An ethnographic study of beginner mathematics teachers’ classroom practices in the first three years of their employment:
Shaping of a Professional Identity

A thesis submitted in fulfilment of the requirements for the degree of DOCTOR OF PHILOSOPHY

of

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By

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Abstract

The main theme in this study examines how beginner mathematics teachers (BTs) shape their professional identity in their first three years of classroom practices in Lesotho. This study, which focuses particularly on BTs’ second and third year of employment, gathers data with an understanding that the notion of professional identity is multi-faceted. Professional identity embraces a host of other identities such as personal identity, teacher identity, mathematics identity and community of practice identity.

This study is framed by social theories of learning. Learning occurs by active participation and practice. BTs’ peripheral participation assists them in making sense of the activities (situated learning) in which they are engaged, in the classrooms. The sense making processes eventually shape their professional identity. In line with situated meanings that BTs form, the key notion (professional identity) is further categorised into personal identity, teacher identity, mathematics identity and community of practice identity. These identities integrate to become the professional identity of a beginner mathematics teacher.

Using a narrative ethnographic approach as the research method, I have made use of extensive classroom observations and interviews to gather data. In this study, six volunteer participant BTs were originally selected. These teachers were from two districts, Berea and Maseru in Lesotho. After being observed in the classrooms, these teachers were interviewed. In the third year of the study, one participant withdrew from the study. I used vertical (descriptive) analysis to narrate their classroom practice followed by horizontal analysis to understand how they shape their professional identity. The analytical model enables the researcher to analyse the data in order to establish how the BTs’ actions, their reflexive stories and their journey in becoming a mathematics teacher shape their professional identity.

The recurring themes that emerged from the horizontal analysis are the ways BTs approach the classroom practice which is dominated by teacher-centred learning. This involves demonstrating an example and then students following this model to practice more examples. In this sense, their approach is the same though these BTs started understanding how their classroom approaches can bring changes in the learning of mathematics.

I analysed the utterances from the BTs’ classroom activities by separating these into mathematizing and subjectifying. The subjectifying utterances were further analysed to understand how these created meaning. These, in my view, are also central features of a teacher’s practice that need interpretation in order to understand the shaping of a professional identity. The key finding is that their narrative helped them to understand how they shape their professional identity.

The study highlights the importance of listening to BTs’ stories of how they become mathematics teachers. Their narratives can be the benchmark for stake-holders, policy makers and potential researchers as the study on BTs’ professional identity is relatively new in Lesotho.
Acknowledgements

The research reported in this thesis would not have materialised without the support of so many people. Many thanks are due to the following individuals for their various contributions towards the successful completion of my study.

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Finally, I gratefully acknowledge the financial support from First Rand Foundation Mathematics Education Chair that I have enjoyed and appreciated through Prof Schäfer and his team. Any opinions, findings and conclusions or recommendations demonstrated in this study are solely mine. Therefore the First Rand Foundation Mathematics Education Chair does not hold any liability.
Dedication
This work is passionately dedicated to:

Narayanan, my late father, who showed me a few tricks in arithmetic that helped me ‘fall’ in love with mathematics,

Uma, my wife, who took care of our family and supported me endlessly with little complaint while I was engaged in the study,

Bhavana, our daughter for her love towards me and her passion towards knowledge that inspired me to work harder to fulfill my dream,

My Supervisor Prof Schäfer who supported me unconditionally during the period of the study; and to,

All teachers who recognise their career as a calling from God.
Declaration of originality

I, Ajayagosh Narayanan (Student number, 11N5151), declare that this doctoral thesis: An ethnographic study of beginner mathematics teachers’ classroom practices in the first three years of their employment: Shaping of a Professional Identity is my own work written in my own words. Where I have drawn on the words or ideas of others, these have been acknowledged in the manner required by the Rhodes University Department of Education Guide to referencing.

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To whom it may concern

This is to certify that the Doctoral thesis: An Ethnographic Study of Mathematics Beginner Teachers' Classroom Practices in the first Two Years of their Employment: Shaping of a Professional identity written by Ajey Narayanan has been edited by me for language.

Please contact me should you require any further information.

Kind Regards

Angela Bryan

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</tbody>
</table>
List of abbreviations

BT: Beginner Mathematics Teacher
COSC: Cambridge Overseas School Certificate
ECoL: Examination Council of Lesotho
FRF: First Rand Foundation
JC: Junior Certificate
LCE: Lesotho College of Education
LGCSE: Lesotho General Certificate in Secondary Education
LSMTA: Lesotho Mathematics and Science Teachers’ Association
MoET: Ministry of Education and Training
NCDC: National Curriculum Development Centre
NTTC: National Teachers Training College
NUL: National University of Lesotho
TSD: Teaching Service Department
TSC: Teaching Service Commission
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We are all apprentices in a craft where no one ever becomes a master.

(Ernest Hemingway)
CHAPTER 1
INTRODUCTION AND ORIENTATION

1.1 INTRODUCTION TO THE STUDY
I am a part-time research student within the FRF Mathematics Education Chair at Rhodes University. During my long career as a teacher, I have been fascinated with the journeys taken by novice mathematics teachers towards their vocational development. This has inspired me to listen and to document their stories.

The emphasis and aim of this study is to examine the stories of beginner mathematics teachers. For the rest of the thesis I shall use the abbreviation ‘BT’ to represent the beginner mathematics teacher who is eager to ‘become’ an experienced mathematics teacher. I shall also use the masculine form of a teacher (he) throughout, to represent male or female BTs. These stories in conjunction with their classroom practices help me to understand how they shape their professional identity. The study follows six selected beginner mathematics teachers and analyses their classroom experiences.

In this introductory chapter, I describe the central theme with an explanation of why this study is important within the Lesotho context. This is followed by a discussion on the significance of the study. This chapter also provides an overview of the literature, research methods and analysis of the data.

1.2 BACKGROUND
I start this section by suggesting why it is important to explore BTs’ experiences in the classrooms, particularly from a situated perspective in order to tell their stories.

From the day a BT joins a school staff, he becomes part of the everyday activities that unfold in the school and its classrooms. As his professional career begins, he engages with, participates in and prepares to understand the norms, values and culture of the school community with which he
works. He starts building a personal meaning of the career he has chosen and begins to design his own professional identity day by day.

The first few years of teaching may be seen as a ‘two-way struggle in which teachers try to create their own social reality by attempting to make their work match their personal vision of how it should be, whilst at the same time being subjected to the powerful socializing forces of the school culture, (Day, 1999, cited in Flores & Day, 2005, p. 1).

Each day counts and is different from the previous one. All kinds of emotions unfold in classrooms like on a stage. While he struggles to understand how his students think, he realises that he is also changing himself (Goldsmith & Shifter, 1997). In this situation, he asks many questions, sometimes anxiously, without necessarily knowing what the future holds for him.

Anxiety can become a contributing factor to many challenges that beginner mathematics teachers face at schools (Brown & McNamara, 2011) which sometimes keep them on the periphery (Lave & Wenger, 1991). Often there is insufficient time for them to adjust to this novel situation because in many schools they are also loaded with other responsibilities. In classrooms they are concerned with selecting appropriate teaching methodologies when embarking on new topics (Ziebarth, Hart, Marcus, Ritsema, Schoen & Walker, 2009). Their apprenticeship thus becomes a short-lived experience for them.

Wenger (1998) and Lave and Wenger (1991) frequently use the term *apprentice* to represent the newcomers and *experienced or skilled person* to represent the ‘old-timers’ in a working community. Within this context, Lave and Wenger (1991) consider apprenticeship as ‘situated learning’.

In order to obtain the inside story of selected BTs and as part of the preliminary investigation, I interviewed two BTs from neighbouring schools and explored the following: What values and beliefs do they have? What does teaching mathematics mean to them? What expectations do they have in their career as a mathematics teacher?

A BT’s entry to the classroom needs to be strategically designed so that his contributions are acknowledged and appreciated by the school. However, in my experience, many development
programmes for teachers are not efficiently managed in Lesotho due to many limitations (lack of resources for instance) which often jeopardises a BTs’ smooth entry into school life.

While exploring and trying to familiarise himself with the norms of the school, a BT struggles to find his own space in the mathematics classrooms. His greatest challenge often lies with students who have to accept him as a mathematics teacher. Who am I, and what do I want to become? These are the questions frequently asked by a BT in order to realise his sense of self and to shape a professional identity (Samuel & Stephen, 2000). His entire first year is a juggling act between ‘ministering’ and ‘dancing with the students’ and maintaining a setting in which the students respect him as a mathematics teacher (Stephen, 2004). He is expected to be an expert who can confidently address and solve issues that emerge in classrooms in a fair way. The experience he gains from the internship prepares a foundation for him, as he starts working as a mathematics teacher. My observation further suggests that, at the end of the initial journey, he will perhaps change his teaching approaches, develop new tactics, or choose an entirely different career.

Against this background, I ask some fundamental questions such as: what makes a person want to be a mathematics teacher? How does he shape his professional identity? And what is this identity? Boaler, William and Zevenbergen (2000) point out that the sense of belonging to a group, the sense of achievement within the norms of the group, and the particular behaviours associated with belonging to this group are the key aspects of developing an identity. In essence, I argue that professional identity comes from realising who that person is, what values he carries within him and how he practices such values to bring changes in others’ lives.

It is important to properly understand how BTs shape their professional identity within the context of school community. This study thus explores how a BT makes sense of his actions and how he shapes his professional identity. To find the answers to these questions, I have selected six BTs from Lesotho whose classroom practice I observed over a period of two years. I also interviewed them regularly to understand how their changing teaching approaches helped them make sense of their classroom practice and hence helped them shape their professional identity. The transition period from being a learner (beginner) to becoming an experienced teacher is a testing time for BTs. They have dreams and expectations to be good mathematics teachers.
(Goulding, 1997). Any undermining of such hopes brings conflicts and tension to them. In the Lesotho context, this should be read together with the introduction of the localised curriculum (MoET, 2013). In my observation, inefficient in-service programmes or insufficient teaching resources perhaps limit BTs’ teaching approaches and restrict their development of content knowledge. In this regard, Forgasz and Leder (2008) observe that teachers with poor mathematical content knowledge find it difficult to make changes in their existing beliefs and practice. It will be useful to find out what this means for BTs.

Goldsmith and Shifter (1997) observe that traditional mathematics instruction is grounded in the belief that students learn mathematics by receiving clear, comprehensible, and correct information about mathematical procedures. The traditional role of teachers thus carries the stigma of a *chalk and talk* style that may not have eroded completely from teachers’ attitudes and beliefs about teaching mathematics (Nkopodi & Mosimege, 2009). Within such a tradition, young BTs easily follow the *chalk and talk* approach of learning, which promotes an instrumental understanding of mathematics (Tanner & Jones, 2000; Skemp, 1976).

Research into the concept of professional identity for BTs is novel in the Lesotho context. According to one study, Goos (2008) indicates that a situational perspective helps researchers to understand how context makes a difference to the development of mathematics teachers and their professional identities. This study therefore focuses on beginner teachers’ own experiences, insights and understanding of who they are within the context of Lesotho.

Wenger’s (1998) social theory of learning is extensively used in this study to understand the components of a BT’s learning, with a focus on his professional identity. The central question that this study asks is how BTs shape their professional identity. In particular, this study will explore how they embody various identities into their professional identity. I answer this question by focusing on how they learn through participation and practice. Learning in this context involves the skills they attain over the early periods of their teaching career in shaping their identity as mathematics teachers. Their transformation from assisted to unassisted performance is the same as a newcomer becoming an old-timer (Lave & Wenger, 1991). Learning is thus seen as key to shaping BTs’ professional identity.
1.3 CONCERNS OF BTs

While searching for the answers to the questions that a BT asks, he has many concerns regarding his classroom practice. The transition period from being a beginner to becoming an old-timer is a testing time for BTs as well as for the school community to which they are affiliated. Other general concerns and challenges that are faced by BTs are:

- The changes in curriculum that have recently been introduced by MoET (2013) do not fully address teachers’ concerns (for instance, insufficient in-service courses) and thus the implementation of these changes becomes inefficient.
- Being the recipients of the chalk and talk approach during their school period as a student, BTs may be comfortable with this approach. This compromises mathematics learning (Vithal, Adler & Keitel, 2005; Vithal, 1993) and may also build tension among BTs.
- The number of teaching lessons for BTs and overcrowded classrooms has an adverse effect on the students’ mathematics learning that may limit BTs’ chances to explore various teaching approaches.

1.3.1 Lesotho context

Formal education in Lesotho has a history of about 150 years that began with the arrival of missionaries (Brown, 1960). It is interesting to note that colonial education mainly focused on the correct answers but not their justification (Ismael, 1993). This made the learners passive in the mathematics classrooms, and during the time of colonisation, generations of teachers learned their mathematics through rote mechanisms.

The purpose of education in Lesotho is directed to the full development of the human personality (MoET, 2008; MoET, 2005). To achieve this goal, MoET (2009) observes that learners are to become responsible for their learning processes and should be able to evaluate their work. This learning strategy suggests a shift from teacher-centred learning to learner-centred learning. Therefore, an integrated and learner-centred approach to teaching and learning guides the implementation of the curriculum in schools (MoET, 2009). Within this context, practice and participation play a critical role in mathematics learning.
The backdrop of this study is the observation that the performance (Table 1.1a&b) in mathematics classrooms at the secondary level of education in Lesotho is generally poor (MoET, 2011b; MoET, 2001; ECoL, 2005; ECoL, 2004). The Tables 1.1a&b show the grades that students received at Junior Certificate (JC) and Cambridge Overseas School Certificate (COSC) examinations:

**Table 1.1 a: Analysis of Mathematics grade at JC level**

<table>
<thead>
<tr>
<th>Year</th>
<th>Total No. of candidates</th>
<th>Grade A to C (Credit +)</th>
<th>Grade D &amp; E</th>
<th>Grade F to H (Fail)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>24429</td>
<td>2264 (9.27%)</td>
<td>10861 (44.45%)</td>
<td>11304 (46.28%)</td>
</tr>
<tr>
<td>2011</td>
<td>24235</td>
<td>2428 (10.01%)</td>
<td>10154 (41.89%)</td>
<td>11653 (48.10%)</td>
</tr>
<tr>
<td>2012</td>
<td>24132</td>
<td>2805 (11.62%)</td>
<td>9674 (40.08%)</td>
<td>11653 (48.30%)</td>
</tr>
</tbody>
</table>

*Source: ECoL, 2014*

**Table 1.1 b: Analysis of Mathematics grade at COSC level**

<table>
<thead>
<tr>
<th>Year</th>
<th>Total No. of candidates</th>
<th>Grade A to C (Credit +)</th>
<th>Grade D &amp; E</th>
<th>Grade U (Fail)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>14853</td>
<td>1702 (11.46%)</td>
<td>4034 (27.15%)</td>
<td>9117 (61.39%)</td>
</tr>
<tr>
<td>2011</td>
<td>16752</td>
<td>1760 (10.50%)</td>
<td>4320 (25.79%)</td>
<td>10672 (63.71%)</td>
</tr>
<tr>
<td>2012</td>
<td>17242</td>
<td>2044 (11.85%)</td>
<td>4728 (27.42%)</td>
<td>10470 (60.72%)</td>
</tr>
</tbody>
</table>

*Source: ECoL, 2014*

Table 1.1 demonstrates that about 50% of students in Lesotho pass mathematics at the JC level, yet at the COSC level, it is only about 40%. However, passing mathematics is not compulsory for a JC student in order to obtain his JC-certificate. This means that even if a student fails mathematics (minimum passing grade is E, at JC level), he could still pass the JC examination provided he has passed his other 5 subjects including English and Sesotho. As a result, the student secures a seat for a COSC course and continues with his high school education. However, it should be noted that mathematics is a compulsory learning subject at both levels (JC and COSC). This policy has a direct impact on the performance of mathematics at COSC level that results in about 60% of students failing in mathematics at this level.

A study conducted by Mogari, Kriek, Stols and Iheanachor (2009) suggests that the need to improve students’ achievement in mathematics is extremely critical in Lesotho. Some would argue that the students’ poor performance in mathematics, as evident from Table 1.1 is a reflection on teachers’ under-performance in classrooms. Others would argue that it reflects the
poor learning of Basotho pupils at this level (MoET, 2011b). Lesotho has long been concerned about this issue (Narayanan, 2011a&b).

The role of BTs cannot be under-estimated in providing high-quality mathematics teaching. The mathematics teachers’ role in promoting good mathematics grades is crucial as they find that only a marginal number of students (about 10% with grade A, B & C) acquire adequate skills in mathematics at JC and COSC level. In order to secure admission for a BSc Ed degree programme at National University of Lesotho (NUL), a student must have obtained a pass with credit in mathematics in COSC (cited from www.nul.ls, 2014). Lesotho College of Education (LCE) has a similar regulation for admission in the diploma programme. This means that about 10% of students who write the COSC examination are qualified to pursue a teaching career at NUL or LCE, though not all would apply to the faculty of Mathematics and Science education as shown in Table 1.2a&b.

### Table 1.2 a: Statistics summary of Diploma in Education (Mathematics and Science)

<table>
<thead>
<tr>
<th>Year</th>
<th>Pass (%)</th>
<th>Supplement (%)</th>
<th>Supplement and repeat</th>
<th>Repeat (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>46 (60.52%)</td>
<td>25 (32.90%)</td>
<td>1 (1.32%)</td>
<td>4 (5.26%)</td>
<td>76 (100%)</td>
</tr>
<tr>
<td>2012</td>
<td>69 (66.35%)</td>
<td>31 (29.80%)</td>
<td>4 (3.85%)</td>
<td>0 (0%)</td>
<td>104 (100%)</td>
</tr>
<tr>
<td>2013</td>
<td>51 (62.20%)</td>
<td>30 (36.59%)</td>
<td>0</td>
<td>1 (1.21%)</td>
<td>82 (100%)</td>
</tr>
</tbody>
</table>

*Source: Lesotho College of Education, Summary by specializations, Appendix A2 TO S.P.2014/8*

### Table 1.2 b: Statistics summary of BSc. Ed (Combination of Mathematics and any one Science subject)

<table>
<thead>
<tr>
<th>Year 2010</th>
<th>Pass (%)</th>
<th>Supplement one paper (%)</th>
<th>Supplement more than one paper (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number (%) in brackets</td>
<td>12 (34.2%)</td>
<td>8 (22.9%)</td>
<td>15 (42.9%)</td>
<td>35 (100%)</td>
</tr>
</tbody>
</table>

*Source: NUL, Appendix 9 to S.P.2011/05, Faculty of Education, Academic year 2010/11*

Based on Table 1.2, it should be noted that for every 100 students who write the final year examinations in the faculty of Mathematics and Science at LCE and NUL, about 35-40 of them have to supplement the failed subjects or repeat the year before graduating. This may indicate their inadequate skill or poor content knowledge among other factors. Once graduated, these
newly qualified teachers are employed at various schools to teach mathematics, as vacancies arise. In turn, they join other members of the community and start their career as mathematics teachers. Table 1.3 shows the statistics of teachers in Lesotho (Statistics on the exact number of Mathematics teachers are not available).

Table 1.3: Statistics on number of students and teachers in Lesotho Secondary schools

<table>
<thead>
<tr>
<th>Year</th>
<th>Students enrolled</th>
<th>% increase/year</th>
<th>No of Teachers</th>
<th>% increase/year</th>
<th>Student/Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>123307</td>
<td>10.61</td>
<td>5006</td>
<td>5.72</td>
<td>24.63</td>
</tr>
<tr>
<td>2011</td>
<td>128172</td>
<td>3.95</td>
<td>5141</td>
<td>2.7</td>
<td>24.93</td>
</tr>
<tr>
<td>2012</td>
<td>127852</td>
<td>-0.25</td>
<td>5094</td>
<td>-0.91</td>
<td>25.10</td>
</tr>
</tbody>
</table>

Source: Statistics Department, MoET, 2014

According to the Teaching Service Department (TSD) pay roll record, 4666 secondary school teachers are paid by the MoET in February 2014 (Source: TSD, date: 22 April 2014). These teachers are spread over about 337 secondary schools and 3198 classrooms (MoET, 2014). One mathematics teacher should teach 7 lessons per class per week. The maximum number of lessons per teacher is 30, which could be a combination of mathematics and any other science subjects. This seemed to be a reasonable workload for many teachers. For instance, at my work place, there are 18 classrooms that require only 4.5 mathematics teachers teaching 920 students in 2014. The ratio for mathematics teachers to students at this school is 1:204, with an average of 51 students per class. As my study focuses on BTs, the participants also come from a pool of mathematics teachers from similar backgrounds.

