

CHAPTER ONE INTRODUCTION AND BACKGROUND TO THE STUDY

‘By three methods we learn wisdom: first by reflection, which is the noblest; second by imitation which is the easiest; and third, by experience, which is the most bitter’ – Confucius (551-479 BC).

1.1 INTRODUCTION

In South Africa primary and early childhood education schools have a diverse learner body. It increasingly demands of Foundation Phase (FP) teachers (Grades R to 3) to continually adapt their teaching and young children’s learning to the varied learning environments for effective and efficient implementation of the new reform-based FP curriculum (Department of Education (DoE), 2003). One way to address the challenge of teacher quality or competence in the education system is through the development and sustainability of a professional teacher identity that is able to accommodate and respond positively to curriculum reform (Carlone, Haun-Frank & Kimmel, 2010; Day & Gu, 2010). For Walkington (2005:45), positive professional teacher identity formation implies that the teacher is a ‘confident’ and ‘flexible, lifelong learner, able to participate in ongoing change’ or in Samuel’s (2008:6) view ‘an agent of change’. As an agent of change or nucleus of transformation the reform-minded teacher’s professional identity is said to consist of knowledge, skills and confidence that will assist teachers to make decisions and to ‘take risks’ (Walkington, 2005:63) in order to make a difference.

This study presents some aspects of six beginning teachers’ professional teacher identity formation in their first year of teaching early mathematics, science and technology (MST) in different South African primary schools and early childhood settings. The study sought to understand their personal biographies and analyse the key factors that are said to influence the ways these new teachers’ professional identities are shaped, reshaped and/or sustained in the context of teaching early MST. Their knowledge and beliefs about MST teaching and learning, which are determined by personal histories, professional educational studies and school

context, are conceived of, among others, as important constituents of their professional teacher identity formation (Flores & Day, 2006; Whitelaw, 2007).

Professional teacher identity is thus seen as important because it reflects not only the beginning teachers' view of themselves as teachers but also their knowledge, beliefs and attitudes towards a given subject and how it is taught in a given classroom context (Flores & Day, 2006; Fleer, 2011; Samuel, 2008). Mayer (1999) maintains that the core beliefs a teacher has about teaching and being a teacher are important in order to support and sustain their professional identity.

In addition, Egan (2004) and Smith (2007) describe professional teacher identity formation as the ongoing 'becoming' of a teacher: in other words, how one grows to be a teacher and how one teaches 'in a given social and cultural space' (Flores & Day, 2006:220). Professional teacher identity formation is thus seen as important because it includes personal and professional aspects that are shaped by 'cognitive responses' (Flores & Day, 2006:220) in a given social and cultural space.

According to Davies (2008) and Osgood (2006), developing and sustaining a professional teacher identity is a process that starts during professional studies and is continued during the lifetime of the teacher as a practitioner. If so, there is the need to understand how initial teacher education programmes contribute to professional identity formation. The institutions of higher learning where pre-service teachers are educated have the responsibility and role of instilling in student teachers a sense of purpose of their own developing professional teacher identity and the teacher they hope to become (Day, 2008; Smith, 2007). It is believed that on successful completion of their teacher education programme, beginning teachers may have acquired a professional teacher identity. However, beginning teachers may or may not necessarily define themselves as professionals who can automatically make meaning and implement knowledge and reform in their professional world (Day & Gu, 2010; Flores & Day, 2006). Becoming a reform-minded teacher is a complex process and takes a very long time to accomplish (Day, 2008; Forde, McMahon, McPhee & Patrick, 2006; Vaillant, 2007), in that it involves personal commitment and an availability to teach and learn (Marcelo, 2009), among other things.

Flores and Day (2006:219) refer to the nature of this teaching and learning process as 'multi-dimensional' and 'context-specific'. Various personal and contextual factors which are internal and external to the beginning teacher are said to play a part in the formation and sustainability of a reform-minded teacher.

The high levels of attrition among beginner teachers worldwide have been documented extensively (Cherian & Daniel, 2008; Rizza, 2011). While existing literature suggests that teacher effectiveness improves sharply in the first few years of entering the profession, research shows that many beginning teachers abandon the profession prior to attaining this level of expertise in any appreciable way (OECD, 2005). Teacher retention problems which have implications for professional teacher identity formation are particularly worrisome in light of the wealth of evidence that suggests that well-prepared and reform-minded teachers have the largest impact on learner performance (Cooper & Alvarado, 2006). How to retain teachers in the profession has become an issue of policy for many developed and developing countries (Rizza, 2011).

In South Africa there is a lack 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; Green, Parker, Deacon & Hall, 2011). Development of a well-established professional teacher identity through a sound teacher education programme may have implications for teacher retention. 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).

