have been shaken when she learns that the curriculum is about to be reviewed: *"I heard that science and technology are being removed from the curriculum and I am against this removal. The subjects are essential for the development of the child"*, *"…The curriculum changes every year. There is a lack of consistency"* (In 2). The change if it occurs may impact on her teacher identity formation, precisely because curriculum renewal is always likely to result in new situations the teachers will have to live by; involving new interpretations and re-interpretations of experiences. In that regard, for Nontombi, two things seem to go together with respect to professional identity, a personal commitment to becoming a good MST teacher and the high value she places on her education and professional training at university.

*Institutional Support:* Professional identity implies both person and context (workplace). Nontombi's sometimes conflicting perspectives, teaching dilemmas and contrasting emotions, what may be termed the 'painful beginnings' of a beginning teacher were largely alleviated by the support she received from her colleagues at school. She approached them on her own for help and she received the assistance she sought: *"I experienced a lot of support from my fellow teachers and my senior" (OR).* The supportive atmosphere at school and good relationship with her peers helped to create positive emotions and experiences, and impacted upon her understanding of foundation level teaching and of her identity as a professional MST teacher. Also, feelings of self worth and increasing self-confidence were manifest in the process of winning the confidence of her colleagues. Because as she said *"I convinced the team (her teamwork amongst her more experienced colleagues) through my enthusiasm hands-on and knowledge they know I am able to do things because they ask me for my ideas and input"* (NR1). Later, in the year she was able to say that she had *"… grown in the past few months from being a 100% theoretical teacher to being one with some experience; I have seen how what I have learnt can be implemented in the classroom"* (In2). Her perception and acceptance of the school's ethos and peer support in her first year impacted positively upon the ways in which she learned and developed her professional identity over time.

*Classroom practice:* Nontombi adapted the curriculum in a way that suited her own beliefs about the nature of mathematics (science and technology not as prominently) and how it should be taught at that level. She positioned herself alongside the children in her class in a somewhat symmetrical relationship as co-inquirer, co-learner in which all the children explore concepts with her through guided discovery (observed classroom practice). Although she has had to change and adjust her pedagogy over time to the reality of her classroom, as a result of better knowledge of her children, her positive beliefs about her teaching ability and skills in inquiry based education have strengthened. For her, teaching goes far beyond mere instruction to encompass also the socialization aspect and well being of children. She says *"I am positive about my teaching. I feel that I am making a difference"* (In1) and *"I believe that my identity is strong enough for me to be successful and to become an even better teacher. I want more*

*knowledge; I have a passion for children and I want to be there for them"* (In2).

*"I adjusted my teaching approach to the practical situation at school. I still have the same attitude and beliefs about the subjects. But I have learnt specific information about the school, who my learners are and how to teach them"* (In2). Caring for the children, being sensitive to the realities of the situation and helping them to deal with their difficulties were crucial features of Nomtombi's depiction of her multiple roles as a teacher. The personal element in teaching is highly cherished by her.

In the classroom, she sees herself as a *"hands-on"* teacher who tries to use what she refers to as creative means (as part of her identity) to teach her children: *"... I believe children need to manipulate resources in order to learn better...I always use counters so that the child can move smoothly from the concrete to the abstract"* (In 1). She seeks to create *"...an atmosphere of discovery and one that fosters learning..."* (NR2). For example, *"With each planned lesson, using a weekly planner I write how each aspect of say a given concept is going to be dealt with and then I play it out in my head. At the time of execution I observe how the learners react ...and this reaction sometimes indicates to me what I should do in a different way and how differently"* (NR1). For her as a new teacher responsiveness to children's need, flexibility, creativity and initiative, learner-centred approach and acknowledgement of diversity were key elements in her practice.

### Case study two: Anne-marie

Anne-marie teaches a reception year (Grade R) class of 33 children in English. The children however come from diverse cultural and language backgrounds. The school is well resourced

***Background experience:*** Anne-marie comes from a school background of limited exposure to mathematics and science but none in technology. Her experience of school mathematics and science was not a particularly memorable one so she ended up *"not liking...maths at school, because the teacher could not make it attractive for me. I found mathematics and science boring"* (In1). Did this early experience in any way impact negatively in shaping her pre-teacher identity? Not necessarily so, because as we shall see later, her process of identity formation was one of continuing but different responses to various practical situations she encountered. These include the challenges and constraints in her working space and the interpretation and reinterpretation of her role as an early childhood teacher -a process that is in agreement with the idea that teacher's identity development in the early years is a complex learning process.