These figures (Table 1.3) indicate that there are challenges such as overcrowded classrooms for mathematics teachers. In addition, these teachers are also allocated lessons in the sciences. These limit their performance in mathematics. Furthermore, inadequate in-service courses, insufficient teaching resources etc., also contribute to under-performance in mathematics classrooms. Therefore, how BTs engage in learning and contribute to the various teaching practices of their community is directly related to the shaping of their identity. Possibly, there may be a few role models among experienced teachers, who inspire enthusiastic but inexperienced BTs. This observation aligns with Sfard and Prusak’s (2005a) claiming that human beings are active agents who play decisive roles in determining the dynamics of social life and in shaping individual identities.
The period of this study (2012-13) is very crucial and interesting because the MoET has introduced a new curriculum policy of ‘localization’ through a circular (MoET, 2013). Ministry of Education and Manpower Development (2002) emphasises that the aim of teaching mathematics is to provide “students with knowledge and skills by enhancing their abilities to think logically and analytically” (p.1). A dynamic change in curriculum might have an impact on teachers’ attitudes and approaches in mathematics teaching, which may influence their professional identity. However, the circular notice does not provide details on the curriculum, except that the “candidates will be sitting for the first localized LGCSE examinations in 2014” (MoET, 2013).

The localization policy brings challenges for stakeholders and BTs. Some of them feel that they are not trained enough to teach the new curriculum. Others observe that there is not much change in the mathematics syllabus and therefore it will not have any impact on the teaching of mathematics.

BTs require an appropriate working environment for their effective classroom teaching (Clarke, 2008). Grant, Kline, Crumbaugh, Kim and Cengiz (2009) recommend supporting, eliciting and extending actions within the framework of the mathematics curriculum that demand elaborated in-service programmes for Lesotho mathematics teachers. As Lesotho teachers come from various academic and professional backgrounds (Ref: Table 1.2 & 1.4) participation in in-service courses are crucial for BTs. It should also be noted that teacher education is not necessarily a pre-condition to secure a teaching job in Lesotho schools (at least not at the time of this study).
Table 1.4: Number of qualified and unqualified teachers

<table>
<thead>
<tr>
<th>Year</th>
<th>Qualified teachers</th>
<th>Unqualified</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>4072</td>
<td>1069</td>
<td>5141</td>
</tr>
<tr>
<td>2012</td>
<td>3969</td>
<td>1125</td>
<td>5094</td>
</tr>
</tbody>
</table>

Source: MoET, Statistics department, 2014

The statistics also show that more than 20% of secondary school teachers in Lesotho are not qualified to teach (Table 1.4). I used the term, *unqualified* with reference to a teacher who does not have any professional qualification in education. Many of them who are employed by the TSD are young graduates. For instance, at my workplace, three mathematics teachers are not qualified in teaching. In mathematics classrooms students rely on their teachers in order to grasp the mathematical concepts, mostly because they are familiar with an instrumental understanding of mathematics from their school education experience. Once they enter into the system, they are mostly on their own to become an expert in mathematics teaching. A newly employed BT thus learns through observing and imitating old-timers.

MoET (2005) is aware of the concerns beginners have as they recognise the absence of a clear career structure for teachers. This de-motivates teachers regardless of their status as newcomer or old-timer. Therefore, “all those who teach mathematics need continuing support throughout their careers in order to be able to develop their professional skills and so maintain and enhance the quality of their work” (Cockcroft, 1982, p. 217).

The situated meanings that surface from the mathematics classrooms have some drawbacks such as the time factor or teaching resources. As a result, some mathematics teachers are tempted to promote and practice certain teaching approaches (Goos, 2008). This author further suggests that their “practice-in person, implies that participation develops identities as the practice becomes part of the individual” (p. 3). It should also be noted that, over the past 20 years, the academic performance in mathematics has been deteriorating in Lesotho secondary schools (ECoL, 2013; ECoL, 2005; ECoL, 2004). Some would argue that this is a reflection of under-performing teachers and their monotonous teaching approach. Brown and McNamara (2011) observe that “school curricula emphasise skills rather than appreciation and doing rather than interpreting” (p.
Therefore, I argue that the role of mathematics teachers within the Lesotho context should not be under-estimated. Their role is also critical to providing high-quality teaching of mathematics that becomes a model for BTs during their apprenticeship.

Many classrooms remain overcrowded and under-resourced. This additionally contributes towards the under-performance of Lesotho students in mathematics (MoET, 2011a&b; MoET, 2010). In such conditions, teachers have difficulty in choosing appropriate strategies and approaches for teaching mathematics (Ollerton, 2001), and as a result, are tempted to choose an authoritative style (Skemp, 1976). This scenario confuses novice teachers too as often they do not know from whom to take advice and how to implement their ideas in the classrooms.

My dream for Lesotho is to have more enthusiastic, dedicated and confident teachers who inspire learners to be passionate about mathematics. These are the same teachers who would inspire young Basotho to study mathematics and perhaps become mathematicians and mathematics teachers. My interest also lies in the building of a young cadre of mathematics teachers who are able to do just that. It is thus important to find out the needs and desires of BTs as they begin their careers in order to investigate how they shape their identities in becoming successful mathematics teachers in the community they work with and the society in which they live (Sfard & Prusak, 2005a&b; Gee, 2001).

1.4 THEORETICAL FRAMEWORK & SUBTHEMES OF THE STUDY

For this study, I explore a wide range of literature from which I extract some relevant information for developing a theoretical framework for this study.

My study draws from the theories of social and cultural learning (Wenger, 1998; Lave & Wenger 1991; Sfard & Prusak, 2005 a&b) with a special reference to Personal identity, Teacher identity, Mathematics identity and Community of Practice identity. Even though these identities are separately examined, these are embedded within professional identity, and are considered as intertwined units.
Learning shapes BTs’ professional identity through practice and participation (Wenger, 1998). Learning thus transforms their actual identity into the designated identity which they visualise (Sfard & Prusak, 2005a&b).

The researcher’s view of reality (ontology), and how one acquires knowledge (epistemology) shapes what he/she wants to explore, and how he/she wants to engage with learning (my emphasis in bold). From an ontological perspective, this study sees reality as socially constructed (Wenger, 1998). It should also be noted that realities vary from individual to individual. Therefore the professional identity that I propose to narrate varies from participant to participant. These narratives present their stories about their experiences, and meaning emerges from these experiences (Sfard & Prusak, 2005a). Learning (social and individual) is thus related to the meaning formation that shapes their professional identity.

1.5 GOALS AND OBJECTIVES
The central goal of this study is to gain insight into the way BTs shape their professional identity. I achieve this goal by listening to their ‘voice’. This study examines how selected BTs develop their professional identity by reflecting on their classroom practice (Spence, 1996) within the context of the participant schools. Sfard and Prusak (2005a) suggest that human beings are active agents who play decisive roles in determining the dynamics of their social life and in shaping their identities. The study explicitly interrogates this agency with respect to the BTs’ individual teaching practice as they show their professional identity.

1.6 RESEARCH QUESTION
The main question that this study seeks to answer:

- How do BTs shape their professional identity in their first three years of teaching?

In particular, this study explores how BTs embody their personal identity, teacher identity, mathematical identity and community of practice identity into their professional identity.
1.7 RESEARCH DESIGN & INTERPRETIVE PARADIGM

The study is oriented within the framework of a qualitative approach and within the anchor of ethnographic methods.

This ethnographic study is designed to follow BTs in their first three years of teaching and to hear their stories. It interrogates the meanings of situations, and explores stories which are actively constructed by participants (Sfard & Prusak, 2005a&b; Gee, 2001; Eisenhart, 1988). Their stories remain a starting point in the practical notion of narrative inquiry as Xu and Connelly (2010) point out, and enable BTs to envisage their professional identity, using their own interpretations and analysis (Anderson, 2007; Sfard & Prusak, 2005a&b; Sfard & McClain, 2002; Gee & Green, 1998).

Phase 1 of the data generation includes observing BT’s classroom practice, which is electronically recorded, after which reflective interviews are conducted. At the end of the academic year, a focus group interview is also conducted to have an overview of their experiences. This process is repeated in the second year. In Phase 2, the classroom activities and interviews are transcribed.

The transcribed data from classroom observations and interviews are discussed and vertically analysed in chapter 4. The findings from chapter 4 are interpreted through horizontal analysis in chapter 5 in order to understand how BTs shape their identities. I borrowed the models and the tools from Heyd-Metzuyanim and Sfard (2012) and Sfard and Prusak (2005a), which are modified to suit this study and to analyse the data. This analytic tool is designed appropriately to understand how BTs’ professional identity is shaped. The sequence of the analytic pattern is demonstrated below:

Table 1.5: Shaping of professional identity

<table>
<thead>
<tr>
<th>Understanding BT’s actual identity</th>
<th>Stories of practice and participation</th>
<th>What and how BTs learn</th>
<th>Narrative of shaping their new identity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key: BTs’ stories are categorised into mathematizing and subjectifying actions (Heyd-Metzuyanim &amp; Sfard, 2012). The subjectifying actions that are linked to mathematizing actions are extracted, categorised, and then analysed as per the tools drawn from Sfard and Prusak’s schools of thoughts. These stories are reified, endorsable and significant.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Some of the dominant theories influencing the professional identity come from the theories of Wenger (1998), Lave and Wenger (1991), and Sfard and Prusak (2005 a&b). The chapter concludes by discussing the insights through microanalysis of the data.

1.8 THESIS OVERVIEW

This thesis is divided into 6 chapters.

Chapter 1: Introduction and orientation

Chapter 1 provides an introduction to this study that outlines the context of the study, research goal and methodology of the study.

Chapter 2: Literature review

This chapter explores the social theories of learning through which BTs shape their professional identity. The notion of identity and specifically professional identity are explored. Personal identity, teacher identity, mathematics identity and community of practice identity are examined as various strands that intertwine to become the single cable of professional identity.

Chapter 3: Methodology

Chapter 3 provides a detailed discussion of the ethnographic method that is used in this study. Methods of data collection such as classroom observation and interviews are described. The chapter concludes by examining the analysis methods.

Chapter 4: Vertical analysis

This chapter analyses the lessons from the participant BTs using the tools borrowed from Heyd-Metzuyanim and Sfard (2012), and Sfard and Prusak (2005a). At the end of the analysis, the findings are linked to the identity.
Chapter 5: Horizontal analysis and discussion

The findings from the discussion in Chapter 4 are analysed horizontally and discussed to understand how BTs shape their professional identity.

Chapter 6: Findings, recommendations and conclusions

A reflection on the research goals and questions with a summary of findings is provided in this chapter. This chapter also explores issues and challenges, and recommendations resulting from the study are proposed. The significance of the study and possibilities for future research are also presented, with a final remark on how this study assisted me to change my own professional identity.

1.8.1 Significance of the study

How BTs shape their professional identity is the central theme of the study. The significance of this study is:

- This study can contribute towards understanding what it means for BTs to belong to a mathematics teachers’ community of practice and to develop a meaningful partnership with their community of practice.
- This study has the potential to create new spaces for debate to develop and design meaningful induction-training programmes for Lesotho beginner teachers.
- The study will also be useful for the MoET in designing meaningful induction and identity-oriented in-service programmes for BTs.
- By participating in this long-term study, the BTs were able to build confidence in their own practice (Graven, 2003) and gain professional satisfaction of being recognised (Gee, 2001) as mathematics teachers.
- This study has the potential to develop a sense of ownership in decision-making processes for the participating teachers (Clarke, 2008). This in turn encourages them to set new goals for their ongoing professional identity.
- I anticipate an impact of this study on my own understanding of professional identity that hopefully also shapes my ever-changing identity (Cohen, Manion and Morrison, 2007).
1.8.2 Limitations
The stories are focused on a small group of participants and, therefore, they cannot generalise the kinds of issues that are important for BTs. The study was limited to 5 classroom observations each from 6 BTs, but these are representations of classrooms in secondary schools in Lesotho. Therefore, the insight gained from this study could be valuable in similar contexts. BTs’ stories may be biased but are significant if they change their (BTs) classroom approach as they gain insight on their classroom experience.

1.9 CHAPTER SUMMARY
The first chapter introduced the reader to the background, rationale, aim, objectives and the research design of the study. It further presented an outline of all the other chapters. The following chapter will introduce the theoretical framework and the key notions used in this study.
CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION
The aim of this chapter is to introduce a theoretical framework that underpins this study. The discussion begins with the social theory of learning (Wenger, 1998) from which aspects of learning, community of practice and legitimate peripheral participation are explored. Learning leads to meaning formation that shapes one’s identity. In this study, the concept of identity is explored to derive the notion of professional identity of BTs.

The overall research is framed from Wenger’s (1998) social theory of learning and community of practice theory that is linked to the views of Atkinson and Hammersley (2007); Lerman (2006); Goos (2005); Boaler (2000); and Lerman (1996). Meaning is formed from one’s learning processes (Gresalfi & Cobb, 2009; Borko, 2004; Clarke & Hollingsworth, 2002; Marsh, 2002; Yackel & Cobb, 1996). The study also discusses the idea of legitimate peripheral participation with reference to learning, in order to understand how BTs shape their professional identity (Lave & Wenger, 1991). In addition, this chapter presents the research on professional identity and its associated narratives from Sfard and Prusak (2005a&b); Gee (2001); Beijaard, Verloop and Vermunt (2000); and Wenger (1998).

Notions of identity are drawn from the writings of Anderson (2007); Boaler (2002); Gee (2001); Wenger (1998); Adler (1998); Lave (1996); Lave (1991); and Lave and Wenger (1991). I also draw on views on situated meanings from Heyd-Metzuyanim and Sfard (2012); Sfard (2006); Sfard and Lavie (2005); and Lave and Wenger (1991) in terms of practice and participation. Following on from this general discussion on identity, the chapter finally reviews texts on BTs’ professional identity by Gresalfi and Cobb (2011); Jaworski (2006); Adler (1998); Lerman (1996); and Lave and Wenger (1991).
The core of this literature framework is the meaning formation that shapes BTs’ professional identity (Heyd-Metzuyanim & Sfard, 2012; Sfard & Lavie, 2005; Sfard & Prusak, 2005a&b; Gee, 2001; Gee & Green, 1998). As the chapter explores professional identity as a social construction (Boaler, 2002; Gee, 2001; Wenger, 1998), identity as narrative is discussed (Connelly & Clandinin, 2011; Sfard & Prusak, 2005a; Gee, 2001; Gee & Green, 1998). Narrative is a way of studying and characterising human stories (Connelly & Clandinin, 2011). BTs’ narratives on their classroom practice are explored to understand how they shape their professional identity (Beijaard et al., 2000; Beijaard, 1990; Nias, 1989).

This chapter thus unpacks the theme learning within the social theories of learning through their narratives. A shared sense of values and meaning consequently appear in this discussion (Gee, 2008; Cobb, 2006; Boaler, 2002; Gee, 2001; Wenger, 1998; Lave & Wenger, 1991). This defines identity as a product of learning. Learning in this context is a social practice through which we connect to know who we are (Boaler, 2000; Wenger, 1998; Lave, 1996; Lave & Wenger, 1991). Meanings are thus formed from BTs’ learning processes (Gresalfi & Cobb, 2009; Borko, 2004; Clarke & Hollingsworth, 2002; Marsh, 2002; Yackel & Cobb, 1996).

According to Boaler (2002), a situated perspective of learning is “something that is distributed between people and activities” (p. 1). Boaler (2002) further argues that “people use knowledge differently in different situations” (p. 2). This knowledge is co-constructed by individuals and by other people with whom they are interacting in a social setting with a focus on the practices and activities of learning.

With this understanding, chapter 2 is divided into sub-sections. I begin the discussion on why there is a need for BTs to develop a professional identity, against the backdrop of teaching in general and teaching mathematics in particular (Section 2.2, 2.3). The focus in this section is on the socio-cultural theories in education. I explore challenges and concerns of newcomers that help them to grow into old-timers (Section 2.2). In section 2.4, I discuss identity using Wenger’s views on learning with an emphasis on practice and participation. Identity in this chapter is defined as a product of learning. Learning in this context is a social practice through which we
connect to know who we are (Bolarer, 2000; Wenger, 1998; Lave 1996). The literature then examines the positioning of professional identity and its importance in BTs’ classroom practices.

The final section (2.5) discusses the research design and concludes the literature review by suggesting and discussing appropriate analytic tools for this study.

The chapter begins with a personal story based on my 25 years’ experience and observation of teaching mathematics in Lesotho. My classroom experience inspired me to ask the questions such as: “who are we, where have we been and where are we going” (Wenger, 1998, p. 149). The answers to these questions may make sense of one’s action (Niven, 2011; Sfard & Prusak, 2005a&b; Gee, 2001) that initiated the research question: how do BTs shape their professional identity? In particular, how do they incorporate various identities into their professional identity? The study also unpacks various identities and explores how these identities are incorporated into their professional identity.

2.2 RATIONALE
To begin this chapter, I provide a brief rationale and context of the study. My experience as a mathematics teacher in Lesotho indicated that there is a need to analyse BTs’ challenges and concerns. Their experiences, in my view, contribute to the shaping of BTs’ professional identity.

2.2.1 What has inspired my study?
The story of a newcomer becoming an old-timer is an interesting and inspiring one for potential students of mathematics to become mathematics teachers. According to Gresalfi and Cobb (2011), teachers’ motivation is not just their ideas about teaching, but their desire to learn to teach in a particular way. Equally important is the concept of what does it mean to be a mathematics teacher (Cobb, McClain, Lamberg & Dean, 2003). Meaning formation thus becomes the learning process that shapes their professional identity (Gresalfi & Cobb, 2011; Sfard & Prusak, 2005a; Wenger, 2002).

My personal story suggests that when a BT starts working as a mathematics teacher, he hopes and dreams of becoming a good teacher. It may also happen that he simply sees teaching as a job
that brings an income. The first few years of teaching may be seen as a two-way struggle in which BTs try to create their own social reality by attempting to make their work match their own personal vision of who they are, whilst simultaneously being subjected to the powerful socialising forces of the school culture (Flores & Day, 2005). They may also encounter conflict that requires resolving (Stephen, 2004). They also engage in a process of familiarising themselves with their students. Their personal desires and professional ambitions are the “two-way struggle” that may merge in due course.

Learning is essential for a BTs’ professional development. Prescott and Cavanagh (2008) consider that learning is an individual’s “change in mind”. Wenger (2002) sees the relationship between a beginner and an old-timer as a complex set of social relationships through which learning takes place. Community in this context acts “as a living curriculum for the apprentice” (p. 3). This view emerged from Lave & Wenger (1991), who observe that learning is a social phenomenon and an on-going social practice. Learning is therefore dependent on membership in the communities of practitioners to which an individual belongs. BTs thus move from a peripheral participation to a central one. During this positional change, he also changes himself (Goldsmith & Shifter, 1997). It will be interesting to follow these changes through their stories and to understand how they reflect on their classroom teaching. In turn, these reflections may illustrate how they shape their professional identity.

2.2.2 Why this study is important

Following these participating BTs and their learning experiences provide valuable insights for other young teachers. As they grow their own professional identity the stories in this study can serve as inspiration and facilitate reflection. As BTs plan and prepare for their classroom practice it is hoped that this study will assist them in shaping their professional identity. Furthermore, it is hoped that this study may help policy makers in their planning and designing appropriate in-service courses and BT-orientation programmes for BTs in Lesotho.
2.2.3 Why the emphasis on identity

The term identity has been used in many ways in mathematics education and related fields (Gresalfi & Cobb, 2011). These range from individual stories (Graven, 2003; Knowles, 1992), their narratives about themselves (Cobb, 2006), to how others see them (Sfard & Prusak, 2005a; Gee & Green, 1998; Wenger, 1998). Identity is also seen and described in terms of the self and how a person is recognised as a certain kind of person (Gee, 2001; Beijaard et al., 2000).