This study is about how six beginning teachers in their first year of teaching, in different school settings, shape, reshape or try to sustain their teacher professional identity in the teaching of MST in the foundation and early childhood phases. The

question that is addressed is how their personal and professional biographies and their pre-service education and training alongside issues of work environment affect their practice and in turn the stability or otherwise of the kinds of teachers they become or want to become. The focus is on their professional teacher identity formation and the influence of their teacher education programme.

1.2 BACKGROUND TO THE STUDY

Since its transition to a democratic dispensation in 1994, South Africa has undergone radical social, political, economic and cultural changes. Changes on the education front have included curriculum transformation based on a philosophy of outcomes-based education (OBE). The Revised National Curriculum Statement ((R)NCS) (Bosman, 2006; DoE, 2003) (hereafter referred to as the National Curriculum), is the school curriculum for South Africa. The National Curriculum promotes an outcomes-based approach to education and of necessity demands a range of teacher competencies for its effective implementation (DoE, 1998; DoE, 2000; DoE, 2003).

It is against this backdrop that teacher education programmes offered at the various higher education institutions are expected to provide the knowledge and skills and develop attitudes that will equip beginning teachers adequately for their task. In other words, on successful completion of the programme pre-service student teachers should have acquired competencies that would help them to develop the intended teacher identity (Bradford, Darling-Hammond & LePage, 2005a; Bradford, Derry, Berliner, Hammerness & Beckett, 2005b; Day, 2002; Hammerness, Darling-Hammond, Bradford, Berliner, Cochran-Smith, McDonald & Zeichner, 2005; Hill, 2003; Keiny, 2008; Keys, 2007; Vaillant, 2007). However, in South Africa, according to Samuel (2008), the quality of professional teacher identity formation may differ, depending on the preparation programme.

In order to place the study in its proper context it is important to give a description and an explanation of the MST curriculum and the teacher education programme offered by the institution where the beginning teachers come from.

1.2.1 CURRICULUM: EARLY MATHEMATICS SCIENCE AND TECHNOLOGY TEACHING

For the purposes of this study, two phases of the early MST curriculum are relevant, as the initial teacher education programme that the six beginning teachers were exposed to prepared them for both phases. The two phases are the early childhood phase (ECP) and foundation phase (FP).

1.2.1.1 Early childhood phase

In this study, ECP refers to children aged between three to five where children attend an educational setting outside the home. In an ideal early childhood setting, children between three and five need to explore, investigate and discover MST concepts and skills (Van Heerden, 2011). Children are more likely to develop MST concepts and skills within meaningful, contextualised curriculum activities. MST curriculum activities can be presented as informal or intentional and instructional teaching inside or outside the classroom (Charlesworth & Lind, 2007; 2010; Van Heerden, 2011). The role of the teacher is to facilitate, scaffold and support MST learning by engaging children in planned activities that will allow them to think, reason and solve meaningful problems (Charlesworth & Lind, 2007; 2010; Davies & Howe, 2003).

Early childhood settings use different theoretical and philosophical frameworks that inform their curriculum approach. These curriculum approaches in many instances apply a set of theoretical descriptions for child development, knowledge construction and pedagogical approaches. Cross, Woods and Schweingruber (2009) explain that many early childhood settings use an integrated curriculum where two or more subject or content areas are combined or merged to help children to make meaningful connections. Cross-curricular themes, topics or projects can also integrate and relate subjects or content areas. Researchers such as Clements (2001), Davies and Howe (2003) and Moyer (2000) support the exposure of hands-on, real-life integrated MST content in early childhood settings. Clements (2001), Davies and Howe (2003), Ginsburg (2006) and Seo (2003) argue for the active involvement of children in MST concepts in a playful context where children are provided with ample time, materials and support.

Perry and Docket (2007:2) are of the opinion that early childhood programmes ‘draw on a long tradition of play-based curricula’. According to Brock, Dodds, Jarvis and Olusoga (2009) and Moyles (1994; 2010a; 2010b), play pedagogy and practical activities provide a context for exploration, investigation and experimentation which, in their opinion, enhances learning. Van Heerden (2011) found that in South Africa many settings implement an early childhood curriculum that supports play-based and inquiry-based learning and instruction and some may even include MST activities in the programme.

1.2.1.2 Foundation phase

South Africa’s curriculum reform has influenced the teaching of MST at primary and secondary levels of the education system (Bosman, 2006; Botha, Maree & de Witt, 2005; Van Heerden, 2005). The FP is the first phase within the General Education and Training (GET) band, designed for young children between the ages of five and nine years, and includes learners in the reception year (informal learning of five- to six-year-old learners), and primary school grades 1, 2, and 3 (formal learning of learners seven to nine years of age). The main educational focus at FP level is the acquisition of basic educational skills, knowledge and values as prerequisites for further education and training. The eight learning areas, of language, mathematics, science, technology, life orientation, economic and management sciences and arts and culture for the FP, are grouped into three learning programmes, namely:

- literacy
- numeracy
- life skills

The learning area of mathematics forms the core of the numeracy programme, while science and technology learning areas are integrated into all three learning programmes (DoE, 2003). The new vision for the reform-based early MST foundation phase curriculum emphasises problem-solving skills and competencies grounded in inquiry-based education (DoE, 2003; Hoadley, Murray, Drew & Setati, 2010).