***Teacher education programme:*** Anne-Marie's perception of mathematics and science gradually changed during her university studies, when she *"... gradually realised that mathematics and science can be interesting"* (In1). Anne-marie however admits that during her extended teaching practice (period of intership) she *"... unfortunately ... learnt very little about science and technology from my mentor teachers"* (NR 1). Nevertheless she insists that the theoretical and practical knowledge acquired during her university education and training programme has been of tremendous importance. *"I have learned so much during my four*

*years at university"* (OR) *"…the knowledge acquired during my studies provides me with the background knowledge to my lessons"* (In1) but she did wonder *"if all the theory (she learned at the university) will work in practice"* (In1). She did accept that *"Theory provides a necessary foundation for what lies ahead"* (In2) and therefore she tried *"… new things with my (her) children to see what can work, and what not, but also to see where I can adjust activities"* (OR). Her envisioned role of wanting to be an innovative teacher with different styles of teaching is in line with constructivist learning. Clearly her pre-service teacher education seemed to have had a strong influence on her practice as observed and the way she approached her teaching and a view of herself as a reform minded teacher.

*School context:* Becoming a professional MST teacher for Anne-Marie meant following a different developmental path from Nontombi, although both seem equally positive about their personal strong commitment to become reform minded teachers. Just as in the case of Nontombi moving from being a student teacher to the reality of a classroom was a rude shock, the same was true for Anne- Marie especially as she was to observe *"… you only realise what happens in a classroom when you stand alone on your own"* (In 2). The situation at school was difficult at first. Feelings of anxiety and despondency emerged in her account of her initial experience, because *"… the principal opposed everything I proposed" and … this had a devastating effect on me"*, *"… one can only stand up for oneself up to a point, especially if she was the principal as well"* (In2). When *"… she (the principal) left the school"*, the situation changed. *"I was lucky enough not to have a whole year of this"*. With the principal gone she was left to her own devices. She came to her own as it were and was absolutely clear about her beliefs and views (and the images as well) about teaching and the role she is expected to play. In other words she had freedom to operate: *"… I have much more freedom and can set up the classroom the way I want to"* (In2). Anne-Marie's idea of constructing her own professional teacher identity was from the onset a challenge within the context of her classroom practice. In her narrative she highlighted the mismatch between her beliefs and images about reform-based teaching and the roles the principal initially expected her to perform as a first year teacher of a reception year class. For her, her role as a reform-minded teacher was beyond an answer to the question 'Who am I now after successfully completing my teacher education and training?' but to include an answer to the question: 'Who do I want to become as a foundation phase MST teacher?'

*Curriculum interpretation and implementation:* Because of the 'freedom' that she gained as a result of the principal leaving the school, Anne-Marie freely interpreted and implemented the curriculum in line with her teaching philosophy. She does *"… think of creative activities in which to get the children actively involved and interested"* (OR). During observational visits to her class she was always seen to present art-related activities in which MST ideas are integrated. For instance in one such activity each child was observed to design and engrave his or her own pattern on a styrofoam tile, and print four images using the concept of symmetry. All three subject matter of MSTwere integrated in that activity, as was the case in other lessons observed

Teaching MST: Anne-marie regards the integration of early mathematical knowledge, science and technology inquiry skills acquisition as an important focus in her teaching. A clear point of her narrative construction of her teacher identity is evidenced in the following responses. She states that *"… mathematics is the foundation subject"* and *"I integrate and apply mathematics, science and technology concepts in structured lessons"* (In1). She describes the following learning activities: *"… a parent brought a box full of silk worms"* to her class: *"I let the children design and build a house as part of my own research. I started the project with a story about Sally Silkworm who lost her house in a fire. Learners were then divided into groups and they could choose materials with which to build the house"* (NR 2). She planned an integrated MST lesson around a real life problem (the loss of habitat) where the children had to plan and design an appropriate habitat for a silkworm. She and the children also *"had to identify the right leaves (mulberry) to feed the worms"* (In2). To continue the real life theme she *"… started a small garden"* and *"… a wormery"* she asked the children to bring *"… potato peels and other material for the worm garden"* (NR2). For her the transition from theory to practice occurs through her innovative or imaginative teaching and classroom activities using real life situations. She is able to identify a variety of learning situations related to her day to day teaching philosophy. For instance as observed she encourages children to learn experientially through discovery. *"I have a nature corner in my classroom where beans sprout and silkworms spin cocoons and shapes. We have birds, fish and a vegetable garden"* (NR2).

Her stories and the way she explains and enthuses about providing imaginative hands-on inquiry-based SMT activities for her learners, and the pleasant learning environment in essence constitute or define her 'core' professional identity as a foundation level MST teacher. Her developing professional identity is one of building practical based knowledge in line with what she views as relevant for inquiry based early childhood MST teaching.

*Institutional Support:* With the departure of the principal Anne-Marie found support for her ideas and worked closely with other teachers who hold similar views about MST teaching at pre-primary level. She explains that she and her *"… colleagues plan and work together... One of my colleagues is an experienced teacher and she supports me very well"* (In2) and *"I have support for my ideas on teaching at pre-primary school because my colleagues feel exactly the same"* (In 1). The centrality of her professional identity as reform-minded pre-primary school MST teacher and one who wants to become an effective teacher is further emphasised in what she believes and practises in the classroom.