According to Grootenboer, Smith and Lowrie (2006) identity is a concept that is important to consider in mathematics education research, because it brings together a range of elements that are integral to our understanding of mathematics contexts and learning spaces. Wenger (1998) suggests that within the social group, identity is shaped through interaction. Sfard and Prusak (2005a) conclude that ‘[i]n the absence of a definition, the reader is led to believe that identity is one of those self-evident notions that, whether reflectively or instinctively, arise from one’s firsthand, unmediated experience” (p. 15). A person defines his identity by making sense of his actions and activities within the community with which he interacts. He in turn learns from such interactions. Against this backdrop, I ask: what makes a person a teacher, how does a teacher shape his professional identity, and what is this identity? Within this perspective a BT also asks the same questions; what makes me a teacher? How do I shape my professional identity? This study intends to find answers to these questions.

2.2.4 Why the emphasis on BTs

Clarke and Hollingsworth (2002) note that the transition period from being a learner (beginner) to becoming an experienced teacher is a testing time and a learning period for a BT. As he makes sense of all events around him, he may begin participating and contributing in various activities that shape his identities. These identities can be stable or fragmented at different times in different ways, based on his situated learning (Day, Kington, Stobart & Sammons, 2006). At the end of the initial journey, some BTs will perhaps change their teaching approaches, develop new tactics, or choose an entirely different career that becomes their new identity. Analysing their journey is therefore important to understand how they shape their professional identity.
In the following section, I explore Wenger’s (1998) social theory of learning with complementary views of Lave and Wenger (1991) on communities of practice.

2.3 OVER-ARCHING THEORY (Wenger’s Socio-Culturalism)

The term sociocultural has been used in many studies “to develop an ethnography of speaking that focuses on the role of language and communication in cultural practices” (Juzwik, 2006, p. 14). Many researchers argue that learning is socially constructed because people are the agents who determine the dynamics of their social life (Sfard & Prusak, 2005a&b; Gee & Green, 1998; Wenger, 1998). According to Sfard and Prusak (2005a), identity is the missing link between learning and its sociocultural context. Gee and Green (1998) elaborate learning and the social context;

Given the complex and continuing nature of life in classrooms and other educational settings, educational researchers often combine discourse analysis with ethnographic approaches to examine questions of what counts as learning in a local setting, how and when learning occurs, and how what is learned at one point in time becomes a sociocultural resource for future learning for both the group and the individual (p. 119).

Gee and Green (1998) also suggest that one way to understand the value of classroom practice is to combine discourse analysis with ethnography because “each represents a logic-of-inquiry” (p. 120). This influences the ways in which learning can be studied in social settings.

Social theories of learning purport learning as the prime factor that negotiates situated meanings for any member in a community (Goos, Galbraith & Renshaw, 2004; Sfard, 2003; Gee & Green, 1998; Wenger, 1998; Lave & Wenger, 1991). Consequently, I examine the socio-cultural theories that provide an umbrella for this study in order to view identity as learning in social settings (Goos, 2012; Goos, 2008; Cobb, 2006; Goos et al., 2004; Lerman, 2006; Wenger, 1998). Classroom practice as the social setting is therefore real and socially shaped for BTs.

The following section discusses social theories of learning with emphasis on the apprenticeship of a newcomer into a community.
2.3.1 Social theories of learning

Wenger (1998) suggests that learning is a product of social activities. Socio-cultural perspectives explore what is learned in a social context, rather than as the cognitive engagement of an individual (Stein & Brown, 1997). In their view: “[L]earning is seen to result from the fact that individuals bring varying perspectives and levels of expertise to the work before them” (p. 159). As individuals work toward shared goals, they create new forms of meaning together.

I use social theories of learning to understand how a BT learns from his classroom experiences. Lave and Wenger (1991) propose that “all theories of learning are based on fundamental assumptions about a person, the world and their relation to each other” (p. 47). For the purpose of this study, I suggest that a BT’s world is mainly the classrooms where he engages in teaching. In this regard, Wenger (1998) describes four premises of a social theory of learning:

- Humans are social beings which make them the central aspect of learning.
- Knowledge is a matter of competence, which activates growing and becoming.
- Knowing is a matter of participating that makes humans active agents of the world; and lastly,
- Meaning is our ability to experience the world and understand what learning has to produce.

These premises are useful for understanding how a BT makes sense of his classroom teaching. His ‘learning’ involves practice and participation, from which he makes meaning that, shapes his professional identity.

As the term, learning is frequently used in this study; it requires a specific definition to fit into the context. The term ‘learning’ carries special meaning with reference to the newcomers who are learning to become experienced mathematics teachers. According to Lave (1991):

Learning is recognised as a social phenomenon constituted in the experienced, lived-in world, through legitimate peripheral participation in ongoing social practice; the process of changing knowledgeable skill is subsumed in processes of changing identity in and through membership in a community of practitioners (p. 64).
Learning thus changes the BT’s way of being and becoming a mathematics teacher. The ultimate recipients of a BT’s actions are the students, who are in formal schooling where BTs teach. Lave (1996) provides a specific purpose of formal education by suggesting:

Formal education was supposed to involve "out-of-context" learning in which instruction is the organizational source of learning activities; learners build understanding through abstraction and generalization, which produces less context-bound, more general understanding, and results in broad learning transfer to times and places elsewhere and later (p. 150).

My stories (Section 2.2) suggest that BTs’ learning is closely linked to their teaching approaches and students’ learning of mathematical concepts. Through classroom practice, BTs give meaning to their teaching approaches (Wenger, 1998), which are meaningful in shaping their professional identity. Learning as social participation thus focuses on ways of reflecting on their teaching practice. In this manner, learning becomes an integral and inseparable aspect of social practice (Wenger, 1998; Lave & Wenger, 1991).

Wenger (1998) integrates the components of learning to meaning, practice, community and identity. Wenger (1998) further elaborates that:

Meaning is a way of talking about our ability to experience the world (learning as experience); practice as a mutual engagement in action (learning as doing); community as a way of talking about the social configuration (learning as belonging) and identity as a way of talking about how learning changes who we are (learning as becoming) (p. 5).

As I explored Wenger’s (1998) social theory of learning, two different perspectives surfaced. Firstly, Wenger (1998) and many other authors like Cobb (2006) and Lerman (2006) consider identity as socially constructed through different levels of learning processes. Lerman (1996) observes learning as a constantly shifting and unending process that shapes identity. Secondly, Sfard and Prusak (2005a) define identity as a sense making process of one’s own actions. These views complement and strengthen each other and focus on their central arguments (learning as social, and sense making as individual). I argue that the sense making of Sfard and Prusak (2005a) and the meaning of Wenger (1998) are the same. For Wenger (1998), meaning is a way of talking about our ability to experience the world and the situation.
I conclude this section by relating the views from Heyd-Metzuyanim and Sfard (2012) proposing that the study of human learning has three aspects; Affective, Intra-Personal (individual) and Inter-Personal (social). These authors define these aspects as cognitive analysis, “whereas studying the activity of identifying means attending to all those phenomena that other researchers label with the adjectives affective, interpersonal or social” (p. 129). In my view, human learning is more social than cognitive in mathematics classrooms. This is why these authors define identifying as “the activity of talking about properties of persons rather than about what the persons do” (p. 129). As they explain: “The resulting approach may go so far to equate mathematics with a particular form of communication” (p. 129). Heyd-Metzuyanim and Sfard (2012) further suggest that the properties of the persons (BTs in this study) and their activities are the identity concerns that introduce the emotional elements to mathematical conversations that shape their interactions in the classrooms. This view assisted me in designing the empirical study using the idea of equating mathematics with BTs’ utterances in the classrooms. With this in mind, I observed BTs’ classroom teaching with a focus on their utterances and then I listened to their reflective ‘voices’.

At this juncture, I elaborate the understanding of apprenticeship in terms of newcomer (BT) and old-timer within the perspective of their legitimate peripheral participation.

### 2.3.2.1 Apprenticeship and legitimate peripheral participation

According to Wenger (1998), an apprentice can learn something by practice and participation that was not learned before. In my study, this observation calls for exploring the term apprenticeship in connection to legitimate peripheral participation.

During the period of apprenticeship, a BT may need to review and assess his classroom experiences. Later on he may then share them with other teachers or listen to their voices. This assists BTs in gaining confidence as they are eager to grow into old-timers (Flores & Day, 2005). One of the findings from the study by Flores and Day (2005) is that: “[t]he teachers who worked in collaborative cultures were more likely to develop and to demonstrate positive attitudes towards teaching’ (p. 13). This justifies the need for BTs to explore the social world, if participation in social practice is the fundamental form of learning. According to Lave and
Wenger (1991), one of the disadvantages of such learning is that the situated meaning considers only the immediate context. Learning in a particular situation is conditional on time, space and socio-cultural background of the ‘learner’ (Goos, 2008). BTs can overcome these disadvantages by becoming active members within the circle of legitimate peripheral participation (Lave & Wenger, 1991). As a result, amending the practice and making sense of the lived experience become sustainable. This practice according to Wenger (1998) may involve what is said or what is left unsaid, which are also part of such legitimate peripheral participation for BTs.

As I explore participation and practice, interactions become the inevitable means for BTs to engage in such activities. Flores and Day (2005) call our attention to the emotion that carries weight on utterances of the participants who are engaged in interactions. If these emotions are not professionally managed, BTs may experience professional uncertainty (Woods & Jeffrey, 1996). Kelchtermans (1996) associates this uncertainty to teacher vulnerability, the feeling that one’s professional identity is questioned. Therefore, from the beginning of a BTs’ career, there is a need for renewed construction of resolutions to dissolve conflicts or tensions if any. This construction calls for a united effort from the apprentice and the community of practice for their active participation towards a designated goal.

My emphasis on the ‘active participation’ within the practices of social communities suggests a relational inter-dependency of agent and world, activity, meaning, learning and knowing (Lave & Wenger, 1991). As an apprentice, a BT’s full participation therefore opens opportunities for him and old-timers if they act together. Tension develops if they see their acts contradicting each other’s dreams. In order to reduce this tension, old-timers should not only make extra effort to introduce the newcomers into the actual practice of their community, but also value what BTs have to offer and thus see how they become part of future progress (Wenger, 1998).

At this juncture, it is necessary to discuss the phrase, ‘legitimate peripheral participation’, as this is vital in this study. Lave and Wenger (1991) separate this phrase into three terms. Each term is then paired with its contrasting one, namely: legitimate versus illegitimate, peripheral versus central, and participation versus non-participation. Gresalfi and Cobb (2011) deliberate that being a mathematics teacher is a legitimised position within the school community. In turn, this
provides him the space to be an active participant through a set of practices. Gee (2001) associates participation as a positional role to identity (Section 2.4). Lave and Wenger (1991) find apprentices’ participation to be peripheral. In this context, I ask: when does the participation become illegitimate, and what impact does non-participation have on BTs’ learning process? Wenger (1991) answers that our identities are constituted not only by what we are, but also by what we are not. That means we also learn from ‘non-participation’ (Figure 2.4). Lave and Wenger (1991) conclude that “the mastery of knowledge and skill require newcomers to move towards full participation in the socio cultural practices of a community” (p. 29).

When a BT begins to work as a mathematics teacher, he recognises the school community with its own values and beliefs. In this respect, Samuel and Stephen (2000) suggest that BTs should ask; “What do we bring with us”? Finding answers to this question prepares them to become active members within the community of practice. Lave and Wenger (1991) associate such memberships as means of learning through legitimate peripheral participation. For Wenger (1998), peripherality (Sic) leads to actual practice. Being on the periphery allows the newcomers and the old-timers to interact in ways that change their practice. In turn, BTs’ positions shift from peripheral participation to central participation. Quoting Wenger (1998):

> I will use the term participation to describe the social experience of living in the world in terms of membership in social communities and active involvement in social enterprises. Participation in this sense is both personal and social. It is a complex process that combines doing, talking, thinking, feeling, and belonging (p. 55).

Learning thus shapes BTs’ identities through knowing about themselves (Knowles, 1992). This occurs only by active participation. At a later stage, the stories of their participation categorise them to be a certain kind of person (Sfard & Prusak, 2005a&b; Gee, 2001; Connelly & Clandinin, 1990). In this sense, a BT’s legitimate peripheral participation is part of his apprenticeship. Learning further provides him a membership within the community that shifts his position from the periphery to the centre. At a later stage, the change in position also changes his actual identity to a designated identity (Sfard & Prusak, 2005a; Wenger, 1998).
Change in position in terms of actual identity and designated identity requires further examination.

### 2.3.2.2 Actual identity and designated identity

In this study, I will be frequently using the terms actual identity and designated identity. For Sfard and Prusak (2005a&b), actual identity consists of *stories about the actual state of affairs*, and designated identity consists of *narratives presenting a state of affairs* that are expected to be the case, if not now, then in future. Sfard and Prusak (2005a&b) further suggest that actual identity is “what is actually happening at the moment” (p.18) and designated identity as presenting a different understanding of these happenings at a later stage.

Within the context of this study, BTs’ narratives about their classroom practice may lead them as well as the readers to understand their actual identity that is reifying and endorsable (Section 3.5.4). As Sfard and Prusak (2005b) suggest, it is also then necessary to acknowledge that “these are just stories and that they have alternatives” (p. 16). Their activities within the period of apprenticeship are thus peripherally situated (Lave & Wenger, 1991). Sfard and Prusak (2005b) observe that:

> The scenarios that constitute designated identities are not necessarily desired, but are always perceived as binding. One may expect to “become a certain kind of person,” that is, to have some stories applicable to oneself, for various reasons: because the person thinks that what these stories are telling is good for her, because these are the kinds of stories that seem appropriate for a person of her sociocultural origins or just because they present the kind of future she is designated to have according to others” (p. 16).

Designated identities thus give directions to one’s actions according to these authors. These actions imply the active participation within a social context. Wenger (1998) justifies the dynamic nature of participation by underlining the inseparable duality of the social and the individual, where “people produce meaning of their own” terms and conditions (p. 15).

To summarise this section, I quote Lave and Wenger (1991) who perceive that “learning in apprenticeship offers opportunities for newcomers to shape their identity by making sense of the situations that help them to become old-timers” (p. 65). Learning as situational meanings thus
shapes actual identity, but evolve into designated identity at a later stage (Sfard & Prusak, 2005b).

These arguments provide an opportunity to examine learning as the central theme in social theories of learning.

2.3.3.1 Positioning learning as central
In this section, I discuss learning and its central position as Wenger suggests. While exploring legitimate peripheral participation, Lave and Wenger (1991) explain learning as a way to discuss the relations between newcomers and old-timers and their activities. This becomes a vehicle for the evolution of practices and for growing professional identities (Wenger, 1998). Learning gains attention from writers who explored identity with reference to sense making, meaning formation and individuals engaging with communities. Learning refers to people’s activities within communities of practice that shape situated meanings (Gee & Green, 1998). When an actor forms situated meaning, this is a sense making activity for him (Sfard & Prusak, 2005a). These views are derived from Lave and Wenger (1991) who suggest that an apprentice initiates situated learning through his peripheral activities. Learning thus becomes the centre of all activities and justifies its position at the centre as shown in Figure 2.1:
The components of participation (meaning, practice, community and identity) thus interconnect with each other and revolve around learning (Prescott & Cavanagh, 2008; Boaler, 2002; Wenger, 1998). However, Boaler (2002) offers an elaboration on situated learning:

This perspective emerged from recognition that people use knowledge differently in different situations and that knowledge, rather than being a stable, individual entity, is co-constructed by individuals and by other people with whom they are interacting and aspects of the situation in which they are working (p. 43).

Boaler’s view suggests that knowledge is dynamic and is constructed through interactions that emphasise the role of participation for active learning. Figure 2.1 illustrates learning for a newcomer as his central participation. In addition, learning shapes and re-shapes the professional identity through active participation. Wenger (1998) elaborates on participation as a “more encompassing process of being active participants in the practices of social communities and constructing identities in relation to these communities” (p. 4). In summary, Wenger (1998) links participation for individuals with learning through which they engage in and contribute to the practice of their communities.
In this section, I discussed the position of learning from Wenger’s (1998) view. Indeed, Graven (2003) suggests that Wenger’s views (of becoming and belonging) “capture the complexity” of learning within the social theory of learning.

For individuals, learning involves engaging in and contributing to the practices in their communities and their learning refines their practices (Wenger, 1998). Clarke and Hollingsworth (2002) support this view by suggesting that teachers change their classroom approach as they make sense of their activities, and shape their identity accordingly. I concur with Sfard and Prusak (2005a), who consider the notion of identity to be the missing link between the socio-cultural context and learning. By acknowledging this, I propose to shift the position of learning to the periphery from the centre so that identity takes a central role. This requires further discussion.

2.3.3.2 Positioning identity as central

Felix (2014) observes a close link between learning and identity, which he derived from Sfard and Prusak (2005a&b); Boaler (2002); Kieran, Forman and Sfard (2001); and Wenger (1998). According to Sfard and Prusak (2005a), “learning is often the only hope for those who wish to close a critical gap between their actual and designated identities” (p. 19). Learning thus becomes a sense making process for an individual that shapes his identities (Anderson, 2007; Sfard & Prusak, 2005 a&b; Gee, 2001). With reference to these views, this study proposes identity to be at the centre of a gradual change in contrast to Wenger’s view (Figure 2.1, 2.2&2.3).

Discourse on identity is one of the ways to understand how a person responds in a certain situation (Gee, 2001; Sfard, 2003). This author refers to this as ‘Discourse Identity’ (Section 2.4.2.1). The term, ‘discourse’ developed a specialised meaning in ethnographic study (Niven, 2011). Niven defines the term discourse as a language that gives expression to values and beliefs that are social, cultural and political. If identity is about, becoming a mathematics teacher, then discourse analysis is crucial to understand the meanings that BTs create in the classrooms. The narratives of sense making, learning and identity formation are thus closely associated to each other through discourse analysis. “Discourse analysis, then, when guided by an ethnographic
perspective, forms a basis for identifying what members of a social group (e.g., a classroom or other educational setting) need to know, produce, predict, interpret, and evaluate in a given setting or social group to participate appropriately (Heath, 1982) and, through that participation, [they] learn” (Gee & Green, 1998, p. 126).

Identity has thus been used in various ways in mathematics education and its related fields (Felix, 2014; Gresalfi & Cobb, 2011; Anderson, 2007). In mathematics education, identity, as one of the products of learning, ranges from a change in beliefs, attitudes and approaches to teaching mathematics or to a mathematics community (Felix, 2014; Anderson, 2007; Knowles, 1992), to their stories (Graven, 2005; Sfard & Prusak, 2005a; Connelly & Clandinin, 1999), and to the change in practice (Wenger, 1998). It also implies that if change does not occur, then learning is limited when participation is situated peripherally (Lave & Wenger, 1991). For this reason, shifting identity from its peripheral position to the centre links learning to meaning formation within the classroom setting. Figure 2.2 demonstrates how learning persuades and shapes BT’s identity by making sense of his actions.

![Diagram](image)

*Figure 2.2: A demonstration of how this study sees identity*
Figure 2.2 illustrates how the meaning of learning is configured through a process of becoming a full participant within a socio-cultural setting and through various practices. This observation pins down the two valuable themes within the context of the study, namely **learning by practice and learning by participation** that shape one’s identity (Section 2.4.2.2). Identity thus moves from periphery to the centre, in this study as demonstrated in Figure 2.3:

![Figure 2.3: Adaptation of Wenger’s social theory of learning in this study that shapes identity](image)

Figures 2.2 & 2.3 also display the transition of learning into meaning formation that shapes identity as the end product of learning. Learning for a newcomer thus becomes an integral part of shaping the professional identity. Quoting Wenger (1998);

> They [BTs in this study] learn how not to learn … They learn how to engage and disengage, accept and resist, as well as how to keep a sense of themselves in spite of the status of their occupation … What they learn and don’t learn makes sense only as part of an identity … and which subsumes the skills they acquire and gives them meaning … In practice, understanding is always straddling the known and the unknown in a subtle dance of the self. It is a delicate balance. Whoever we are, understanding in practice is the art of choosing what to know and what to ignore in order to proceed with our lives (p. 40-41).