In recent years, the results and pass rates of the senior certificate public examinations have shown that South African learners perform poorly in mathematics and science at secondary school level (Howie, Barnes, Cronje, Herman, Mapile &

Hattingh, 2003). The poor performance may be seen as an indication of the foundational problems and challenges of MST education at the earlier foundation and primary stage. The groundings in MST education at that level are likely to determine their future performance as they move up the educational ladder. For example, the Systemic Evaluation conducted by the Department of Education in 2007 indicated that the achievement and performance of the learners (Grade 3) in Literacy and Numeracy was unacceptably low (DoE, 2008). The report indicated a need to have a better understanding than hitherto of factors that mediate teachers' practice, particularly that of new teachers, in the context of implementing the new reform-based early MST curriculum (Jansen, 2003; Jita & Vandeyar, 2006; Onwu, 2008). It may very well be asked to what extent teacher education programmes currently on offer in different higher education institutions are in sync with the demands of the new FP curriculum, particularly in the area of MST education.

Within the last decade several authors (Clements, 2001; Fuson, Grandau & Sugiyama, 2001, Saracho & Spodek, 2009) have advocated the benefits to children of early exposure to mathematics and science. Saracho and Spodek (2009), for instance, refer to the increasing awareness of the importance of mathematics (Anderson, Anderson & Thauberger, 2008; Cross *et al.*, 2009) and science (Gillard, 2008; Martin, 2003) to society and to children's development. For young learners, proper groundings in early mathematics and science are necessary in helping them to more easily comprehend the more complex and sophisticated mathematics and science concepts that they will encounter at a later stage. This recognition has led to increased interest in, and attention to, inquiry-based mathematics and science teaching and learning for young children (Saracho & Spodek, 2009; Cross *et al.*, 2009; Gillard, 2008; Martin, 2003).

In South Africa, however, for many teacher educators, implementing the new inquiry-based foundation phase MST curriculum has highlighted the fact that inquiry-based education demands of the teacher skills that differ considerably from 'traditional' teaching (Hoadley *et al.*, 2010). Given that beginning FP teachers often find it difficult to teach early science and technology, studies by Bosman (2006) and Van Heerden (2005) have revealed that they invariably enter a period of uncertainty and doubt about the place of science and technology at the FP level. In addition, Furtak

(2006:64) has noted elsewhere that ‘it may not be sufficient for teachers to have acquired the skills of inquiry; without the beliefs, the skills fall short of full implementation’, therefore teachers need to be convinced of inquiry-based education efficacy.

According to Akerson, Buzzelli and Eastwood (2010), without this belief or conviction for the inclusion of science and technology in the curriculum, they neglect or avoid teaching those two learning areas as much as possible. The integration of science and technology into all three learning programmes is likely to present additional challenges to the FP beginning teacher in implementing the new curriculum because of curriculum constraints. The lack of clear curriculum guidelines on science and technology subject matter integration poses a challenge to many teachers as to how to implement the integration in practice (Hoadley *et al.*, 2010). Although an integrated curriculum approach is not new for FP teachers, the learning area boundaries and knowledge of science and technology (Bosman, 2006; Van Heerden, 2005) are unclear and not well defined and therefore further influence the integration of MST teaching.

Hence, for the beginning teacher, learning to become an effective inquiry-based MST teacher at FP level without proper grounding is not anticipated to be a particularly simple and easy process. Lack of expertise and confidence in teaching MST could negatively impact on the formation of professional teacher identity. The solution apparently lies in equipping student teachers in early MST with sound pedagogical content knowledge in these specific learning areas during their initial teacher education programme (Fleer & Hardy, 2001; Ginsburg & Ertle, 2008).

1.2.2 TEACHER EDUCATION PROGRAMMES

A variety of studies (Cherubini, 2009; Davies, 2008; Green *et al.*, 2011) have demonstrated that good teaching brings about valuable change, such as better teaching and learning in language, mathematics and science, in early school education. Becoming a ‘good’ teacher is a process that starts with initial teacher education and is likely to progress throughout a teacher’s career. A well-designed teacher education programme is assumed to prepare teachers who will respond to challenges and are able to adjust to changing and hitherto unforeseen situations.

Green (2008:2) argues that South African teacher education programmes 'should encourage teachers to adopt, from the beginning of their training, a critical reflective stance towards their classroom practice and their development as pedagogues. Such teachers may be described as reform-minded teachers with a well-developed professional teacher identity. These teachers are deemed to be confident and able to teach subject matter and content effectively, even under challenging and changing circumstances (Green, 2008; Onwu, 2008; Walkington, 2005).