*Classroom practice* She explains that *"MST are important and I try to make the subjects interesting so that my children will realise the subjects are worthwhile and important"* (In1). She is convinced that *"… one should have a passion for teaching"* (In 1) and *"I have a passion for children"* (In 2), *"… my identity is strong enough for me to be successful and to become a better teacher"* (In 2). She values her current teaching experience and teaching culture and insists that *"Experience means more than theory"* (OR) and *"I would not change my work or my school for*

*anything. Many children in my class come from all over Africa and others even from abroad ...which makes my work interesting and enjoyable"* (NR1).

Once again as with Nontombi caring for her children, is a crucial feature in her understanding of role as a teacher. The personal touch in teaching is also highly regarded. For her being a teacher is highly rewarding. Anne-marie as observed uses hands-on, practical approaches and out of doors activities to engage her young children, who invariably have great fun in those science-related lessons. She explains: *"Not only did I enjoy the lesson.... my children enjoyed the lesson.' ....The children enjoy science because they think it is magic and they are fascinated and they think and wonder about what they experience. When we went to the Willem Prinsloo Museum they observed candle making, which is a scientific process and they learnt something more!"* (NR2). Anne-Marie's positive experiences and relationship with her children have given her a broad understanding and appreciation of her role as a teacher. In her case it would appear that the more central her role and identity is, as a teacher who wants to make a difference the less easy it is to change or lose that identity.

The table below (Table 1) gives a brief summary of the personal and professional characteristics of the two teachers.

**Table 1. Summary of two case studies**

| *Case study one* | *Case study two* |
|---|---|
| Grade one class in a township primary school | Reception year class in a city early childhood setting |
| **Prior experiences in MST** | |
| • Little background in science and technology.<br>• Mathematics at matric level.<br>• Negative feelings towards mathematics. | • Little background in science and technology.<br>• Mathematics at matric level.<br>• Negative feelings towards mathematics. |
| **Initial teacher education programme** | |
| • Developed MST knowlegde, skills and pedagogic content knowlegde.<br>• Changed MST beliefs and attitude to positive.<br>• Exposure to MST teaching during internship. | • Increased MST knowlegde, skills and developed pedagogic content knowlegde.<br>• Changed MST beliefs and attitude to positive.<br>• Little exposure in science and technology during internship - negotiated teaching oppotunities with mentor teachers. |
| **MST classroom and school experience as a first year teacher** | |
| • Reality shock: Teachers' work is emotionally demanding and complex.<br>• Socio-economic factors like poverty, absenteeism affect MST teaching.<br>• Support and working environment at school have a positive influence.<br>• Initial problems with mathematics curriculum implementation.<br>• Curriculum interpretation and implementation: constraints and the fixed school culture of science and technology results in lack of teaching and learning opportunities causing negative emotional effect and frustration. Integrates science and technology into other subjects.<br>• Positive, confident and caring MST teacher. Negotiates and integrates science and technology. Uses hands-on, practical approaches in MST. | • Reality shock: Teachers' work is emotionally demanding and complex.<br>• Initial negative experience with principal influences MST teaching and learning. This was solved when principal left.<br>• Finds support from like minded colleagues. Negotiates and collaborates with other teachers.<br>• Mathematical knowlegde and skills acquisition from the main focus of her teaching.<br>• Curriculum: Intergrates MST with art and language.<br>• She is a positive, caring and passionate MST teacher.<br>• Uese creative and research skills to plan and teach MST. Applies hands-on, practical approaches and field trips. |

## 8. Conclusion

The study has highlighted the mediating influence of the 'personal' the 'professional' sides and teachers' work environment in shaping the professional identities of two beginner primary level teachers in early mathematics science and technology teaching. Through their own accounts, coupled with observations and analyses of their practices, we were able to reflect on how their teacher identities were being constructed on the basis of key influencing factors of initial teacher education programme, personal beliefs and character traits, alongside issues of school culture and in-school support. Identity formation is thus seen to be an ongoing process of integration in which those factors emerge as strong mediating influences in determining the kinds and relative stability or otherwise of beginning teachers' professional identity formation. But what counts as 'professional' in professional identity?

The beginning teacher's voice, the subject matter conceptions and practice, provide indicators of possible 'core' professional identities of not only who the teacher is at any point in time but also who he/she wants to become. Although the transition from student teacher to novice teacher is mostly an unstable period of coping and survival (Day & Flores, 2006) yet for the two teachers it was a positive experience. Both enjoyed their work because of the confidence and belief in their ability, the difference they felt they made to children's learning, the strong bonding with their pupils and the support of their peers. The findings suggest that the nature of the initial teacher preparation programme is a strong predictor of how readily successful or otherwise new teachers are likely to be in undertaking the role they are expected to play and the kind of teachers they may eventually become.

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