The dynamic nature of identity is an opportunity to continue learning (Wenger, 1998). **Not** learning at a particular moment thus provides an opportunity to explore the same event from a different angle. In my view, this brings a human touch into the mathematics classrooms. BTs’ narratives of these activities in mathematics classrooms are the lens to understand how they shape their professional identity in this study (Sfard & Prusak, 2005b; Romberg & Kaput, 1999).
Figure 2.4 illustrates why there is a need for a BT to visit, re-visit or de-visit the approach that he takes in order to establish an appropriate mathematics classroom practice. I use the term ‘de-visit’ in the sense of starting afresh with a different approach. The figure 2.4 also demonstrates why making sense is equally important to not making sense.

From this discussion (Section 2.3), I conclude that learning is socially constructed, but individually achieved (Sfard & Prusak, 2005a; Wenger, 1998). The discussion also suggests that an individual’s participatory position changes from periphery to centre (Lave & Wenger, 1991). Within the context of this study, the central participation activates BTs’ learning processes and shapes their identities. Therefore, identities are likely to play a critical role in determining if “learning will end with what counts as success or with what is regarded as failure” (Sfard and Prusak (2005a, p. 19). Learning thus shapes BTs’ professional identity.
A discourse on identity is therefore necessary to understand the professional identity of BTs. I explore this section within a framework of identity as social practice and identity as classroom practice.

2.4 IDENTITY

At this stage, I outline the key definitions of identity as drawn from Sfard and Prusak (2005), Gee (2001), Wenger (1998) and other authors. These definitions are important to provide a framework for the study to understand how BTs shape their professional identity. The objective of this section is to explore identity as social practice (Sfard & Prusak, 2005a&b; Gee, 2001; Wenger, 1998; Lave & Wenger, 1991) and identity as classroom practice (Beijaard et al., 2000; Grootenboer & Zevenbergen, 2008). The discussion examines ideas such as making sense, and being recognised as a certain kind of person. At the end of this section, I summarise the notions of identity that are drawn from the literature (Table 2.1 & 2.2). These notions are used to understand how BTs shape their identity.

Lave and Wenger (1991) associate identity with situated learning within the immediate contexts that emerge from the meanings. For Wenger (1998), identity is the layering of participation and reification from which our experience and its social interpretation inform each other. In addition, Wenger (1998) views identity as a way of talking about how learning changes who we are. Identity thus refers to the personal histories of becoming ‘who we are’ in the context of our communities. Gee (2001) sees identity as a certain kind of person in a given context and as a person’s own narrativisation. Sfard and Prusak (2005) elaborate that foregrounding a ‘person’s own narrativisation’ and telling who one is, is an important element of identity. These authors connect identity to attitudes and beliefs a teacher has while he engages in teaching.

Moje and Luke (2009) believe that identities are social rather than individual constructions. If identity is socially mediated, they argue, one’s identity is likely to be dependent on the community in which he is located. This view coheres with Gee (2001) and Wenger (1998), who emphasise the role of individuals in building their identity within their social context. In addition, Moje and Luke (2009) observe that an individual’s attitudes and approaches may lead people to
view identities as individual qualities of a person (BT). In a socio-cultural perspective, identity focuses more on the interactions between the individual, culture and society. In this sense, identity is located both within and external to the individual, but developed through social and cultural practice (Grootenboer et al., 2006).

### 2.4.1 Understanding identity

Although the term ‘identity’ is not new, it is only recently that it has begun to be explored by educators at large and by researchers in mathematics education in particular (Bishop, 2011; Sfard & Prusak, 2005b; Gee, 2001). Furthermore, Sfard and Prusak (2005a, p. 43) believe that the notion of identity is a perfect candidate for the role of “the missing link” in the researchers’ story of the complex relationship between learning and its sociocultural context.

According to Goos (2008), a situational perspective helps researchers to comprehend how context makes a difference to the development of identities. Sfard and Prusak (2005a) observe that talking about identity makes us able to cope with new situations in terms of our past experience and gives us different tools to plan for the future.

Wenger’s (1998) social theory of learning and identity in practice are intertwined with each other when answering questions such as who am I? And, what do I want to become? For instance, Wenger’s (1998) ‘identity as learning as trajectory’ describes who we are, where we have been and where we are going. BTs thus find answers to these questions that become the key to shaping their identity. These answers also help them to make sense of their activities. Interestingly Stein and Brown (1997) argue that meanings are not abstract in the minds of individuals, but exist as a product of situated learning, where individuals are co-participants.

Gee (2001) suggests that the process of recognition is central to identity formation, noting that in any given context, an individual is recognised as a certain ‘kind of person’. Jansen (2001) associates recognition as being known as a facilitator and a performer in classrooms. Graven (2003) suggests confidence as one of the key pivots for evolving identity. From these standpoints, I deduce that identity is not a set of personal characteristics or beliefs. Instead, identity refers to the set of practices and expectations that shape participation in particular
contexts. Within the context of this study, a BT’s teaching approaches and the way he employs these approaches in classrooms defines him as a certain kind of person. Therefore, his stories become the indicators of how he shapes his professional identity in mathematics classrooms. The stories narrated by BTs are the conceptual link emphasising the attention to the kind of utterances that a narrator uses in his stories (Moje & Luke, 2009). This confirms the necessity to analyse the utterances of the participant BTs to understand their stories (Sfard & Prusak, 2005a&b), and hence their identities.

Kieran et al. (2003) observe that “learning mathematics uses a special form of communication known as mathematical discourse” (p. 28). Subsequently, Heyd-Metzuyanim and Sfard (2012) introduce two terms, those of mathematizing and subjectifying in the narratives of identity formation (Section 3.5.3). In their study, mathematics learning for students is seen as the interplay between these two concomitant activities. Communications or conversations about mathematical objects, figures, pictures, graphs, terms or concepts are considered to be mathematizing (Heyd-Metzuyanim & Sfard, 2012). Subjectifying is communicating the qualities of mathematizing or about the person who is engaged in mathematical discourse (Heyd-Metzuyanim & Sfard, 2012; Heyd-Metzuyanim, 2011). Heyd-Metzuyanim and Sfard (2012) use these tools to understand how students learn mathematics in classrooms (Learning-as-an-interplay-of-Mathematizing-and-Identifying, p. 133). I have borrowed this concept from this study to understand how BTs’ learn to become mathematics teachers. In my opinion, if these tools are useful to identify students’ mathematics learning, the same can be useful to understand BTs’ learning to become mathematics teachers.

These are the tools that I borrowed to analyse this study. During the preliminary analysis of the classroom observations, I separate BTs’ utterances into mathematizing and subjectifying (Section 3.6.1). Once identified, the subjectifying utterances are further scrutinised to identify if these are reifying. Sfard and Prusak (2005a) see identities as collections of stories about persons or as narratives about individuals. These stories are reifying, endorsable, and significant. They say;
The reifying quality comes with the use of verbs such as be, have or can rather than do, and with adverbs always, never, usually, and so forth, that stress repetitiveness of actions. A story about a person counts as endorsable if the identity builder, when asked, would say that it faithfully reflects the state of affairs in the world. A narrative is regarded as significant if any change in it is likely to affect the story teller’s feelings about the identified person (p. 16-17).

**Reifying** is the discursive activity of rendering the status of an object, which means attributing a person with permanent qualities and mental properties (Heyd-Metzuyanim & Sfard, 2012; Heyd-Metzuyanim, 2011; Sfard & Prusak, 2005a). BTs’ stories are **endorsable** if they faithfully reflect what was happening in classrooms. Sfard and Lavie (2005) clarify that endorsed narratives are accepted and labeled as **true** by a given community. These narratives emphasise mathematical theories, concepts or ideas. Narratives are **significant** if these endorsable utterances are likely to affect the BT’s (Storyteller’s) feelings (Sfard & Prusak, 2005a&b). Narratives perhaps bring about changes in him or in his classroom practices. Heyd-Metzuyanim and Sfard (2012) elaborate:

One way to operationalize the property of significance is to say that a story about a person will count as significant in the eyes of the storyteller if an alteration or removal of any of its main elements would change how the author feels about her protagonist (p. 8).

These changes are thus significant for a BT, who changes his classroom approaches accordingly. In my view, these are the benchmarks for BTs, shaping their professional identity. Wenger (1998) further elaborates identity as;

- **Negotiated experience.** It defines who we are by the ways we experience ourselves through participation as well as the way we and others reify ourselves
- **Community membership.** It defines who we are by the familiar and the unfamiliar
- **Learning trajectory.** It defines who we are by where we have been and where we are going (Wenger, 1998, p. 149).

The above section reinforces the notion that identity has multiple meanings (Moje & Luke, 2009). In the next section, I discuss identity as social practice.
2.4.2. Identity as social practice

From a social context, the mathematics classroom is seen as a community that constitutes its own norms and practices in service of developing shared mathematical knowledge (Goldsmith & Shifter, 1997). Similarly, Wenger (1998) challenges the assumption that learning is an individual process that has a beginning and an end, is independent of any activities and the result of someone teaching the other. The socio-cultural perspective, with its focus on interactions between individuals, culture and society, thus locates identity within the social and cultural practices of learning and meaning formation (Grootenboer et al., 2006). Professional identity of a BT is thus understood as a process of learning and meaning formation within the classroom setting.

In the discourse on identity, many researchers emphasise situated views of learning in which they emphasise the importance of identity formation in learning. This locates identity within communities of practice (Bishop, 2011; Niven, 2011; Sfard & Prusak, 2005 a&b; Graven, 2002; Gee, 2001; Wenger, 1998). Bishop (2011) further suggests: “learning goes beyond constructing new and flexible understanding and entails becoming a different person with respect to the norms, practices, and modes of interaction determined by one’s learning environment” (p. 36). A BT is thus recognised as a certain kind of mathematics teacher through his communities of practice (Moje & Luke, 2009; Sfard & Prusak, 2005a; Gee, 2001; Wenger, 1998).

Identity, mathematics and learning are thus linked to BTs’ interactions in classroom settings (Sfard & Prusak, 2005a). Such interactions activate their learning and shape their identities (Cobb, Gresalfi & Hodge, 2009; Moje & Luke, 2009). Graven (2002) finds that many teachers changed their understanding of what it meant to be a competent professional mathematics teacher. They “began to see learning as an integral part of being a professional, irrespective of one’s level of formal education” (Cited in Graven & Lerman 2003, p. 191).

BTs’ meaningful interactions with the members of the teacher community fill the gap between socio-cultural activities and learning (Sfard & Prusak, 2005b). These interactions and BTs’ utterances are useful for recognising a BT as a certain kind of a mathematics teacher.
The following section presents the notion of identities with the views from Gee; Wenger; Lave and Wenger; and Sfard and Prusak.

2.4.2.1 Views from Gee

Identity, according to Gee (2001) is “an important analytic tool for understanding schools and society” (p. 99). Identity indicates how learning changes who we are and creates personal histories of becoming a certain kind of a person within the context of our communities (Gee, 2001). Gee (2001) further argues that people can construct and sustain identities through discourse and dialogue. This refers to the choices of words that BTs use in their practices. Being recognised as a certain kind of a person for Gee (2001, p. 99) is part of identity formation (My emphasis in italics). Wenger (1998) may argue that being recognised is becoming a mathematics teacher in their communities of practice. This observation coheres with Wenger (1998) who emphasises that “the members of the community act as resources to each other, exchanging information, making sense of situations, sharing new tricks and new ideas as well as keeping each other’s company and enjoying their ‘work’ together” (p. 47). A BT in a mathematics teaching community can thus be recognized accordingly.

Gee (2001) finds research into identity to be imperative for understanding a community in their similar social practices. What people in the group share is allegiance to, access to, and participation in specific practices that provide each of the group’s members the requisite experiences (Gee, 2001, p. 105). The process through which this power works is participation and sharing as this author argues. A focus on identity thus provides a research tool to understand the communities of practice for BTs and the way they participate in these communities. His changing identity thus becomes a way to understand how he interacts with the members of this community (Gee, 2001). In this sense, “all people have multiple identities connected not to their ‘internal states’, but to their performances in society” (p. 99).

Gee (2001) identifies four identities as the ways to focus on how identities are formed and sustained. Firstly, Nature-identity; the source of this identity is nature, not society. “The process through which this power works is development” (p. 101). Gee (2001) further notes that Nature-
identities can only become identities because they are *recognised* by others or by self as meaningful when one continues to be the kind of person one is. Secondly, Institution-identity, which is a position one attains through an institution that authorises this position with rules, principles or traditions. Thirdly, Discourse-identity is recognised as an individual trait and is subjected to the discourse related to this person in a community (Gee, 2001). The manner in which other members talk about, and interact with this person makes him a certain kind of person in that community (Gee, 2001). Therefore, the BT’s utterances in mathematics classrooms can be crucial to recognise him as a certain kind of mathematics teacher. Lastly, Affinity-identity is the experience that is shared through practices with empathetic groups (Gee, 2001). These identities, according to Gee (2001), assist a person to be meaningfully recognised as a “kind of person” within his communities of practices.

Gee and Green (1998) complement Gees’ (2001) views on affinity-identity by linking this to communities of practice. They also link these to situated meanings, reflexivity and an ethnographic perspective. They observe that situated meanings are formed through various constructive activities. Incidentally, I observe that such views are useful when conversations are explored to identify the way a BT approaches teaching. It is also useful to portray their certain way of classroom practice (Section 2.4.1).

Views on identities that are drawn from Gee (2001) serve as a pivot between the community and the individual, so that each can be talked about in terms of the other (Wenger, 1998). In this study, becoming a part of the school community through social practice makes BTs *the master practitioners*, which brings an increased sense of identity for them, and makes their learning legitimate (Lave & Wenger, 1991, p. 111). My interpretation of master practitioner is to ‘become an experienced mathematics teacher’ who plays an active role in the mathematics classroom.

Gee (2001) emphasises identity as being recognised as a certain kind of a person. He concludes that the notion of identity “can be used as an analytic tool for studying important issues of theory and practice in education” (p. 100).
2.4.2.2 Wenger’s views

In a social context of learning, practice and participation are the means of shaping and re-shaping a newcomer’s professional identity (Wenger, 1998). In addition, he defines identity as ways of talking about how learning changes who we are. In connection to this, Gee and Green (1998) argue that, what is learned at one point becomes the resources for future learning.

I now lead the readers to two important themes of learning in this study that shapes BTs’ professional identity; that is learning a) by practice and b) by participation.

a) Learning by practice: The first theme refers to BTs’ learning by practice. Wenger (1998) describes practice as a shared history of learning (p. 93). He further observes that practice is not stable, but combines continuity and discontinuity. Learning in communities of practice involves mutual engagement, a joint enterprise, and a shared repertoire (Section 2.4.5.4)

Learning is the **engine of practice** that is ultimately produced by the members through negotiation of meaning (Wenger, 1998). Practice, therefore is an ongoing, social and interactional process (Wenger, 1998). Practicing members interact, do things together, negotiate new meanings, and learn from each other. In my opinion, these activities thus gradually assist a BT to make sense of his classroom practice that shapes his professional identity. Wenger (1998) links practice to identity by suggesting: “We not only produce our identities through the practices we engage in, but we also define ourselves through practices we do not engage in” (p. 164). As a result, “identities are likely to play a critical role in determining whether the process of learning will end with what counts as success or with what is regarded as failure” (Sfard & Prusak, 2005a, p. 19). Either way we learn.

One of the key components of communities of practice theory discusses identity as legitimate peripheral participation (Section 2.3.2.1). This provides a way to speak about the relations between newcomers and old-timers, about activities, identities, and communities of knowledge and practice. Communities of practice, according to Wenger (1998), are “the prime context in which we can work our common sense through mutual engagement” (p. 47). Furthermore, they play a vital role in negotiating **meaning**.
Developing a practice requires the formation of a community whose members can engage with one another and acknowledge each other as participants (Wenger, 1998). This results in identity becoming a negotiated experience for newcomers. Practice thus activates learning for a beginner who negotiates meaning. In this regard, Wenger (1998) points out that the negotiation of meaning involves the interaction of two constituent processes, namely, participation and reification.

b) Learning by participation: The second theme of learning refers to BTs learning by participation. It deliberates how the integration of a BT’s beliefs that he comes with and practice that he is obliged to follow within the school community bring meaning to his actions. Wenger (1998) finds participation and reification as two dimensions of practice and identity formation, influencing future approaches of newcomers as they learn new tactics to become old-timers. Lave and Wenger (1991) notice that learning is not merely a condition for membership, but an evolving form of membership that links our past with future. Wenger (1998) observes these as learning trajectories. Identities are thus formed as long-term, living relations between persons and their place, and participation in communities of practice.

As learning activates increased participation, individuals move from newcomer to old-timer status in the group (Lave & Wenger, 1991). They take on increasingly critical and complex group functions, they develop an augmented sense of identity as master practitioners, and they gradually appropriate the knowledge and skills that are characteristic of old-timer practitioners (Stein & Brown, 1997). We should read this together with Lave and Wenger (1991) pointing out that learning consistently occurs in communities of practice.

Wenger’s (1998) observations on the connection between identity, practice and participation serve to summarise this section on participatory learning that connects identity and practice as images of each other. He further suggests that identities are defined by combinations of participation as well as non-participation in communities of practice. Identity is thus shaped by reflecting our power as individuals and communities that assist us to locate ourselves within the social context. In this exercise, we also realise what we care about and what we neglect.
In this section, I discussed Wenger’s views on identity within the context of practice and participation as follows: Firstly, identity as negotiated experience defines who we are by the ways we experience ourselves through participation (Wenger, 1998). Secondly, identity as community membership defines who we are by the familiar and unfamiliar. This means that our identity is negotiated through participation and interpretations in a mix of familiar and unfamiliar ground (Wenger, 1998). In addition, he says: “What they learn and don’t learn makes sense only as part of an identity, which is as big as the world and as small as their computer screens, and which subsumes the skills they acquire and gives them meaning” (p. 41). Thirdly, identity as a learning trajectory defines who we are by where we have been and where we are going (p. 153).

The following section examines the views of Lave & Wenger (1998) on identity.

2.4.2.3 Views of Lave & Wenger

Learning provides a way to speak about the relations between newcomers and old-timers, identities, and communities of practice (Lave & Wenger, 1991). As learning involves practice and participation of a beginner, their actions at a particular moment suggest the situated meanings. Such meanings are located within the context of the classroom practices. This leads to form their actual identity that can evolve into their designated identity at a later stage (Sfard & Prusak, 2005b).

For Lave and Wenger (1991) the contexts of meaning are also relative to space and time. The meaning created in a particular classroom and time for BTs differs as the situation changes. Therefore, different persons behave differently in the same situation (Sfard & Prusak, 2005a&b; Gee, 2001). I argue that different BTs understand and shape their identity differently regardless of their similar classroom approaches as well as the meaning they form. As a result, their peripheral participation transforms into central participation that changes their location (space and time). For instance, Graven (2003) in her study observed that over a period of time, teachers eradicated ‘insecurity in relation to talking about or making sense of the new curriculum’ (p. 27). This is the change that is anticipated for a BT as he becomes an old-timer.

The new position for BTs comes with their full participation as experienced mathematics teachers, and their experience and authority are ‘recognised’ by others. According to Adler
“Becoming full member means becoming more knowledgeable, entails having access to wide range of ongoing activity in the practice – access to old-timers, other members, to information, resources and opportunities for participation” (p. 5). Changing perspectives is part of actors’ learning trajectories, developing identities, and forms of membership (Lave & Wenger, 1991).

I conclude this section by suggesting that identity includes our ability and our inability to shape the meanings that define our communities and our forms of belonging (Wenger, 1998; Lave & Wenger, 1991). Theories that are used to understand how BTs form meaning and how they make sense of their experiences are the focus of the next section.