Researchers (Anderson *et al.*, 2008; Fler & Hardy, 2001) have described reform-minded teachers as well-trained, positive teachers who try to develop creative thinking and inquisitive minds. There is a strong case, therefore, to be made for the training and development of reform-minded teachers who can teach effectively and are willing to take risks (De Kock & Slabbert, 2008). Such teachers will be able to accommodate and successfully respond to change and curriculum reform (Day, 2002; Day, 2008; Forde *et al.*, 2006; Vaillant, 2007).

In the last decade or so there have been thoughtful and exhaustive debates about achieving the academic and pedagogical objectives of teacher education programmes. For example, Korthagen, Loughran and Russell (2006:1022) call for a 'new effective pedagogy' to reform teacher education and they point out that the 'complex methodological issues' such as the theory and methodology underpinning teacher education programmes need attention.

With regard to MST teaching, Saracho and Spodek (2008a; 2008b) advocate the importance of pre-service teacher education programmes that provide experiences that can improve early school teachers' MST knowledge. More important, Davis and Higdon (2008) and Korthagen *et al.* (2006) argue that student teachers need opportunities during practice teaching to develop and expand their professional knowledge. In this way, they learn to link theory and practical experiences (Cooper & Alvarado, 2006) as they construct their own understandings of MST teaching and learning through critical reflection on their learnt MST knowledge base and their current classroom practice.

Lunenburg and Korthagen (2009) explain that it is difficult for beginning teachers to apply the theory that they acquire during their professional preparation to classroom practice. Therefore, student teachers need opportunities during their teacher education programme to develop and expand their professional knowledge and to apply the theory that they acquired. In their study, Flores and Day (2006:224) found that the ‘gap between theory and practice was a recurring theme’. According to Lunenburg and Korthagen (2009), practice theory can be addressed through:

- School-based teacher education to bridge the gap between theory and practice.
- Reflective practice as an important tool to make the connections between practice and theory.
- Research projects that will develop critical thinking and deeper learning practices.

Studies in South Africa (Botha, 2004) and abroad (Bransford *et al.*, 2005a) identify the following main components for the Bachelor of Education Degree (B.Ed) Early Childhood and Foundation Phase programme:

- Phase-specific content and pedagogic knowledge (ECP and FP);
- Integrated teaching and learning theories; and
- Practical application of pedagogical theory in the classroom (school-based practical learning).

In South Africa, reform after 1994 had implications for teacher education. For example, the Department of Education wanted to improve the quality and status of FP teacher education programmes and therefore changed the qualification to a four-year degree course offered only by universities (Green *et al.*, 2011). According to the Council on Higher Education (2010:69), the aims for the B.Ed. FP qualification are to:

- Integrate the academic components of the programme with work-based learning, i.e. school-based teaching practice.
- Develop student teachers as reflective practitioners, i.e. enable them to see the coherence between theories of teaching and their practice.
- Develop professional competence. For example, teacher education programmes should make provision for teaching and learning theories,

professional and educational studies and FP specialisation modules that include FP pedagogy and knowledge.

In South Africa very little research has been done at FP level on the value and practical implementation of the FP specialisation components of teacher education programmes (Botha, 2004; Green *et al.*, 2011). This disparity in teacher education at the early primary level is also relevant to other countries (Fullan & Stiegelbauer, 2000; Hallinan & Khmelkov, 2001; Hammerness *et al.*, 2005). For this reason, this study focused on how beginning teachers that have completed their teacher education programme sustain or change their professional teacher identity in the teaching of early MST.

The teacher education programme to which the six beginning teachers were exposed, prepared them for becoming reflective teachers with their own philosophy of teaching. Furthermore, they acquired theoretical and practical MST content and pedagogical knowledge as well as curriculum knowledge through school-based practical learning and a fourth year research project.

The B.Ed Early Childhood and Foundation Phase programme consists of the following MST modules:

- Two modules for mathematics pedagogical knowledge (one in early numeracy and one in numeracy);
- One module in basic mathematical content knowledge;
- One module in technology pedagogical content knowledge, and
- One module in science pedagogical content knowledge.

These specific MST modules aim to develop in the pre-service teachers a deeper understanding of inquiry-based teaching and learning at FP and early childhood level. The programme further aims to develop deep reflective thinking through a fourth-year research project during their 18-week internship period. In this teacher education programme, student teachers are encouraged to construct their own philosophy of teaching (practice theory).

During their research project the student teachers employ a teaching philosophy to interrogate and perhaps change their practice. They have to plan lessons and

teaching strategies based on the teaching philosophy. After implementing the lesson they have to reflect consciously on their teaching activities and explain in written narratives how they will modify and change their pedagogical practices and teaching techniques if need be. The research project and reflective practices are integrated with their practical experiences during the internship period. The philosophy that underpins this programme is aimed at preparing beginning teachers to gain insight into and to understand their practice and to employ innovative and reform-minded ideas that may lead to changes in their teaching practice.

1.2.3 THE BEGINNING TEACHER AND PROFESSIONAL IDENTITY FORMATION

Most first-year 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 (Billet, 2008; Cherubini, 2009; Day & Gu, 2010). This sense of teacher identity has largely been shaped by previous and current history or experiences (Cieslik, 2006; Day, 2002; Day, 2008; Day *et al.*, 2006; Hamman *et al.*, 2010; Sachs, 2001). According to Stanulis, Little and Wibbens (2012), the first years of teaching are an important stage in a teacher's working life because they implement and refine the knowledge and skills they acquired from their initial teacher education programme. The success they experience at the beginning stage of their career is said to have an impact on the quality of their practice (Stanulis *et al.*, 2012) and willingness to stay in the profession (Rizza, 2011, Samuel, 2008). Central to the process of learning is the process of constructing knowledge through practice (Billet, 2007; Smith, 2007). Billet (2007) explains that professional teacher identity is formed and implemented through learning activities within their working environment.

Hamman *et al.* (2010) maintain that the school context of beginning teachers can present a background for understanding professional identity formation. Current studies involving beginning teacher socialisation into the school culture (Cherubini, 2009) asserts that the dynamics of school context may challenge their teacher identity development. When teachers enter the new teaching environment, they often feel pressured to conform to the specific requirements of a school's culture (Day & Gu, 2010; Parkison, 2008; Whitelaw, 2007). According to recent studies (Cherian & Daniel, 2008; Parkison, 2008; Whitelaw, 2007), this institutional pressure and

conflicting emotions sometimes isolate the beginning teacher from the broader landscape of the school's social setting, which in turn may prevent them from developing a positive professional teacher identity. These emotional conflicts, feelings of a lack of professional realisation of expectations and coping difficulties are related to the pressure to conform to the school's culture (Alves, 2001). Day and Gu (2010) are of the opinion that the school environment and culture can develop or diminish beginning teachers' willingness to unveil and establish their professional teacher identity. For example when unexpected events occur these experiences cause teachers' to move backwards and forwards trying to make sense of the anticipated or totally unexpected events that occur during the first year of teaching.

According to Fantilli and McDougall (2009) as well as Rizza (2011), the initial teaching experience of the beginning teacher can be positive or negative depending on the nature of mediating influences that are internal and/or external to the teacher. These positive or negative events may cause teachers to become uncertain. Avalos (2011) for example identifies factors such as the teaching environment, curriculum demands and the feeling of isolation, among others that can influence their practice. The upshot is that teacher professional identity can be influenced and affected by personal, professional and social factors.

Many of the studies that have been carried out on teacher professional identity have emphasised the 'personal' and tend to underestimate the contextual side that plays a crucial role in identity formation (Coldron & Smith, 1999; Dymoke & Harrison, 2006; Flores & Day, 2006; Forde *et al.*, 2006; Whitelaw, 2007). The teacher's workplace, as noted by Reynolds (1996) and Samuel (2008), is clearly a landscape which can be very persuasive, very demanding and in most cases very restrictive and constrained. Indeed, various researchers (e.g. Beijaard, Meijer, & Verloop, 2004; Day & Gu, 2010; Flores & Day, 2006; Whitelaw, 2007) have investigated how the social setting is likely to affect a person's professional identity as a teacher. However, hardly any reported studies have highlighted the interaction, if any, between beginning teachers' personal histories in MST education and the contextual influence of school and classroom practice in the implementation of the MST curriculum at early childhood and foundation phase level.

This study therefore sought to address the question of whether the as yet unspecified ‘core’ professional teacher identity, if any, that beginning teachers might have acquired through their teacher education programme is sustained, changed or adapted when they are faced with the reality of their school and classroom situation. In this study, the school context within which beginning teachers teach was explored as a factor that might or might not influence the formation of their professional teacher identity.

1.3 THE PROBLEM OF THIS STUDY

In South Africa, as in other countries, many early childhood and FP teachers feel negative, anxious and inadequate in teaching early MST (Bosman, 2006; Eshach & Fried, 2005; Ginsburg & Ertle, 2008; Scherer, 2004; Van Heerden, 2005; Young & Elliot, 2004). Various studies (Botha *et al.*, 2005; Ginsburg & Ertle, 2008; Perry & Dockett, 2007) on mathematics in early childhood settings have established that not all teachers include mathematics in their planning. In order to feel confident enough to teach mathematics, teachers need to understand the specific nature of the subject matter and the implications it has for pedagogy (Cross *et al.*, 2009; Ginsburg & Ertle, 2008).