2.4.2.4 Views from Sfard & Prusak

In this section, I explore the views of Sfard and Prusak (2005a) on identity that equates ‘identities with stories about persons’ (p. 14). This view is crucial in this study for two reasons: Firstly, BTs’ narratives on how they make sense of their activities can bridge the gap between learning and identity as I stated earlier (Section 2.4.2); secondly, Sfard and Prusak’s model is used to analyse BTs’ reifying utterances in this study (Chapter 3). While engaging in practice, BTs’ narratives are explored for manifestations of identity and meaning formation. Connelly and Clandinin (1990) suggest that people by nature lead storied lives and tell stories of those lives, while researchers describe such lives, collect and tell their stories, and write about the experience of these people, because these stories may have important significances.

Borrowing the concepts from Gee (2001) and other authors, Sfard and Prusak (2005a) observe that a person’s way of narrating his story may lead to his identity by telling who he is. Their key observations suggest that the “notion of identity proves helpful in dealing with issues of power and of personal and collective responsibilities for individual lives” (p. 15). These authors conclude that “identity talk makes us able to cope with new situations in terms of our past experience and gives us tools to plan for the future” (p. 16). Sfard and Prusak (2005a) take the notion of identity presented by Gee (2001) and Wenger (1998) further by equating identity building with storytelling. These are the stories the identity builders narrate about themselves, their activities and about their community. In this manner, identities are not only represented but
also constructed in and through the stories people tell about themselves and their experiences to others (Moje & Luke, 2009).

Sfard & Prusak (2005a&b) associate identity with “stories about persons” and subsequently define identity as a set of reifying, significant and supportive stories about a person. As the understanding of professional identity varies from individual to individual, BTs’ stories may also vary. Such stories could be collectively shaped and can be changed according to the authors’ (BTs) and recipients’ (readers) perceptions in due course (Sfard & Prusak, 2005b).

‘Being an active participant’ in the practices of social communities are more important for beginners in order to visualize their designated identities (Wenger, 1998). While visualising his identity, a BT may need to talk about it in terms of his experience that gives him a tool to plan for the future (Sfard & Prusak, 2005). For Wenger (1998) this tool is a certain practice that embodies a long and diverse process, which is referred to as reification. Negotiation of meaning thus takes place through such reifying actions. Reifying action takes various forms from a simple word to a complex sentence. Wenger (1998) considers reification as projecting ourselves onto the world. Reification thus shapes our experience.

For Heyd-Metzuyanim and Sfard (2012), reifying is the discursive activity of rendering the status of an object to something that was not previously treated to a certain level. In identity narratives, one’s stories dominate one voice; the stories of hopes, dreams and success, whose interactions and conversations therefore carry meanings of reality. In mathematics classrooms, mathematizing is the term used to identify the utterances that express ideas and concepts of mathematics (Heyd-Metzuyanim & Sfard, 2012). Subjectifying is the term used to identify the utterances that describe or explain the mathematizing utterances. According to these authors, subjectifying utterances are regarded as “problem-solver’s own moves”, (p. 130). Such utterances have an influence on the interlocutors as well as the listeners. In this study, BTs’ subjectifying utterances can be investigated “when one tries to decide whether they can count as identifying their power to reify and their significance in the eyes of the speaker” (p. 130).
Heyd-Metzuyanim and Sfard (2012) suggest mathematics learning as the interplay between concomitant activities of subjectifying and mathematizing in classroom practice. These authors also observe that mathematizing can go wrong in many ways. Therefore, “the basic condition for the effectiveness of mathematical communication is that all the interlocutors speak about the same objects (or at least the same realisations) when using a given word in a given context” (p. 129). Simultaneously, mathematizing and subjectifying intertwine, which makes sense in mathematics learning. The terms mathematizing and subjectifying are elaborated further in chapter 3 (Section 3.6).

In summary, I borrow the perception that identities are stories that an identifier tells about himself or about others (Sfard & Prusak, 2005a). This becomes the window to understand the world (community) of the beginner (BT) and the situation through his eyes. Consequently, their stories are evolving and are accepted for what they appear to be. Therefore, words (as well as silence and pauses) are crucial, not only as shaping one’s actions (Sfard & Prusak, 2005a&b) but also representing and constructing identities in and through these stories (Moje & Luke, 2009).

At this juncture, I discuss the views on BTs’ professional identity within the perspectives of their classroom practice in the following section.

### 2.4.3 Identity as classroom practice

The identity discourse so far examined suggests that situated meanings shape designated identity for BTs (Sfard & Prusak, 2005a&b; Gee, 2001; Wenger, 1998; Lave & Wenger, 1991). Clandinin (1989) in a study with beginner teachers observed that even within the first year of teaching, there is a change expected in their understanding of personal meaning in the way they know their teaching approaches. Classrooms thus play a crucial role in BTs’ learning to become a teacher. This section discusses the identity discourses within the context of classroom practice.

The focus on classroom activities is important in this study as most identity discourses for BTs are based on the events that take place within the classrooms. Discourse on identity is also progressed to a level of discussion on professional identity of teachers. Against this backdrop, I
explore the views from Beijaard et al. (2000) and the views of Grootenboer & Zevenbergen (2008) on professional identity.

2.4.3.1 Views from Beijaard, Verloop & Vermunt

Beijaard et al. (2000) introduce three major ideas to the notion of identity. These involve:

a. teachers’ knowledge of their professional identity
b. how they perceive themselves as teachers, and,
c. what factors contribute to these perceptions (p. 749).

According to Beijaard et al. (2000), these concepts are closely associated to being experts in subject matter, pedagogy and didactics that make teaching and learning meaningful for teachers and students (p. 751-752).

For Beijaard et al. (2000) teachers’ perception of their professional identity reflects their personal knowledge as well as their understanding of what it means to be a teacher. They further elaborate that teachers’ perception on the professional identity affects their efficacy and professional development as well as their ability and willingness to cope with educational change and to implement innovations in their own teaching practice. Identity formation is also an ongoing process that interprets oneself as a certain kind of person. For a BT, this involves the way he interacts in a community (his utterances) as well as forming affirmative attitudes towards educational changes (his thoughts). Beijaard et al. (2000) describe teachers’ professional identity in terms of being experts in subject matter, pedagogy and didactics. According to Beijaard, Meijer and Verloop (2004) teachers are expected to think and behave professionally, not simply by adopting professional characteristics, but including knowledge and attitudes. This suggests a close link between professional identity and their teaching approaches (Beijaard et al., 2004).

During the period of apprenticeship, a BT faces difficulties in negotiating new meanings at the workplace as his beliefs and experience differ from his actual identity at that time (where he previously belonged – personal identity). For instance, teachers believe that students learn mathematics when the teacher makes sense of it for them. Therefore, they believe that teachers should model mathematical thinking and encourage students to construct and evaluate
conjectures (Goos et al., 2004). One of the outcomes of such measures is that these students form an identity together with the BT in their mathematics classrooms (mathematics identity). As a result, learning mathematics becomes interesting, meaningful and enjoyable (Ollerton, 2009; Manyeli, 1994; Sidhu, 1994; Blair, 1982).

Beijaard et al. (2000) further observe that the teachers’ perceptions of their professional identity shape their ability to handle educational changes and their capacity to improvise during the classroom activities. From a professional development point of view, identity is an answer to many questions such as ‘‘who do I want to become?’’ (Brown & McNamara, 2011; Beijaard et al., 2004; Wenger, 1998). Gee (2001) refers this as recognition that is understood as an identity that is produced and reproduced in the ways in which people talk to and about others in discourse and dialogue.

Consequently, learning goes beyond constructing a new identity that entails becoming different persons with respect to practices and modes of interaction determined by one’s learning environment (Sfard & Prusak, 2005a&b). Bishop (2011) takes this further and suggests that we learn who we are, and the way we learn affects who we become. In teachers’ own words, identity formation is conceived as an ongoing process that involves the interpretation and reinterpretation of experiences that continually inform through self-evaluation (Beijaard et al., 2000).

In the following section, I discuss the observations from Grootenboer and Zevenbergen, who take classroom practice, mathematics identity and teacher identity to a different level.

2.4.3.2 Views of Grootenboer & Zevenbergen
While Beijaard et al. view identity of teachers as the way they perceive themselves as teachers, Grootenboer and Zevenbergen (2008) consider identity as a unifying and connective concept that brings together elements such as life histories, affective qualities and cognitive dimensions. These authors find identity in how individuals know and name themselves, and how an individual is recognised. Grootenboer and Zevenbergen (2008) adopt Wenger’s social theory of learning that relates to a sense of ‘community of practice identity’ where identity is a constant process of becoming by negotiating who we are. For mathematics teachers, teacher identity
involves positioning themselves within the discourses of education in general and mathematics teaching in particular.

BTs’ approach towards mathematics learning can be different from the one of experienced teachers. BTs may live every moment of their classroom practice and perhaps imitate old-timers, while engaging with mathematics teaching. Specifically, these authors emphasise the cognitive aspects of knowing mathematics and thinking like a mathematician. Clandinin (1989) observes that learning to teach involves the reconstruction of their lived experience of teaching through which the teachers come to know their classrooms. This allows them to cope with variations as they reconstruct the stories. It will be then interesting to see how novice teachers would develop knowledge about their classrooms and live these moments everyday of their teaching.

However, mathematics is not the only issue. Whatever happens in a mathematics classroom encourages learning, whereby students are the recipients and teachers are the prime agents to activate learning (Lasky, 2005). Grootenboer and Zevenbergen (2008) illustrate the relevance of this view using three aspects of mathematics classroom as shown in Figure 2.5:

![Figure 2.5 Three aspects of a mathematics classroom](image)

In this model, mathematics students and the teacher are given equal importance in the mathematics classroom. This model suggests a democratic approach that activates the efficacy in learning mathematics (Grootenboer & Zevenbergen, 2008). This model also suggests the idea of relationships which are important in developing an effective mathematics classroom. In support of this view, Grootenboer and Zevenbergen (2009) observe that teaching is not a knowledge
base, but is an action. Teacher knowledge is only useful to the extent that it interacts productively with all the different variables in teaching. Knowledge of subject, curriculum or teaching methods are needed to be combined with teachers’ own thoughts and their views as they engage in something of a “conceptual dance” (p. 264). This model suggests equal roles for mathematics learning, teacher and students that shape the identities for teacher and the students within the context of students’ mathematics learning. Grootenboer and Zevenbergen (2008) conclude: “Students’ (and teachers’) identities incorporate a range of dimensions, including knowledge, abilities, skills, beliefs, dispositions, attitudes and emotions related to mathematics and mathematics learning – their mathematical identity” (p. 244).

Grootenboer and Zevenbergen (2000) consider mathematics teaching as the interplay between mathematics activity and the content knowledge of mathematics. According to Sfard and Prusak (2005), this interplay results in effective learning. Therefore, teachers need to engage in a dance of agency (Grootenboer & Zevenbergen, 2008) and decide when to encourage students’ own agency.

In brief, a BT shapes his professional identity through authentic practices and participation (dance of agency) in mathematics classrooms. Through such practices, he positions himself as a person who behaves in a certain way, and is recognised accordingly among the members of the community as that kind of a person.

I summarise the above views on identity in Table 2.1:
Table 2.1: Summary of identity as described by various authors

<table>
<thead>
<tr>
<th>Author</th>
<th>Identity discourse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sfard and Prusak (2005)</td>
<td>Identity is a set of reifying, endorsing and signifying stories about a person.</td>
</tr>
<tr>
<td>Gee (2001)</td>
<td>Identity is a tool to measure one’s action and to be recognised as a certain kind of person.</td>
</tr>
<tr>
<td>Beijaard et al. (2000)</td>
<td>Professional identity of a teacher is associated with his expertise in subject matter, pedagogy and didactics. Identity is to know who I am and who I want to become.</td>
</tr>
<tr>
<td>Grootenboer and Zevenbergen (2000)</td>
<td>Identity is how an individual knows and names himself and is recognised.</td>
</tr>
<tr>
<td>Wenger (1998)</td>
<td>Identity is a way of talking about, how learning changes who we are, by practicing and participating.</td>
</tr>
</tbody>
</table>

Section 2.4 expounded on the meaning of the term identity as narrated by various authors. The key words that frequently surface in the professional identity discourse from this discussion are; learning, being a certain kind of person, being an expert, confidence and recognition, whereby their actions are reified. I summarise the discourse on identity by indicating some of the perspectives of identities indicating how these views are used in this study (Table 2.2).

Table 2.2: Notion of identity in this study

<table>
<thead>
<tr>
<th>Key words on identity</th>
<th>Authors and supporters</th>
<th>What it means in this study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Being certain kind of person</td>
<td>Heyd-Metzuyanim and Sfard (2012); Grootenboer and Zevenbergen (2008); Sfard and Prusak (2005); Gee (2001); Jansen (2001).</td>
<td>Being recognised as a certain kind of mathematics teacher through meaningful actions; Being known by others/self as a certain kind of person</td>
</tr>
<tr>
<td>Confidence</td>
<td>Graven (2003); Beijaard et al. (2000)</td>
<td>Becoming an old-timer through learning and gaining experience</td>
</tr>
<tr>
<td>Recognition</td>
<td>Cobb (2011); Gee (2001)</td>
<td>Being recognised as an active member of the mathematics community</td>
</tr>
</tbody>
</table>

I conclude the discussion on identity by observing that conceptualisation of identity ranges from an emphasis on individual teachers’ beliefs about themselves (Knowles, 1992) to the stories teachers tell about themselves (Drake, Spillane & Hufferd-Ackles, 2001; Connelly & Clandinin, 1999) and to the ways that teachers participate in particular types of activities (Kazemi & Franke, 2004). When a BT’s actions make sense to himself and to the community (Sfard & Prusak, 2005), the meaning that is formed helps him to be a certain kind of person (Gee, 2001).
The discourse on identity refers to the multiple nature of identity that suggests its fluid and changing nature (Sfard & Prusak, 2005a&b; Gee, 2001; Wenger, 1998). This indicates that facets of identity may co-exist simultaneously in a single individual. For teachers, significant identity facets may include professional identity (Clarke & Hollingsworth, 2002).

The next section explores various strands of identities in order to understand how identities are shaped and amalgamated into BTs’ professional identity.

2.4.4 Professional identity

So far, the discussion focused on learning that makes sense of one’s activities and practice which progressed on to the discussion on identity. An important element of BTs’ learning experience can be expressed as professional identity. In this section, I discuss professional identity as a single cable of various strands of identities namely: Personal Identity, Teacher Identity, Mathematics Identity, and Communities of Practice Identity. The individual strands of these identities are also discussed in order to understand how these strands become a single cable of BTs’ professional identity.

Beijaard et al. (2000) emphasise that teachers’ professional identity affects their ability to grow professionally. This influences how BTs implement innovations in their own teaching practices that find new meanings in their learning to become an old-timer. From this point of view, Beijaard et al. (2004) argue that professional identity is something teachers use in order to make sense of themselves as teachers. Professional identity is thus associated with pedagogical content knowledge and skills according to Grootenboer and Ballantyne (2010). The content knowledge influences a BT’s teaching approach. A study by Ballantyne (2007) reveals that pedagogical content knowledge and skills are important to teachers in the early stages of their careers. Teacher identity for instance incorporates their personal knowledge, beliefs, values, emotions and practices about teaching, about the disciplines they are teaching and about themselves as educators (Grootenboer et al., 2006). This is linked to professional development programmes and professional identity, changing BTs’ beliefs and attitudes that “lead to changes in classroom practices” (Clarke & Hollingsworth, 2002, p. 949).
From this point of view, there is a need to consider various strands of identities that construct, reconstruct and shape an ideal model of professional identity. Exploring aspects of identities such as a BT’s personal identity (where he comes from, how he views himself and his ontology), his mathematical identity (his relationship to mathematics) and teacher identity (his epistemology and his pedagogy) need to be discussed in detail. The notion of different identities is complex. Identities do not exist individually in this study – they are intertwined and interconnected. However, these are explored individually to facilitate effective analysis in this study (Section 2.4.5). The emerging identities thus will present the BT as a certain kind of person within the community of practice. These identities are illustrated in Figure 2.6, in order to highlight how these intertwine to become professional identity.

I use Wenger’s perspectives extensively on learning (belonging, becoming, experiencing and doing) in order to shape the strands of identities (personal identity, teacher identity, mathematics identity and communities of practice identity). I borrow a model from Kilpatrick, Swaford and Findel (2001) to demonstrate how these strands are interwoven yet are independent. The model helps the reader to understand how BTs shape their professional identity through various classroom practices.

BTs need to articulate identities through a continuous learning process. The learning trajectories thus assist them to define these identities. For instance, the knowledge and the experience a BT attains so far may display his attitudes and beliefs (Personal identity) in classrooms. Kaasila (2007) considers a person’s mathematics identity to be part of his narrative identity. He observes, “[O]ne’s mathematical identity is manifested when telling stories about one’s relationship to mathematics, its learning and teaching” (p. 206). In this manner, all claims about mathematics identity are also applied to teacher identity, according to Felix (2014).
When people engage in an activity as a team in social settings using the tools available to them, they are building their identities as well as working towards their designated professional identity (Lasky, 2005; Tharp & Gallimore, 1988). The approach that a BT takes in a classroom generates a feeling of belonging to one community (Boaler, et al., 2000) within which, all members shape their identities individually and collectively.

### 2.4.5 Intertwined strands of Professional Identity

In this section, I present and discuss the four identities (Personal identity, Teacher identity, Mathematics identity and Community of practice identity). These identities are integrated, fluid and interwoven. Conceptualising BTs’ thoughts and actions are socially negotiated but individually experienced and displayed (Marsh, 2002). This may infer that the study needs to explore these four strands of identities in order to capture both the social and the individual aspects of BTs’ professional identity.

#### 2.4.5.1 Personal identity

Many authors observe that identity is influenced by personal, social and cognitive responses (Grootenboer & Ballantyne, 2010; Flores & Day, 2005; Beijaard et al., 2004; Wenger, 1998; Woods & Jeffrey, 1996; Kelchtermans, 1996). There is continuing debate about whether an
individual has one identity with many aspects, or if they have multiple aspects of identities (Grootenboer et al., 2006).

Emphasising the importance of personal identity, Wenger (1998) observes that even our private thoughts make use of concepts, images and perspectives that we understand through our participation in social communities. Lasky (2005) views personal identity as how individuals think (for instance BTs’ willingness to learn) and act (BTs’ attitudes and approach in mathematics classrooms) within the social and cultural structure of the community in which they live. Beijaard et al. (2000) emphasise that the personal dimension in teaching is correlated to how a teacher’s personal life experiences from the past interweave with his professional life.

According to Flores and Day (2005), the personal response of a person and the emotional climate of a community (love, care, joy, pride, etc.) influence his identity. The individual capacity is what an individual brings with him to the school setting. These involve commitment, a willingness to learn and to view learning as on-going and substantive knowledge about new ideas (Lasky, 2005). The implication is that identity is influenced by personal, social and cognitive responses (Flores & Day, 2005, Chakalisa, Motswiri and Yandila, 1995). Therefore, a BT’s *lived experience of engagement in practice* (Wenger, 1998, p. 51) constitutes part of his teacher identity and personal identity.

The *personal identity* that a BT develops in a particular context concerns the extent to which he identifies with others' expectations for competent teaching in that context (Gresalfi & Cobb, 2011). In identifying with what counts as competent teaching, obligations-to-others become *obligations-to-oneself* for him (p. 275). In this regard, these authors illustrate that “changes in the types of instructional practices with which teachers identify, and thus in their personal identities as mathematics teachers involve changes in their motivations for teaching” (p. 271). Graven (2003) observes that there is power in understanding one’s own capacity and limitations that help to see learning as an integral part of being professional. Thus, they shape their professional identities by combining parts of their past experience and parts of their present (Flores & Day, 2005) as a beginner with a sense of purpose for teaching mathematics and being a mathematics teacher.
Through this discussion, I observe that a BT’s personal beliefs and attitudes change as his approaches in the classroom practice change (Flores & Day, 2005; Clarke & Hollingsworth, 2002). Lasky (2005) in her study concludes that a sociocultural approach to understand teacher identity necessitates examining individual action. She quotes Wertsch (1991) suggesting “priority is given to the social contexts and cultural tools that shape the development of human beliefs, values, and ways of acting” (p. 900). This in turn changes one’s personal identity and other identities. Against this backdrop, in the following section, I discuss the perspectives of teacher identity.

2.4.5.2 Teacher identity

By teachers’ identities, we mean their sense of self as well as their knowledge and beliefs, dispositions, interests, and orientation towards work and change (Drake et al., 2001). Teacher identities according to Jansen (2001) are “described as the way teachers feel about themselves professionally, emotionally and politically given the conditions of their work” (p. 242). In Lasky’s (2005) view, teacher identity is formed as teachers evolve through their career, until they become experienced. She further suggests that teacher identity is how they define themselves as teachers. Clarke and Hollingsworth (2002) note that the notion of teacher change is open to multiple interpretations including those that are associated with a particular perspective on teacher professional development. For instance, teachers seek to change in an attempt to improve their performance or to develop additional skills or strategies, and this change is a personal development (p. 948).

Carrim (2011) suggests two aspects on teacher identity: teachers as workers and teachers as professionals. The view is that a teacher as a professional requires frequent professional development that helps him to change his beliefs and attitudes (Clarke & Hollingsworth, 2002). These authors further suggest that such changes will lead to changes in classroom practice and behaviours, hence a BT’s teacher identity. In this sense, teaching is much more than the transmission of knowledge that shapes their teacher identity (Beijaard et al., 2000).
When BTs engage in classroom practice, they see and hear things that change their approaches in mathematics teaching (Franke, Fennema & Carpenter, 1997; Nelson, 1997). Teacher identity is thus closely associated to personal identity that includes commitment so that they attain the ‘joy of the work’ (Flores & Day, 2005). Through their task performing exercise, they may learn their new roles and new responsibilities that make them experienced teachers (Flores & Day, 2005). Teacher identity is thus conceptualised in terms of the ways BTs engage in classroom activities, for instance, classroom instructions. According to Grootenboer and Ballantyne (2010), teacher identity incorporates their personal knowledge, beliefs, values, emotions, their practice about teaching, what they think and do, about themselves as educators, and their sense of who they are. It is useful to connect the nature of professional development activities with the ways teachers participate in classrooms (Cobb, 2011) and outside the classrooms. The treatment of identity therefore acknowledges both social structure and personal agency.

For mathematics teachers, teacher identity involves positioning themselves within the discourses of education in general and mathematics teaching in particular (Cooney & Shealy, 1997). Teachers are learners within the contexts of communities of practice in which they are participants (Borko, 2004), who consistently interact with students in the mathematics classroom. Thus, learning becomes the vehicle for the evolution of practice and the inclusion of newcomers for growing professional identities. The strategic task for the community including BTs, according to Jansen (2001), is to create dialogues of meaning between teachers’ understanding of the teacher identity in transforming education and to know what is in their best interests.

I conclude this section by suggesting that a BT’s teacher identity and his sense making are greatly invested in his classroom practice. This understanding calls for a discussion on the mathematics identity of BTs.

2.4.5.3 Mathematics identity

Learning mathematics in schools involves becoming a ‘certain type’ of person with respect to the various practices of a community (Anderson, 2007). As students are engaged in learning mathematics for a significant period of their school life, they come to learn how to participate in many mathematic activities. They make sense of the lessons within that context (Boaler et al.,
Simultaneously, when students become actively engaged in efforts to make sense of the mathematics they study, the mathematics teachers’ role is critical and meaningful because they engage in shaping a mathematics identity for them and for students (Anderson, 2007; Goldsmith & Shifter, 1997).

“If a teacher is to be effective in developing students’ mathematical identities, then the teacher must himself have a well-developed mathematical identity” (Grootenboer & Zevenbergen, 2008, p. 246). Mathematical identity, according to these authors, involves significant mathematical knowledge and skills, a positive attitude towards the subject and a sense of joy and satisfaction in undertaking mathematics practice for students as well as for teachers. According to Smith (2006), “[t]o develop a middle ground for teaching, prospective teachers would need to feel secure in their own identity so that they can take risks and imagine the teaching of mathematics as if it could be otherwise” (p. 622). Grootenboer and Zevenbergen (2008) elaborate this further:

If the goal of mathematics education is to develop a strong mathematical identity, then the critical focus is the relationship between the student and the discipline of mathematics. The facilitating context for the development of this relationship is the classroom community, and specifically the teacher, but the classroom community is temporal, and it will be the mathematical identity that will remain (p. 245).

However, the mathematics teaching strategies are drawn from a general pool of teaching strategies, like any other subject, as they are taught (Brown & McNamara, 2011). Grootenboer and Zevenbergen (2008) argue that mathematical pedagogy is fundamentally different from other subject pedagogies, because of the nature of practices that mathematics education requires compared to other disciplines. Willoughby (1990) asserts a similar point:

“[T]he way in which people originally learn Mathematics plays an important role in determining whether they are able and willing to use it subsequently to help understand the world around them and solve problem using their Mathematics” (p. 43).

The mathematical epistemology that underpins the teacher’s pedagogy significantly influences the mathematical identity for students and for teachers (Grootenboer & Zevenbergen, 2008; Jansen, 2001). The teacher’s role in facilitating the development of students’ mathematical identity is one that bridges the gap between students and mathematics (Grootenboer & Zevenbergen, 2008). With this understanding, BTs are able to negotiate the meaning within the community of practice that improves mathematics learning. Interestingly, in the Lesotho context,
even though mathematics teachers enjoy being members of communities of practice, their primary identity is closely associated to being a mathematics teacher. One of the reasons for limiting their practice within the school community is the lack of continuous professional support (MoET, 2013; Cockcroft, 1982). This calls for a discussion on the communities of practice identity for BTs.

2.4.5.4 Community of practice identity

The notion of community of practice identity is borrowed from Wenger (2002), who defines that communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly. Gee and Green (1998) suggest that members, through their face to face interactions, construct the very patterns of practice that define a community. According to Wenger (1998), communities of practice are the prime context in which we can form meanings through mutual engagement. In support of this view, Grootenboer and Zevenbergen (2008) find Wenger’s social theory of learning relates to a sense of ‘community of practice identity’ where identity is a constant process of becoming by negotiating who we are within a community. These definitions suggest that the members in a community when follow certain practice, they mutually negotiate meaning, hence they shape their community of practice identity.

Community of practice is a set of relations among persons, activity and the world through meaningful participation (Lave & Wenger, 1991). From a social perspective, Goldsmith and Shifter (1997) present the classroom as a mathematics learning community that constitutes its own norms and practices in the service of developing shared mathematical knowledge. With respect to the BT’s experience in communities of practice, the classroom and the mathematics community are important for understanding what they mean to do and learn mathematics, and what one comes to believe about the nature of mathematics. In my opinion, communities of practice strengthen BTs’ professionalism by broadening their view to an external world to observe what is happening there.
Wenger (1998) proposes three dimensions of the relations through which practice and community associate. These dimensions are mutual engagement, a joint enterprise and a shared repertoire. He further elaborates that practice exists because people are engaged in actions whose meanings they negotiate with one another. Joint enterprise keeps communities of practice together through a collective process of negotiation that reflects mutual engagement. Lastly, Wenger talks about a shared repertoire that creates resources for negotiating meaning. Through these dimensions, BTs can strengthen their practices in relation to their community that shapes their identity as a product of a joint effort.

I conclude this section by quoting Roberts (2006): “One of the strengths of the communities of practice approach is that it can be applied in a wide range of organisational settings. However, this can also be viewed as a weakness, since it may encourage its inappropriate application” (p. 634). It will be interesting to explore how well BTs move from being a newcomer to becoming an old-timer through such limitations of communities of practice.

2.4.6 Synthesising all identities

A model of professional identity is portrayed through the strands of personal identity, teacher identity, mathematics identity as well as community of practice identity. As these are constructed, it is possible that they overlap, intertwine and enrich each other and shape the professional identity. These identities are shaped, re-shaped or de-shaped through learning processes as well as associating them with different levels of meaning in order to shape and mutually strengthen these identities. Learning occurs through practice and participation, which are the foundation for building and shaping professional identity. Even though these identities are elongated separately, they should not be identified as independent, separate or as growing individually. As identities are intertwined, they empower each other and finally appear as a single and unique structure of professional identity. Table 2.3 summarises the characteristics of these identities as used in this study.
Table 2.3: Key characteristics of identities in this study

<table>
<thead>
<tr>
<th>Strands of Identities</th>
<th>Characteristics used in this study</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Personal identity</td>
<td>Personal knowledge and experience that shapes attitudes and beliefs in classroom approaches</td>
</tr>
<tr>
<td>2. Teacher identity</td>
<td>Evolution of teachers themselves to become mathematics teachers based on their experience and classroom practice. A shift in position of the BT and his pedagogy</td>
</tr>
<tr>
<td>3. Mathematics identity</td>
<td>Engaging with significant mathematical knowledge and skills, positive attitude towards the subject, a sense of joy and satisfaction in undertaking mathematics practice for students as well as for teachers</td>
</tr>
<tr>
<td>4. Community of Practice identity</td>
<td>Negotiating who we are in relation to students, mathematics teachers and teaching communities</td>
</tr>
<tr>
<td>Professional identity</td>
<td>Intertwined strands of identities answering who we are and where we are going. The meaning of identity is socially negotiated, individually shaped and professionally programmed.</td>
</tr>
</tbody>
</table>

2.4.7 A brief reminder of the research goal

In this chapter I have explored the relevant literature in order to gain insight into the way BTs achieve their professional identity. As explained in Chapter 1, the study aims to follow a selected number of BTs during their classroom practice to shed light on how their identities change as they make sense of being a professional mathematics teacher. The objective of this study is to follow them and narrate their stories by exploring how they shape their professional identities. This is achieved by asking how they embody various identities into their professional identities as well as analysing their classroom practice.

2.5 CHAPTER SUMMARY

The literature that is explored in this chapter so far offers key views on identities from Wenger (1998), Lave and Wenger (1991), Sfard and Prusak (2005a), and Gee (2001). Other views were also examined (Beijaard et al., 2000; Grootenboer & Zevenbergen, 2008) to understand the approaches that are taken by BTs in classrooms along with their involvement in mathematics teaching.
From the literature review, it can be seen that **learning** becomes the key for any change that may occur in BTs’ teaching approaches. The discussion suggests learning as **sense making** through which participants negotiate their own **meanings**. These are central for **shaping identities** through personal identity, teacher identity, mathematics identity and communities of practice identity. These are the strands shaping a single cable of professional identity in this study. The views from Sfard and Prusak (2005), Gee (2001), and Wenger (1998) were used in this chapter for realising these strands of identities.

The study explores the key question; how do BTs shape their professional identity? The literature extensively explored the aspects of identity in order to better understand the research question and its relevance. This suggested that meaning formation through **participation and practice** are key for learning. Learning thus shapes one’s identity (Wenger, 1998). The literature further suggested that BTs’ classroom approaches embrace sense making (Sfard & Prusak, 2005a) for them and for the members in the community with whom they interact. The utterances in BTs’ classroom observations can be separated and categorised into mathematizing and subjectifying from which subjectifying utterances are examined further (Section 2.4.1 & 3.5.4).

Analysing these utterances helps to understand BTs’ identities that intertwine and shape their professional identity. Therefore, their sense making activities in classrooms are considered as crucial to elicit the answers to the research questions identified below:

- How do BTs shape their professional identity in their first three years of teaching?
- In particular, this study explores how BTs embody their personal identity, teacher identity, mathematical identity and community of practice identity into their professional identity.
Teachers choose to tell a particular version of events, and this choice predicates a selective account governed by the teacher’s own self-image (Brown & McNamara, 2011).

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

This study aimed to investigate how BTs shape their professional identity in their first three years of teaching. This chapter reports on the research process. A classroom-based research approach was selected for this study.

Section 3.2 examines the orientation and methods used in this study which were qualitative in nature. Section 3.3 examines the research design. Section 3.4 explores methods and techniques of the analysis. Section 3.5 discusses the analytic tools. Section 3.6 covers validity and ethical issues. Section 3.7 summarises the research design. The last section then concludes the chapter.

3.2 ORIENTATION

In a broader sense, this study is embedded in the social theories of learning (Wenger, 1998; Lave & Wenger, 1991). The study focused on BTs’ lived experience, therefore their classroom practices were observed and analysed to understand how they made sense of their practices. The study also attempted to explain how their sense making processes contributed to shaping their professional identity. Equally important was how they understood the social world within the context of their classrooms (Atkinson & Hammersley, 2007; Cohen et al., 2007; Geertz, 1973).

Mertler and Charles (2008) find that researchers who engage in qualitative methods are concerned with how people make sense of their daily lives. These authors also observe that qualitative data are analysed “logico-inductively, a thought process that uses logic to make sense of observation” (p. 149). They further argue that this method is “typically interested in learning what participants in a study are thinking and why they think what they are thinking” (p. 194). In this study, this view is important for two reasons. Firstly, it justifies the observation of BTs in their classroom practices as a tool to gather data for the study. Secondly, this view suggests
ethnography as the research method (Section 3.2.2), which investigates BTs’ interactions within the classroom settings.

3.2.1 Interpretive study

The interpretive paradigm, according to Cohen et al., (2007) is characterised by a concern for the individual, that is, to understand the subjective world of human experience. This approach helped me to make sense of the events that took place in BTs’ mathematics classrooms. The interpretive paradigm thus linked the study to the proposed qualitative analysis, because qualitative data analysis makes sense of data in terms of the participants’ understanding of the situation (Cohen et al., 2007; Gay, Mills, & Airasian, 2006). Eisenhart (1988) observes that the purpose of doing interpretive research is to provide information on how participants make sense of the world (classroom and community in this study).

In order to make BTs’ stories convincing, the researcher needs to be part of their lives so that the researcher also understands the meaning of what they do and why they act in a certain way (Sfard & Prusak, 2005a; Gee, 2001). Within the interpretive paradigm, the situated meanings are formed at any particular moment of the activities in the classrooms. In this study, the interpretive paradigm was used to analyse BTs’ utterances in classrooms. The notion of identity can thus be understood through these interpretations, which can be a perfect link between “learning and its sociocultural context” (Sfard & Prusak, 2005, p. 15).

In the following section, I discuss the ethnographic approach to examine how this research process assists me to understand BTs shaping their professional identity.

3.2.2 Ethnography

In this section, I justify the selection of ethnography for this study. Ethnography is a research process involving methods of inquiring, describing, understanding and interpreting a culture in-depth from the view point of its participants (Atkinson & Hammersley, 2007; Cohen et al., 2000; Punch, 1998; LeCompte & Preissle, 1993; Goetz & LeCompte, 1984).

According to Mertler and Charles (2008), ethno refers to human cultures and graphy means description of their actions that suggests ethnography to be a research process used to study
human interactions in social settings. When studying a group of people, ethnography begins with the assumption that the shared cultural meanings of the group are crucial to understand their behaviour (Punch, 1998).

Ethnographic research involves an in-depth description and interpretation of the shared or common practices and beliefs of a culture, social group, or other community (Mertler & Charles, 2008). According to Punch (1998) an ethnographic approach is, “an excellent way of gaining insight into a culture or social process ... and sensitize[s] us to the cultural context and symbolic significance of behaviour we need to understand in a way that other research approaches cannot” (p. 162). Mertens (2005) takes this further and suggests that, by entering directly into the lives of the people being studied and by interacting with them, the researcher could reach a comprehensive understanding of the beliefs and the approaches of these individuals.

Atkinson and Hammersley (2007) describe the key characteristics of ethnographic research as follows: It has a tendency to work with unstructured data. The research focuses on a small number of cases. The analysis of data also involves explicit interaction of meanings and functions of human actions. Atkinson and Hammersley (2007) argue that if the focus of any study is the production of knowledge, rather than setting out to test hypotheses, exploring the nature of particular phenomena then helps to achieve this through ethnographic study. In their words, “ethnography has been directed towards contributing to disciplinary knowledge rather than towards solving practical problems” (p. 253).

Atkinson and Hammersley (2007) further observe that “the ethnographic methodology in recent years has been based on a rejection of positivism supporting the argument that social research should adopt scientific method” (p. 251). When studying a group of people, ethnography begins with the assumption that the shared cultural meanings of the group are crucial to understanding behaviour (Punch, 1998, p. 60). This method of research empowers the researcher to learn how people make sense of their everyday world, how participants achieve and sustain interaction in a social encounter, and how they seek to understand social accomplishments in their own terms (Cohen et al., 2007). Ethnographic research also unveils the meanings of situations by exploring stories (Sfard & Prusak, 2005a&b; Gee, 2001). These stories are actively constructed by BTs’
narratives and emerge from them (Cohen et al., 2000; Wenger, 1998). Learning thus takes place. In my view, an ethnographic approach can thus assist me to understand how BTs shape their professional identity.

Hammersley (1992) recognises that the ethnographer’s representation of reality makes some phenomena represented relevant and others irrelevant. These are multiple, non-contradictory and valid descriptions and explanations of the same phenomenon. According to this author, in ethnographic study, descriptions are about particulars of objects and events in specific time-place-locations. The ethnographic perspective is used to guide a discourse analysis (Spindler & Spindler, 1987). Subsequently, Gee and Green (1998) suggest that an ethnographic perspective involves analysing the choices of words and actions that members of a group use to interact with each other within and across time, actions and activity. In conclusion, Gee and Green (1998) quote Heath (1982):

Discourse analysis … when guided by an ethnographic perspective, forms a basis for identifying what members of social groups (e.g., a classroom or other educational setting) need to know, produce, predict, interpret, and evaluate in a given setting or social group to participate appropriately (Heath, 1982 – cited in Gee & Green, 1998, p. 126).

According to Emerson, Fretz and Shaw (1995), ethnography is an active enterprise that incorporates dual impulses of observing and analysing one’s activities. The characteristics of an ethnographic study thus consist of participant observation (full or partial), socio-cultural description and making theoretical connections (Stewart, 1998). One of the disadvantages of ethnographic research according to Atkinson and Hammersley (2007) is that it relies on what people say rather than what they do and what is ‘observable’ (p. 251). In this study, in order to understand what BTs do in classrooms, I used observation and interview approach for this study. This also helped me to scrutinise what BTs say.

Subsequently, such a traditional ethnographic approach is seen by some as reifying social phenomena claiming illegitimate expertise over people studies based on their relationships of hierarchy and control (Atkinson & Hammersley, 2007). On other hand, it has been argued that the ethnographic study is able to get closer to the people studied, discover their behavior and to make sense of their experience (Atkinson & Hammersley, 2007). In traditional or classical ethnography, the researcher is typically unfamiliar with the cultural setting under study and
enters the setting with a broad, undefined purpose (Morse & Richards, 2002). This was not the case in this study, as I am fully occupied in teaching. The familiarity of the setting thus helped me to get closer to the participants (Atkinson & Hammersley, 2007).

An ethnographic approach provides various advantages. Kress (1989) notices that discourse organises how a topic is discussed understood and acted on. Gee and Green (1998) present a theoretical orientation to language as social resource of a group demonstrating discourse analysis. They show that an ethnographically grounded approach to discourse analysis involves a particular perspective on discourse and social action. This approach thus helped me to subjectively interpret the meaning of BTs’ actions and their significance within the context of the community. This also assisted me to follow the progress they made in their career development (Punch, 1998). In short, this research method, according to Hammersley and Atkinson (1995), involves the researcher participating in people’s daily lives for an extended period of time, watching what happens, listening to what is said (as well as what is not said), and asking questions. In fact, collecting whatever data are available throws light on the issues that are the focus of the research, which in this study is the shaping of BTs’ professional identity.

Another advantage of this method is that the ethnographer penetrates new worlds and new relationships. Atkinson and Hammersley (2007) suggest that rethinking the relationship between ethnography and social practice is required in order to restructure goals of ethnographic study. Narratives are thus important in order to feel what the ethnographer saw, and what the participant said (Stewart, 1998). These stories and narratives are the appropriate means to portray his-story that becomes ‘the history’ of the participant (idea adapted from Kvale, 1996).