With the implementation of the National Curriculum, many South African teachers had to adapt to a whole new range of teaching strategies and roles (DoE, 1998, 2000, 2003; Wilson-Thompson, 2005) to effectively implement it. For example the new curriculum emphasises the integration of eight different learning areas into learner-centred, inquiry-based teaching and learning activities. The recommended teaching approach was sometimes difficult and problematic to implement in the classroom (Howie *et al.*, 2003; Maree & Erasmus, 2006; Reddy, 2006; Wilson-Thompson, 2005) as little support within the inquiry-based approach was provided and the National Curriculum lacked adequate specification of content knowledge in the eight learning areas (Hoadley *et al.*, 2010).

Furthermore, the implementation of the National Curriculum has led to some uncertainty about how much science and technology should be included in the foundation phase where the time allocation is said to be insufficient for inquiry-based learning (Bosman, 2006; Van Heerden, 2005). Teachers often find it difficult to teach

science and technology in the FP classroom and tend to neglect those subjects (Bosman, 2006; Van Heerden, 2005), because they are uncertain about the place of science and technology activities in the classroom. In addition, anecdotal evidence suggests that technology is a new and sometimes unknown learning area for many teachers and so they neglect teaching it at this level. They are essentially not equipped with the pedagogic knowledge and content knowledge to teach it. Therefore professional teacher identity formation is influenced or not by the curriculum.

The lack of adequate time and space allocated for exploration and investigation during learner-centred activities has had a negative impact on the teaching and learning of MST in South Africa and has led to worksheet-dominated classrooms (Bosman, 2006; Botha *et al.*, 2005; Van Heerden, 2005). The use of workbooks and worksheets in early learning (3-8 years) is strongly contested by Carruthers and Worthington (2006), Fisher (1996) and Pound (1998), as they feel that worksheets limit and hinder what young children experience, know and understand about early mathematics. Alexander (2000) found that early mathematics teaching in many countries is influenced by worksheets and workbooks. In South Africa, Schäfer (2011:174) found that teachers in Grade R use worksheets and lessons 'uncritically, without questioning whether they are appropriate for their own context'. Pedagogical approaches where worksheets and workbooks dominate are fundamentally different from inquiry-based pedagogy. The question is what happens in the school context if student teachers are educated in inquiry-based pedagogy.

Egan (2004) shows that beginning teachers sometimes have to work within intrinsic constraints in order to establish their professional teacher identity within their classrooms and often feel obliged to conform to the specific requirements of a school culture. Beginning teachers who do not conform to the specific school culture may be isolated from the school community and this situation may prevent them from developing or maintaining a positive professional teacher identity (Parkison, 2008; Whitelaw, 2007). In this regard Samuel (2008:10) refers to the 'wash-out effect of initial professional teacher education'. He explains that in South Africa beginning teachers are likely to 'face a brick wall of resistance' in the school when more experienced teachers insist that beginning teachers should 'abandon what you have learnt at university' (p10). So the question is: if the beginning teacher has been

trained to use a particular pedagogy such as inquiry-based training, how are any such classroom dilemmas resolved? Is the learnt professional teacher identity, retained or discarded?

The question then is how school culture affects beginning teachers' MST classroom practice in the context of teacher identity formation. With regard to the influence of school culture on professional teacher identity, Flores and Day (2006:221) and Whitelaw (2007) found that the school culture had a strong 'influence on the process of becoming a teacher'. Therefore, it is argued that the teacher education programme should prepare beginning teachers 'to deal with the complex and demanding nature of their daily job in schools and in classrooms' (Flores & Day, 2006:231). But what happens in practice during the first year of teaching? To what extent have their teacher education programme, personal histories and the context of the school been instrumental in professional teacher identity formation? This study seeks to address such questions.

From the discussion it seems that professional teacher identity is influenced by a variety of factors that are both internal and external to the beginning teacher. This study therefore sought to investigate how the identified factors, facilitate, undermine or complicate the identity formation or otherwise of teachers in the first year of teaching.

Problem statement

The problem of this study was to determine how first-year beginning teachers develop and sustain, if at all, their professional teacher identity in the context of teaching early MST and to identify the internal and external factors that influence this process.

1.3.1 RESEARCH QUESTIONS

The main research question was derived from the problem statement.

How do beginning first year early childhood and FP teachers form, sustain or change their professional teacher identity in the teaching of mathematics, science and technology in the early years and in different school settings?

The sub-questions derived from the main question are:

1. What internal and external factors, if any, influence beginning teachers' professional teacher identity formation in the context of teaching MST?
2. How do the identified factors, if any, affect their professional teacher identity formation in the teaching of MST in different school settings?
3. Why do these teachers sustain, change or adapt their professional teacher identity?