Ethnographic research methods also raise some concerns (Frank, 1999; Hammersley, 1992; Hammersley, 1990). Hammersley (1992) notices that ethnographers usually study one or a few small-scale cases (settings, groups or people) over periods that range from a few days to several years. Hammersley (1992) is concerned with the validity of the account of an event because there is no independent, immediate and reliable access to reality. In such a situation, we judge the validity on the basis of the adequacy of the evidence offered. Hammersley (1992) is also concerned with who is the central audience of ethnographic research. In my view, current and
future teaching practitioners are the potential candidates to become the audience of this study. The potential future researchers and stake-holders in the field of education may find this study inspiring when exploring the identity discourse in education.

3.2.3 Identification of style and genre for narrative
Writing BTs’ stories requires a particular style. In order to benefit from this study, I narrate these stories as said by a BT. His utterances in the classrooms and from the interviews are quoted in support of these stories, which is the technique that I followed in chapter 4. This is a realistic approach that portrays a BT’s world (Banfield, 2004). A realist view suggests that a phenomenon exists independent of human knowledge of them (Hammersley, 1992). This approach benefits the study because realistic ethnography achieves its effects through its narrative structures (Atkinson & Hammersley, 2007; Hammersley, 1992). Therefore, an ethnographer has the responsibility of reconstructing the scene to illustrate participants’ activities. This also helped me to pick certain utterances or phrases that were used by the BTs to see how they made sense of their activities.

An ethnographer’s representation of reality, according to Hammersley (1992), “makes some features of the phenomena represented relevant and others irrelevant. Thus there can be multiple, non-contradictory and valid descriptions and explanations of the same phenomenon” (p. 51). As I categorise the transcribed utterances into mathematizing and subjectifying, the subjectifying utterances are analysed further to identify their significance. In this process, I may use the selected utterances, identify these as reifying and then interpret if necessary. As a result, the same phenomena can be examined from different perspectives in order to understand how such utterances make sense for a BT or others.

From this point of view myself as a researcher and BTs as the participants are the inhabitants of a shared social field. The realist techniques of ethnographic study may endow the researcher as the narrator. This calls for a need to explore the idea of narrative ethnography (Atkinson & Hammersley, 2007).
3.2.4 Narrative ethnography
Realistic ethnography achieves its effects through its narrative structures and its stylistic devices. Narrative forms, according to Atkinson (1990), are used to convey accounts of social action and causation (cited in Atkinson & Hammersley, 2007, p. 256). As a result, an ethnographer reconstructs the action in a different setting that will assist the reader to understand the actor (BT) in a social setting. Xu and Connelly (2010) observe that the story remains the starting point in narrative inquiry. They define narrative inquiry as the ‘experiential study of experience’. This view justifies my approach of describing and interpreting BTs’ stories.

The narrative ethnographic approach enables me to understand BTs’ work. Reviewing their classroom practice and discussing the findings with them is an effective way of experiencing their stories (Xu & Connelly, 2010; Gubrium & Holstein, 2008). In this way, I attempt to make sense of their ‘lived experiences’ through their stories and narratives. Gubrium and Holstein (2008) refer to narrative ethnography as an “ethnographic study of narrativity” (p. 250). According to them, this is a method of procedure and analysis aimed at making sense of social situations, the actors (BTs in my study), and their activities in relation to their narratives. In my view, the narrative approach is critical to examine BTs’ activities, and can facilitate the gathering of inside information. In this research, I was not able to execute this fully because I was not part of their planning, implementing and evaluating their classroom activities. However, being the deputy principal at one of the high schools, it was also my responsibility to monitor teachers’ classroom activities, where two of the participant-BTs were working. Observing their classroom activities thus can be qualified as partial-participant observation. In this sense, I was an insider.

Xu and Connelly (2010) observe that a narrative inquiry in school-oriented research is based on stories and the subsequent construction of narratives of the participants’ experiences. I used rich and textured vignettes and quotations to identify learning as a sense making process (Sfard & Prusak, 2005a; Graven, 2003; Gee, 2001; Wenger, 1998). These narratives comprise the interplay between experiences of BTs (as these emerge from their stories), descriptive resources, and the environment that conditions and facilitates story telling (Gubrium & Holstein, 2008).
Even though the stories can be complex, the narrative ethnography provides the analytical platform, tools and sensibilities for catching the rich and variegated outlines of narratives (Xu & Connelly 2010; Gubrium & Holstein, 2008). I examine the participants’ narratives and stories to understand how they shaped their identity. BTs’ voices are brought to the fore in this study through their classroom utterances. Telling their stories thus involves reflection, selection and arrangements of events in an artful manner, which carries meaning for the teller (BTs). I use a tool from Sfard and Prusak (2005a) in order to extract the significance of their utterances (Section 3.5.3). This study thus constructs interesting, informative and potentially meaningful impacts on the participants shaping ‘their story’ (Mertler & Charles, 2008).

3.2.5 Participants and the selection criteria

In an ethnographic study, once the investigator selected a site (classrooms in this study) with a cultural group, the next stage is to identify who and what would be studied. Mertler and Charles (2008) describe participants as the individuals specially selected to undergo scrutiny in research. The study required purposeful sampling of the participants based on the research questions and the nature of participants as they are the beginners in the teaching field (Cohen et al., 2000; Creswell, 1998). Newly employed mathematics teachers were scarce during the time of this study. Therefore I had to choose the participants purposely, who could volunteer to participate in the study. According to Cohen et al. (2007), “voluntarism entails applying the principle of informed consent and thus ensuring that participants freely choose to take part in the research and guarantees that exposure to risks is undertaken knowingly and voluntarily” (p. 52).

The logic and power of purposeful sampling lies in selecting information-rich cases for study in depth from which one can learn a great deal about issues of central importance to the purpose of the inquiry, thus the term purposeful sampling (Patton, 2002). Mertler and Charles (2008) elaborate purposeful sampling as the selection of a certain segment of the population for the study. They also suggest an alternative term; judgmental sampling. I used my judgment for selecting the participant BTs for this study.
The research goal was not necessarily new in the research world. For instance, Flores and Day (2005) in a similar study infer that the study explores how beginners’ assumptions and values about teaching and being a teacher were challenged in school settings. This was useful to understand the ways in which professional and cultural environments affected BTs in their study.

The site of the field work was 5 high schools from Maseru and the Berea districts in Lesotho. When I approached the two BTs from my workplace, they agreed to participate in the study. They also helped me to search for other newly employed mathematics teachers in other schools through their college mates. With their support, I identified four more newly employed BTs in other schools. By the end of 2011, I had 6 BTs who were willing to be the participants in the study. They were in the first year of their teaching at that time. Four of the BTs hold BSc degrees in education. One BT graduated from NUL with a general BSc degree and holds no teacher qualification. The sixth participant holds a diploma in education from LCE. In order to protect their privacy their real names are not used in this study; instead pseudo-names are given to these participants as well as to the schools where they are working.

In the first year of the field work (2012), I observed these participants three times. I interviewed them after each observation and at the end of the year I conducted a focus group interview. However, in the second year (2013), one of these BTs had to discontinue his participation from this study, as he left his teaching job for reasons unknown to me. Cohen et al., (2007) warn that “validity can be compromised if participants come and go from the study” (p. 175). I continued observing the remaining 5 participants twice and then interviewed them afterwards. The second focus group interview was conducted at the end of the second year (2013). The schedule is mapped out in Table 3.1 below:
Table 3.1: Participants and their schools (Pseudonyms)

<table>
<thead>
<tr>
<th>Participants</th>
<th>Qualification</th>
<th>School</th>
<th>Observation 2012</th>
<th>Interview 2012</th>
<th>Observation 2013</th>
<th>Interview 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Jack</td>
<td>Diploma from LCE</td>
<td>Town High School (Urban)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>2. Jim</td>
<td>BSc</td>
<td>Ha-Rasta High School (Suburban)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>3. Max</td>
<td>BSc Ed</td>
<td>Ha-Rasta High School (Suburban)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>4. Sam</td>
<td>BSc Ed</td>
<td>Ha-Lerato High School (Suburban)</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>5. Peter</td>
<td>BSc Ed</td>
<td>Central High School (Urban)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>6. Thabo</td>
<td>BSc Ed</td>
<td>Hills’ View High School (Rural)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

3.3 RESEARCH DESIGN (Phase 1, 2&3)

The study took two years to complete and was divided into three phases.

**Phase 1 & 2:** The first and the second phases were dedicated to capturing the data from the field. These were observations (April, August and November in 2012; February and April in 2013) and interviews (April/May, August/September and December in 2012; March and June/July in 2013).

I transcribed the data usually within the period of a month after video-recording the events. I recorded BTs’ classroom activities electronically using a video recorder. After recording their classroom practice, I completed the transcription within a month. However, transcribing the focus group interviews took longer due to the elongated duration of this activity. I decided to transcribe the recorded data myself. This helped me to critically analyse and compare these activities and to identify any pattern in their approach. I revised the transcriptions after the completion of the first draft. It was then crosschecked by another person for correction if any, by watching the recordings. This took place within a period of four weeks after the completion of the task of transcribing. Revisiting the transcripts by another person was necessary to confirm if the utterances were transcribed correctly. The BT and I watched the video recording of the lesson on the same day as the one-to-one interview, which helped me to clarify some of the vague utterances that he might have made in his lesson.
Semi-structured interviews were designed with the objective of gathering BTs’ beliefs, views, attitudes and expectations (Merter & Charles, 2008; Cohen et al., 2007). The interviews were suitable to engage with, understand and interpret some of the key features of BTs’ professional identity. I also engaged in casual chats with BTs before observing the classroom lesson. I also used an unstructured and informal interview style for the post observation interviews (chats) with the participants. These chats were helpful for drawing some conclusions during analysis. These activities, according to Cohen et al. (2007), provide the participants with greater flexibility and freedom ‘to open up’ with me. The final activity of the research year was the focus group interview with all participants.

I repeated these activities twice in 2013 as phase 2, ending with the final focus group interview. In addition, I gathered their personal information through a questionnaire (beliefs, attitudes and views) and reflective thoughts that were also recorded (ref: Table 3.2; Appendix 3).

**Phase 3:** This was the final phase that started in January 2014 and involved the data analysis, reporting the progress to the supervisor, as well as writing the full thesis.

In summary, to retain the integrity of the phenomena being investigated and to realise BTs’ actions within the frame of ethnography, I observed their classroom teaching over a 2 year period. Interviews were then held in order to analyse the observed classroom teachings (Atkinson & Hammersley, 2007; Cohen et al., 2007; Lasky, 2005; Frank, 1999). The following section discusses the methods and techniques used for the collection of data from the field.

**3.4 METHODS AND TECHNIQUES**

In this section I discuss the techniques that I used to gather data from the field work. The participating schools (where participant BTs work) were situated in urban, sub-urban or rural regions of Lesotho. These BTs had recently started working at their respective schools by the time I selected them. Prior to the BTs’ participation, I briefed them about the purpose of the study and the method of data collection. It was also necessary to obtain their informed consent.
3.4.1 Data and document collection

In an ethnographic study, the investigator collects descriptions of the participants’ activities using observations and interviews, which are the most popular form of data collection (Creswell, 1998). In this section, I discuss various tools that I used to gather the data from the field. The primary sources for my study were observation of the participants’ classroom practice and the interviews.

The prolonged fieldwork for my study employed observation and interviews as the key data collection methods. The data collected from preparation books, lesson plans and journals that they wrote were also reviewed with the objective to use the data gathered if the need arose. In addition, they also answered the questionnaires that I presented to them (Appendix 2&3). These questionnaires provided me with information on how they constructed meaning from their stories, hence how they shaped their identities. According to Sfard and Prusak (2005a), “[I]dentify talk makes us able to cope with new situations in terms of our past experience and gives us tools to plan for the future” (p. 16). With this understanding, I explore the main data collection processes.

3.4.2 Observation

According to Cohen et al. (2007), observation offers investigators the opportunity to gather data from naturally occurring social situations and to understand natural human behaviour. Morrison (1993) points out that the observation enables the researcher to gather data on the physical setting, the human setting and the programme setting.

In this study, the physical setting was the classrooms, the human setting was BTs’ interactions with students and the programme setting was the classroom practice. One of the purposes of the classroom observation was to gather data on participants’ teaching activities in the natural settings and to understand their situation (Cohen et al., 2007). Observations also complemented the interviews. Therefore, the observations specifically focused on BTs’ classroom practice and their interactions with students in the mathematics classrooms.

The observations that I conducted were systematic and enabled me to generate data (Cohen et al., 2007). The observation of classroom practice, participation of students and BTs’ use of
knowledge resources helped me to understand how they made sense of their actions (Sfard & Prusak, 2005a). In this regard, Frank (1999) warns that “entering the classroom only for a few minutes and only occasionally is a challenge to identify the patterns and know what kind of classroom was being constructed” (p. 3).

The observation in this study had two stages:

**Stage 1:** Hammersley and Atkinson (1983) argue that all social research is a form of participant observation. They also suggest that a researcher cannot study the social world without being part of it. Therefore, some form of participation was necessary for an ethnographer, which was an instrument for the ethnographer’s inquiring experience (Stewart, 1998). On the other hand, Atkinson and Hammersley (2007) caution that a “non-participant observer plays no recognised role” (p. 248). This allowed me to be a ‘non-participant observer’ because my intention for observing BTs’ classroom teaching was not to play any recognised role or to influence them. It also allowed me to closely and accurately record (video record) what I observed, without distracting the teaching and the learning (Cohen *et al.*, 2007). I observed them with the objective of investigating their role of being active participants in the communities of practice without any interference from me. The observation also helped me to record their involvement in constructing identities in relation to these communities (Wenger, 1998).

I selected my position in the classroom in order to capture a BT’s activities and his movements. I also followed him as he moved in the classroom in order to capture his voice. However, my location in the classroom was strategically chosen to avoid any possible distraction to the students as well as to help me to see, hear and write all discourses that were taking place in the classroom (Cohen *et al.*, 2007). I acknowledge though that, as a senior teacher, my presence in the BT’s classroom inevitably inhibited some of their activities in the classroom.

At the end of the lesson that I observed, I asked each participant to reflect on their experience of the classroom teaching (Section 3.4.3). This was done outside the classroom for less than 5 minutes. Their instant response was also video recorded. Xu and Connelly (2010) consider this as re-experiencing the experience that becomes ‘thinking narratively’, and was scrutinised critically in the study.
Stage 2: The recorded and transcribed classroom activities were coded verbatim. I also reviewed and critically analysed the video recordings of the classroom observation together with the BT concerned during the one–on-one interviews. I conclude this section, quoting Hammersley (1992):

The nature of social world must be ‘discovered’; This can be achieved by first-hand observation and participation in natural settings, guided by an exploratory orientation; that research reports must capture the social processes observed and the social meanings that generate them (p. 12).

3.4.3 Interview

An interview is literally an inter-view, an inter-change of views between two persons conversing about a theme of mutual interest (Kvale, 1996). Interviews therefore play a central role in the data collection (Creswell, 1998). Kvale (1996) adds that “interviews are conversations with participants that highlight experiences, feelings, hopes and the world they live in” (p. 14). Within the context of my study, I carried out an informal conversation while introducing questions. According to Spradley (1979), the ethnographic interview shares many features of an informal conversation. For Gee and Green (1998) interviews are essential to explore participants’ perceptions within the local situation. From this point of view, interviews enable the researcher to extract the situated meanings that they form. The interviews aimed at stimulating BTs to reflect on their classroom experiences and to tell their stories. In this sense, interviews were used to derive the perspectives of participants on those events of which they are part.

I conducted one-on-one (and face-to-face) interviews (Kvale, 1996). The questions were semi-structured (Appendix 4). I further elaborate on the focus of the interviews.

The first interview was immediately after the lesson that I observed. I asked each BT to narrate their story of the particular lesson that I observed. This helped me to gather their instant response about the situated meanings that they had drawn from the lesson (Lasky, 2005).
At a later stage, the BT concerned and I watched the video-recorded classroom teaching together. After viewing the video recording, I asked some questions (Table 3.2; Appendix 4). His responses to what he viewed in the recordings were his stories. In my view these stories narrated his learning to become a mathematics teacher. Later, I analysed his stories for themes and insights into their position in the community of practice. The interview occurred within the time frame of one week to two months depending on the BT’s availability for the interview. The interview helped him to evaluate his classroom activity and to provide an in-depth elaboration into the ways he understood professional vulnerability (Lasky, 2005). This one-on-one interview provided a picture of ‘what was going on’ in the classroom (Gee & Green, 1998). An ethnographer’s main tool to understand how BTs make sense of a situation is to ask questions that seek clarification and description of the situation (Spradley, 1979). Simultaneously, Sfard and Prusak (2005a) point out that, similar situations can bring different meanings. Therefore, I repeated some questions on different occasions. The answers from BTs thus assisted me to compare their sense making process.

The interviews enabled the BT to discuss his interpretations of the world in which he lives and to express how he made sense of situations (Cohen et al., 2007). The interviews thus attempted to understand the world from the participants’ points of view, unfold the meaning of peoples’ experiences, and uncover their lived world (Kvale, 1996).

The final stage was to invite all participants to my house at the end of the year, whereby we (all BTs and I) participated in a focus group interview where we discussed general issues related to teaching (Appendix 5&6). In my opinion, the focus group interview assisted them to conceptualise their experience by listening to the stories from other BTs. This activity improved their capacity to make sense of their practices that perhaps shaped their professional identity.

When an open discussion was conducted during the focus group interview, it was possible for me to form a close and informal relationship with BTs. Spradley (1979) says: “It is best to think of ethnographic interviews as a series of friendly conversations into which the researcher slowly introduces new elements to assist informants to respond as informants” (p. 465). Simultaneously, the chance of being ‘one of them’ for me was also less likely to happen because I am an old-
timer. However, one impact of such ‘together-ness’ was to build trust that helped me to understand what was happening in their minds.

Table 3.2 demonstrates a sample of some of the questions that I asked the BTs (Appendices 1-6).

**Table 3.2: Sample questions**

<table>
<thead>
<tr>
<th>Section A: The preliminary questions (Wenger, 1998). These were answered in writing.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What kind of a person are you?</td>
</tr>
<tr>
<td>2. What kind of a mathematics teacher are you?</td>
</tr>
<tr>
<td>3. What kind of a mathematics teacher would you like to be?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section B: One-on-one interview questions and Focus group interview (Adapted from Wenger, 1998)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. How do you assess your teaching approach in mathematics classrooms?</td>
</tr>
<tr>
<td>5. What changes have you brought into the students’ approach towards mathematics learning through your classroom practice?</td>
</tr>
<tr>
<td>6. What changes have you brought to yourself through your teaching experience?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section C: At the end of the research, I asked these questions (adapted from Brown &amp; McNamara, 2011)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Who are you, who do you think you are?</td>
</tr>
<tr>
<td>2. Who are you, who do you want to be?</td>
</tr>
<tr>
<td>3. Who were you, before you started participating in this study?</td>
</tr>
<tr>
<td>4. Who are you, as seen by your students?</td>
</tr>
</tbody>
</table>

**3.4.4 Journal**

I requested the participants to write reflective journals for which I supplied notebooks. According to Bowerman (2011), a reflective journal provides the participants with a method for looking back at the experience based on their actions. Writing a reflective journal helps BTs to record their opinions on their own actions without any external interference from me. The act of reflective thoughts, ideas, feelings, and their own learning encourages skills such as evaluation of their actions. The data collected from the journals could have enhanced the data from interviews and observations. However, this did not happen as I expected. One of the limitations in this study
was that I was unable to gather data from the journals as the BTs met with a few challenges in writing them and I only managed to obtain journals once from two BTs. Subsequently, these narratives were not included in this study.

### 3.4.5 Questionnaire

I also used questionnaires to be answered by the BTs. This occurred at the beginning and at the end of the study (Table 3.2; Appendix 1, 2 & 3). The purpose of this exercise was to obtain preliminary information about them and their understanding of being a mathematics teacher. According to Cohen *et al.*, (2007) a questionnaire is a useful instrument for collecting information in a straightforward manner. I distributed the questionnaires to BTs thrice. The first one was given in 2011 at the beginning of the pilot study. This pilot study was undertaken to refine the final questionnaire questions. I used three volunteers who were not part of the study to complete this questionnaire. The second one was given to them during the field work and the final one was given at the end of the study (Appendix 1, 2 & 3). The information gathered from the questionnaires was used in chapter 4 in order to portray BTs’ stories. This assisted me to understand what kind of people they are (Gee, 2001).