1.4 SIGNIFICANCE OF THE STUDY

At the beginning of this study it became clear that although mathematics and science are seen as important in the teaching and learning at FP and early childhood levels, not many studies in South Africa have focused on MST teaching and learning at these levels. Researchers from South Africa, Australia and America have indicated a need for research on MST in the early years (Botha *et al.*, 2005; Maree & Erasmus, 2006; Perry & Dockett, 2007; Saracho & Spodek, 2008a; 2008b). For example, Ginsburg and Golbeck (2004:197) contend that '... we know little about what actually happens when teachers teach mathematics and science to young children' and therefore it is important to investigate and understand the factors that affect the complex nature of teaching mathematics and science in the early years. Ginsburg and Golbeck (2004:197) further recommend that there is a need to know what teachers understand about the nature of mathematics and science learning and thinking, what teachers understand about mathematics and science content and pedagogical knowledge and how teachers' own feelings about mathematics and science influence their teaching.

This study is significant because it focuses on beginning teachers' practices in MST teaching at the FP and early childhood levels. This study furthermore explores the teaching of early MST in different learning environments (FP and early learning settings).

In the literature review it is evident that the first year of teaching is a critical stage in a teacher's working life. Cherubini (2009:219) for instance identified three major professional identity themes in the literature over the past three decades on the teachers' transition from student teacher to beginning teacher. The themes include,

in that order, 'teachers' perceptions of self; professional sustainability; and 'emerging identity during the process of their socialisation into school culture'. However, hardly any research on early childhood and FP beginning teachers' professional identity formation has been done in the South African context. There is a void in the voice of South African first year teachers at this level. This study addresses some aspects and therefore hopes to fill the void on professional teacher identity formation in the South African school context.

It is said and indeed assumed that the development of a teacher's professional identity starts during the initial teacher education programme. However, Flores and Day (2006:224) in their study found that the pre-service programme 'had a relatively weak impact upon the way in which new teacher approach teaching'. Conversely, Green (2008:2) insists that teacher education programmes ought to be an important professional learning opportunity for identity development and 'should reflect the pedagogical and professional needs of teachers'. Likewise, in South Africa, Whitelaw (2007) recommends that an initial teacher education programme should prepare teachers for the diverse school culture they are bound to experience. However, Samuel (2008:10) argues that beginning teachers face a 'wash-out effect of initial professional teacher education', meaning that they may not be able to apply the skills acquired through their teacher education programme. The reality is that beginning teachers sometimes have to work within intrinsic constraints in order to establish their professional teacher identity and to employ their acquired pedagogical and content knowledge and expertise within their classrooms (Egan, 2004; Flores & Day, 2006; Rizza, 2011; Whitelaw, 2007). This study is therefore significant because it gives some insight into six beginning teachers' learnt MST identities and the impact of the initial teacher education programme and school culture on their identity formation process.

The study is also considered significant because its findings could provide a deeper insight into how the professional teacher identity of beginning teachers acquired during the B.Ed. early childhood and foundation phase programme at a specific institution in South Africa is sustained, changed or adapted during their first year of teaching in different school contexts. This may provide some information for strengthening teacher education programmes and to better prepare beginning teachers to cope with diverse school contexts and classrooms (Cooper & Alvarado,

2006) and to stay positive and idealistic (Stanulis *et al.*, 2012) and to remain in the profession (Rizza, 2011; Samuel, 2008).

1.5 PURPOSE OF THE STUDY

The purpose of this study was to identify what factors affect professional teacher identity development and how they affect the formation process as well as to provide an identity profile of six beginning teachers in the context of MST teaching at foundation phase and early childhood phase level. The voices and practices of these beginning teachers provide some insight into the process of professional teacher identity formation and its sustainability or otherwise in different school settings.

More specifically, this study aimed to:

- Explore how beginning first-year early childhood and FP teachers form, sustain or change their professional teacher identity in the teaching of MST in the early years and in different school settings.
- Identify and gain insight into which factors (internal and external), if any, influence beginning teachers' professional teacher identity formation in the context of teaching MST.
- Gain insight into how the identified factors, if any, affect their teacher professional identity formation in the teaching of MST in different school settings.
- Explore why these teachers sustain, change or adapt their professional teacher identity.

1.6 CLARIFICATION OF CORE CONCEPTS AND TERMINOLOGIES

To ensure a clear and common understanding the following concepts and terminologies are clarified for application in the context of this study.

1.6.1 PROFESSIONAL TEACHER IDENTITY

Professional teacher identity can be defined as teachers' view of themselves as teachers, but also as their knowledge, beliefs and attitudes towards a given subject

and how it is taught in a given classroom context (Flores & Day, 2006; Fler, 2011; Samuel, 2008).

1.6.2 PROFESSIONAL TEACHER IDENTITY FORMATION

Professional teacher identity formation is an ongoing process of becoming and being a teacher (Beijaard *et al.*, 2004; MacGregor, 2009). In other words, it describes how one grows to be a teacher (Flores & Day, 2006). Professional teacher identity is socially constructed and it is a self-motivated, intellectual and emotional process (Day, 2002; Day, 2008; Day, Kington, Stobart & Sammons, 2006).

1.6.3 REFORM-MINDED TEACHER

Reform-minded teachers are defined as teachers with sufficient content and pedagogical knowledge (early MST in the context of this study) to enable them to make informed decisions, to construct their own philosophy about teaching and learning and to become the nucleus of reform in their classroom and professional setting (Egan, 2004; Parkison, 2008; Whitelaw, 2007).

1.6.4 EARLY CHILDHOOD PHASE

Early childhood phase (ECP) in this study refers to children between the ages of three and five years that attend an educational setting outside the home or formal school. The reception year (Grade R), which precedes Grade 1 and caters for five-year-old children, can also be placed in an early childhood setting.

1.6.5 FOUNDATION PHASE

The foundation phase (FP) is the first phase within the General Education and Training (GET) band, designed for young children between the ages of five and nine years, and includes learners in the reception year (informal learning of five- to six-year-old learners), and the primary school grades 1, 2, and 3 (formal learning of learners seven to nine years of age) (DoE, 2003).

1.6.6 INQUIRY-BASED APPROACH

An inquiry-based approach to early MST teaching implies learning through investigation, discovery and inquiry. An inquiry-based approach uses resources that will represent hands-on inquiry teaching and learning. The MST curriculum includes natural phenomena in MST that relate to children's everyday life (DoE, 2003; Hoadley, Murray, Drew & Setati, 2010).

Inquiry-based teaching is a pedagogical approach that allows children to explore, investigate, discover and answer questions (Bruner, 1961, 1999). The role of the teacher in an inquiry-based classroom is to guide exploration, discovery and investigation. Inquiry-based learning further implies different learning experiences and opportunities that are open-ended and will stimulate curiosity (Healey & Roberts, 2004). Inquiry-based teaching and learning allows the development of abilities such as MST knowledge creation and problem-solving and creative thinking skills.

1.6.7 BELIEFS

Teachers' belief systems influence the quality of their learning and teaching (Brownlee & Berthelsen, 2006; Egan, 2004) because individuals' beliefs influence their behaviour (Pajares, 1992). This means that student teachers come into teacher education programmes with a set of beliefs about teaching and how children learn, stemming from their own educational experiences (Pajares, 1992; Thomson, 1992).

Researchers and theorists such as Pajares (1992) and Thomson (1992) have contributed to defining the nature of beliefs. According to them, teachers' beliefs are formed and sustained against inconsistencies and entrenched beliefs that are integrated into a belief system and are difficult to change. On the other hand, newly acquired beliefs are more susceptible to change. Hammerness *et al.* (2005:384) contend: 'Teachers naturally bring their own cultural values, beliefs and understanding to their work with children.'

Teachers develop belief systems about how children learn through the study of learning theories, critical reflection and personal experience (Lundeen, 2004; MacNaughton & Williams, 2004). This leads to the development of teaching choices

that may or may not result in excellence in teaching (MacNaughton & Williams, 2004).

1.6.8 CRITICAL REFLECTION

Reflection is used in teacher education and educational research in several ways. The idea that reflection is an intentional, natural process for the practice of teaching is not a new thought (Schön, 1983; Van Manen, 2007). Dewey (1933: 1) defined reflection as the ‘active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends’. Natural reflections occur regularly in teachers’ daily lives as they encounter new or challenging situations that require careful thought and judgement (Kelchtermans & Ballet, 2002). Critical reflection can therefore be used in different ways to produce narratives based on the recall of MST classroom experiences and teaching activities. In this study, critical reflection provided beginning teachers with opportunities to reflect on their experiences at schools and to assist them to explain their professional learning within the context of their experiences (Davies, 2008; Rodgers & Scott, 2008; Rots *et al.*, 2012).

1.7 CHAPTER OUTLINE

The layout of the study is as follows:

CHAPTER ONE

Provides an orientation and framework for the study; it introduces the reader to the study by providing a brief background to the research problem and a statement of the problem. The chapter includes the significance and purpose of the study.

CHAPTER TWO

Offers a review of relevant literature, which focuses on the research questions. It includes a brief introduction to the contextual background of teacher training in South Africa and further reviews what the literature says about the role of teacher education programmes in the formation of teacher identity. This chapter also explores the teaching and learning of early MST. It concludes with a description of a learning

identity framework as a conceptual framework for the development of the research instrument and data analysis.

CHAPTER THREE

Provides a description of the research methodology employed and justification for the choice of a qualitative phenomenological research approach used to address the research questions.

CHAPTER FOUR

Presents the results of the study. The results are presented in six cases describing each individual beginning teacher's professional identity in the context of teaching MST in different school contexts.

CHAPTER FIVE

Presents the discussion of results and its major findings.

CHAPTER SIX

Gives the conclusions and recommendations of the study including final suggestions for further research.

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