### 3.5 DATA ANALYSIS (Vertical & Horizontal)

Data analysis involves organising, accounting for, and explaining the data in order to make the analysed situation coherent (Cohen *et al.*, 2007). Analysing the vast quantity of transcript data (more than 600 pages) that I gathered from the participants (Table 3.1) could be time consuming and confusing if not managed efficiently. I needed to address this matter before I started the analysis.

After a discussion with my supervisor, I decided to analyse only 3 classroom observations from 3 BTs, of which he approved. The next task was to decide whose data should be analysed. Jack was the only BT with a diploma in education. Jim was a BT without a diploma or degree in Education. Jack and Jim thus qualified due to the unique nature of their qualifications. The rest of the participants had degrees in Education, amongst which Max was working with Jim. Therefore, I decided not to analyse his lessons. Sam discontinued his participation in 2013, so he
was automatically excluded. I selected Peter to be my third candidate because it was easier for me to meet Peter when the need arose, as he was living nearer to my residence. I thus, considered the lessons from Jack, Jim and Peter for analysis.

The next stage was to decide the lessons that needed to be analysed. In order to keep the chronological pattern, I decided to analyse the three lessons that I observed in 2012. However, the data from all interviews and focus group interviews were also used in the analysis. Furthermore, I used the data from other lessons when necessary.

The next stage was to select the method of analysis.

**Vertical analysis & Horizontal analysis:** Vertical analysis is described as a chain of interpretive transformations of the data during the collection process resulting in a synthesis of text (Kelchtermans & Vandenberghe, 1993). According to Felix (2014), a vertical analysis demands interpretive and meaningful connections that are made between the identity-shaping stories and other supporting stories. Horizontal analysis is a comparative analysis that identifies apparent patterns or differences (Felix, 2014).

In the vertical analysis, my main focus was on the internal coherence and consistency of the individual BT’s story. In the horizontal analysis I looked for commonalities, apparent differences and recurring patterns (Kelchtermans & Vandenberghe, 1993). Horizontal analysis is a cross-referencing of what had transpired from the vertical analysis (Felix, 2014; Kelchtermans & Vandenberghe, 1993). Stories cannot be considered in isolation as these stories shape an individual BT’s professional identity. Therefore, horizontal analysis of the stories narrated is useful to understand the shaping of BTs’ professional identities. Using this technique, I could identify the turning points or the twist in the stories of the participants. These twists helped me to understand their ‘sense making’ process. Therefore, I found that vertical and horizontal analysis complemented each other in this study.
3.5.1 Analytical process

The transcribed data was categorically coded. Coding is a process of disassembling and reassembling the data (Cohen et al., 2007). The manuscripts (data) were disassembled into sections.

One actor’s (In this case, BT) utterances, actions or interactions were categorised in each section. I rearranged these utterances by giving each one a number in sequence. One number indicated all transcribed utterances of one BT at that particular moment. This was considered as one line. When another actor (for instance, a student) responded, the next sequential number was used. This became the next line. According to Cohen et al., (2007) this approach is axial coding, which links categories and codes. The essence of axial coding is its interconnectedness that relates one code with another (Cresswell, 1998).

I used these codes or parts of the codes in order to capture the flow of BTs’ sense making processes. Abbreviations were used to indicate the utterances from various recorded activities using the pseudonym of the BTs (Jim, Jack or Peter in this study). For example, ‘Ob’ referred to the observation. ‘Int’ referred to the interviews. ‘Re’ referred to BTs’ responses/reflections after the lessons. ‘FG’ referred to the focus group interview. For instance, Jack Ob 1.001 referred to the first utterances from Jack’s first lesson that I observed.

In the analysis, repeated utterances were used only once. Utterances such as um, eh etc. were omitted when quoting. However, I might have altered these criteria depending on the context or the situational meanings of such utterances in the analysis.

When quoting these utterances, longer conversations and interactions were presented as vignettes. “A vignette is a short, thickly described, recounted version of an event, person, or setting which is used to convey an interpretive theme”, (Graue & Walsh, 1998; Erickson, 1986). I used these vignettes as supporting evidence when analysing the data. A sample is shown below:

When I talk about myself to some teachers at work, I always say to them, no I am a kind of person who loves students. And then I have ... time for students ... but then my problem is, I am staying very far from the school and then walk very long distance (Jack Int 4.109).

When some utterances were omitted, I used three dots (…) to indicate this.
3.5.2 Analytic tools

When searching for ideal analytic tools, the challenge was to identify the tool that elicited the appropriate meaning of the data. Classifying and categorising these data was crucial to interpreting these, so that the narrative looks exactly as it was portrayed by the narrator (Cohen et al., 2007). The analysis used discourse from classroom interactions and utterances from interviews to extract the meaning that BTs created (Gee, 1999). My emphasis on the term, ‘discourse’ is meant to cover important aspects of communities of practice within the classrooms.

Discourse is communication that is socially situated and that sustains social positions (Hicks, 1995). Identity discourse is the “relations between participants in face-to-face interactions” (Hicks, 1995, p. 49). This involves examining the utterances that I categorised into mathematizing and subjectifying as discussed in the literature (Section 2.4.1). I discuss these terms further in Section 3.5.3 with the purpose of linking the theory (literature) with the practice (method of analysing).

3.5.3 Mathematizing and Subjectifying

In the narratives of identity formation in mathematics classrooms, mathematizing and subjectifying are the two terms frequently used by Heyd-Metzuyanim and Sfard (2012). Mathematizing referred to any utterances indicating all mathematical terms or ideas. The aim of mathematizing usually revolves around mathematical concepts, operational activities and mathematical objects such as numbers or mathematical objectives such as sets, functions etc. These mathematical objects produce endorsed narratives of the actors when they are engaged in intensive mathematizing (Heyd-Metzuyanim & Sfard, 2012). The actors can be the students or the teachers, depending on the setting such as the classrooms.

Utterances are subjectifying when linked to mathematizing (Heyd-Metzuyanim & Sfard, 2012; Heyd-Metzuyanim & Sfard, 2011). When these two intertwine, the utterances make sense to the recipient and the actor. Quoting Heyd-Metzuyanim and Sfard (2011):
Of all subjectifying activities, the most consequential for learning seems to be that of identifying – the activity of talking about properties of persons rather than about what the persons do. Scrutinizing the activity of mathematizing is the commognitive counterpart of cognitive analysis, whereas studying the activity of identifying means attending to all those phenomena that other researchers label with the adjectives affective, interpersonal or social (p. 1).

In this study, not all subjectifying utterances were identified. I examined the subjectifying utterances from the transcriptions to understand how these made sense for BTs (talking about properties of persons). I used selected transcriptions of verbal utterances for categorising subjectifying utterances, which are identified based on the way these made sense of what is going on in classrooms. Most of these subjectifying utterances, whether pronounced by the BT or the student, speak about mathematical ideas, concepts or about how to perform certain mathematical tasks.

Heyd-Metzuyanim and Sfard (2011) argue that performing a certain kind of task in a particular way makes sense for the performer. Therefore these authors find such patterns as identifying the person in a particular manner. They add that the tightly intertwined activities of mathematizing and subjectifying shape one another. In their words:

Subjectifying utterances that regard the problem-solver's own moves, and which are the commognitive parallel of meta-cognitive activity, can certainly be of help. Certain types of identifying activities, on the other hand, may be expected to hinder the learning process. More generally, the activity of identifying may well be the type of subjectifying which correlates most strongly with permanent patterns in student’s learning, such as lasting learning difficulties or repetitive success (p. 5).

Even though, I am not particularly searching for a pattern to identify a manner in which BTs communicate to students, such patterns may emerge from this study. Yackel and Cobb (1996) in their study clarify “how the teacher can serve as a representative of the mathematical community in classrooms where students develop their own personally meaningful ways of knowing” (p. 461). The role that teachers play is also associated with their personal beliefs, values, mathematical knowledge and understanding (Yackel & Cobb, 1996). Heyd-Metzuyanim and Sfard (2011) link this role to the activity of talking about properties of persons. In this manner, BTs’ classroom activities (mathematizing and subjectifying utterances) are associated with identifying discourses. For instance, when I considered utterances such as; it can’t be converted;
they are not equal etc., (Jim Ob 1) which were linked to mathematizing, this indicated mathematical action (conversion of fractions) that displayed a property that Jim wanted the students to attain so far.

In short, the study mainly explored certain subjectifying utterances that were concomitant to mathematizing actions. These subjectifying utterances indicated how the mathematics concepts became meaningful to all. This meaning formation thus assisted the particular BT to shape his professional identity.

I present the following utterances to demonstrate samples of mathematizing and subjectifying utterances from one of Jack’s lessons (Jack Ob 4).

Table 3.3: An example of categorising the utterances into subjectifying and mathematizing

<table>
<thead>
<tr>
<th>Utterance</th>
<th>Subjectifying</th>
<th>Mathematizing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack Ob 4.005: We are going to look at multiplication of decimals. How do we multiply decimals?</td>
<td>We are going to look at … How do we …</td>
<td>Multiplication of decimals. Multiply decimals?</td>
</tr>
</tbody>
</table>

According to the definitions given by Heyd-Metzuyanim and Sfard (2012), the word, multiply and its derivatives indicate mathematical actions. Decimal is a mathematical term linked to numbers. Therefore, these utterances can be classified as mathematizing. The utterances associated with the mathematizing utterances complement the action or guide the students towards certain mathematical processes or concepts; hence these are the subjectifying utterances.

I present a sample to demonstrate mathematizing and subjectifying utterances with my interpretations.
Table 3.4: An example of categorising the utterances with interpretations

<table>
<thead>
<tr>
<th>Transcription</th>
<th>My subjective interpretation</th>
<th>Subjectifying</th>
<th>Mathematizing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Ob 1.022: If you want to simplify the function, what do you do? You look at the common factor.</td>
<td>In order to simplify a fraction, the first step is to identify the common factor of the numerator and the denominator.</td>
<td>If you want to …</td>
<td>Simplify the function (fraction).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>What do you do?</td>
<td>The common factor.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>You look at...</td>
<td>What is the common factor between 3 and 6?</td>
</tr>
</tbody>
</table>

I borrow the arguments from Heyd-Metzuyanim and Sfard (2012) suggesting that in mathematics classrooms, mathematizing would often revolve also around other mathematical objects, such as fractions, sets, functions and geometric figures. The aim of this mathematizing would be to produce different types of endorsed narratives, with descriptions of objects’ properties (e.g., investigating simplification of fractions) and identification of their realisations (e.g., finding solutions to equations). Therefore, there may be a need to interpret the utterances before categorising them into subjectifying and mathematizing in order to analyse the subjectifying utterances further as shown in Table 3.4 above.

These utterances were examined further to understand how BTs shape their professional identity. The link between subjectifying utterances and shaping of identity is usually informed through the utterances pronounced by a BT that makes sense for him (as well as his students). In my opinion, such utterances identify the BT’s way of engaging in mathematizing.

There are three levels of subjectifying actions that Heyd-Metzuyanim and Sfard (2012) suggest. The 1st level of subjectifying is the narratives of one’s specific actions (e.g., you said, you found, I forgot). The 2nd level of subjectification is concerned with one’s routine actions (e.g., you don’t know, you cannot do this, how can you do this?). The 3rd level is the highest level that is attained by the utterances that claim something as an inherent property of the interlocutor (BT). This implies that the actor performs a particular task in a certain way, and identifies in a particular manner (e.g., you are mathematically good, I cannot allow you to do this). I present a sample to demonstrate this.
Table 3.5: An example of categorising the utterances to different levels (Jim Ob 1.045)

<table>
<thead>
<tr>
<th>1st level subjectifying</th>
<th>2nd level subjectifying</th>
<th>3rd level subjectifying: About the actor</th>
</tr>
</thead>
<tbody>
<tr>
<td>About specific performance</td>
<td>About performance</td>
<td>You will have to make the denominator the same or do it your way.</td>
</tr>
<tr>
<td>Now, what we do?</td>
<td>What you have to do is to make the denominator to be equal. We need to compare numerators.</td>
<td>Ok, do you have someone who could do this?</td>
</tr>
<tr>
<td>Ok, who can do this for us?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Let us see what he is going to do</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The utterances in bold indicate the need for further analysis of these words. For instance, consider the utterances such as ‘what we do’, and ‘what you have to do’. In these utterances, the BT uses the pronouns, we and you (and their derivatives) sending certain message either to him or to the students. As a result, the use of these pronouns identifies him as a certain kind of person. This implies that a person would perform a certain task always in a certain way, hence identifies this person in a particular manner (Heyd-Metzuyanim & Sfard, 2012).

All the subjectifying utterances that I analysed were quoted either from a BT’s classroom practice or from the interviews. The selected utterances are examined further and discussed if these utterances have power to reify (Heyd-Metzuyanim & Sfard, 2012).

The next section elaborates on the terms reifying, endorsable and significant (Sfard & Prusak, 2005a) in connection with subjectifying utterances.

### 3.5.4 Reification, endorsable and significant

In this section, I discuss how the selected subjectifying utterances of BTs were analysed to identify if these utterances reify and signify the purpose of the action. This tool further assisted me to narrate their stories as identifying and sense making. Sfard and Prusak (2005a) present identity as a collection of stories, more specifically as those narratives about individuals that are reifying, endorsable and significant. Based on this view, two features of subjectifying utterances were investigated: their power to reify and their significance in the eyes of the speaker (Heyd-Metzuyanim & Sfard, 2011). These utterances were then endorsed and counted as identifying.
The reifying utterances were further categorised as indirect and direct reifying actions (Table 3.6). Heyd-Metzuyanim and Sfard (2011) suggest that the reifying effect could be direct, as is the case when one is describing people rather than their actions. The direct reifying actions are further classified into 1\textsuperscript{st} level (insistent), 2\textsuperscript{nd} level (permanent feature of a person’s performance) and 3\textsuperscript{rd} level (describing the permanent feature of a person). I present a sample below.

**Table 3.6: An example of categorising the subjectifying utterances into various levels of reifying**

<table>
<thead>
<tr>
<th>Indirect reification (Providing information on what has to be done regarding something)</th>
<th>Direct reification (describing a person): 1\textsuperscript{st} level</th>
<th>Direct reification: 2\textsuperscript{nd} level</th>
</tr>
</thead>
<tbody>
<tr>
<td>What you have to do is to make the denominator to be equal. Do it your way. We need to compare numerators.</td>
<td>So you will have to make the denominator the same or do it your way. Let us see what he is going to do.</td>
<td>What you have to do is to make the denominator equal (insisting)...We need to compare the numerators.</td>
</tr>
</tbody>
</table>

These actions were identified through the words such as *be, have* and their derivatives as well as through other words. In this study, such attributions are done by a BT with regard to himself or with regard to others (Indirect reification – eg. *Do it your way*; 1\textsuperscript{st} level reification – particular performance - you will have to; and 2\textsuperscript{nd} level reification – routine performance - *We need to ...*) or done by others with regard to BT (eg: you will have to …, *how could you ..., you cannot add etc.*). Learning implies becoming a different person (Lave & Wenger, 1991). Therefore, analysing these utterances using various levels of reifying will help me understand the nature of these utterances (endorsable or significant). This is useful for understanding what they have learned. The purpose of examining the subjectifying utterances through the lens of reifying is thus justified in this study.

The subjectifying and reifying utterances were analysed within the single framework of subjectifying-reifying-identifying in order to conclude a pattern in the identifier’s classroom approach. In this regard, subjectifying utterances complemented reifying actions and became significant when such utterances were endorsed by the identifier or from the outcome in the classroom teaching.

Heyd-Metzuyanim and Sfard (2012) suggest that “[w]hen analysing identifying stories, we will make a distinction between “stories about feelings” and “stories about emotions, with the
former type of stories referring to momentary experiences and the latter – to experience that
tends to repeat itself over time” (p. 133). In this study, my focus is on the BTs’ classroom
practices, and therefore I searched for the words that indicated ‘stories about practice’ rather than
about feelings and emotions, though these can be intertwined. If learning is considered as the
interplay between mathematizing and identifying, the utterances that are pronounced by a BT can
make sense for him that shapes his identity as expected.

In summary, the analytic tools of Heyd-Metzuyanim and Sfard, and Sfard and Prusak (Tables 3.3
to 3.6) helped me to explore how BTs made sense of their utterances. Pierson (2008) in this
regard asks: “What do we gain from a discourse-based approach to studying mathematical
thinking, learning, teaching and doing?” (p. 16). In my view, firstly, analysing subjectifying
utterances based on their reifying and significant nature acknowledges the influence of social
contexts on BTs’ meaning formation (Sfard & Prusak, 2005a; Wenger, 1998). These tools are
consistent with a view of learning mathematics and becoming fluent in its discourse. Secondly, a
discourse analytic approach acknowledges both students and teachers as active agents in the
process of learning. However in this study, my focus is on teachers. Lastly, this approach allows
me to view learning mathematics as improving participation in a community of practice, shifting
BTs from legitimate peripheral participation to full participation (Lave & Wenger, 1991).

In this study, classroom discourses were thus analysed to identify the particular manner in which
BTs communicate with students as well as BTs’ learning to make sense of their classroom
practices. At this juncture, I introduce the summary of the analytic tool (Table 3.7) adopted and
adapted from Heyd-Metzuyanim and Sfard (2012) and Sfard and Prusak (2005a).
Table 3.7: Analytic tool to understand how learning shapes identity

Identity talk makes us able to cope with new situations in terms of our experience and gives us tools to plan for the future (Sfard & Prusak, 2005a).

<table>
<thead>
<tr>
<th>Classification &amp; Criteria</th>
<th>Definition &amp; Description</th>
<th>My understanding &amp; Indicators</th>
<th>Examples</th>
<th>Linking to identity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mathematizing</strong> (Mathematical terms, numbers etc.)</td>
<td>Communicating about mathematical objects (Heyd-Metzuyanim &amp; Sfard, 2012)</td>
<td>PS: Focus is on BT’s mathematical utterances (and students).</td>
<td>Talking/discussing/describing about sets, mathematical operations, functions, geometric figures etc. (Heyd-Metzuyanim &amp; Sfard, 2012).</td>
<td>Mathematizing utterances are directly linked to Mathematics Identity. Mathematics knowledge, skills &amp; a positive attitude is demonstrated</td>
</tr>
<tr>
<td><strong>Subjectifying</strong> (linking mathematical terms, ideas etc.)</td>
<td>Communicating about participants of mathematical discourse (Heyd-Metzuyanim &amp; Sfard, 2012). Note: Subjectifying act could be verbal as well as non-verbal.</td>
<td>BT will have specific performance -1st level e.g., <em>You said</em> - routine performance -2nd level; e.g. <em>Let us do this</em> and generalising performance -3rd level e.g. <em>Are we together?</em> A pattern in approach is identified as per the need of the practice. PS: Focus is on any utterance that indicates BT’s actions or something happening to BT in terms of his classroom practice. This brings changes in BT’s approach in classrooms.</td>
<td>E.g., <em>Would you like to do it on the board? Do you remember...? This is how I see ... Oh, I forgot ... etc.,</em> (Heyd-Metzuyanim &amp; Sfard, 2012). <em>My examples: Are you saying ...? How can you add ...? Are we together ...? Are you out of your mind?</em></td>
<td>BTs’ stories are focused on change in practice, change in approach using the evidence from subjectifying utterances. BT’s activities (of talking about properties of BTs) identify mathematizing (mathematics learning). This recognises the BT to be a certain kind of a mathematics teacher. Change as learning shapes professional identity.</td>
</tr>
<tr>
<td><strong>Reification</strong> (Selected subjectifying)</td>
<td>Reification refers to the process of giving form to one’s experience, which is</td>
<td>Reification shapes one’s experience and gives meaning to their action (Identify utterances Reifying quality comes with the use of verbs such as be, have, can etc., (Sfard &amp; Prusak, 2005a).</td>
<td>Reifying a person’s actions into mental properties and the person with certain</td>
<td></td>
</tr>
<tr>
<td>Identity</td>
<td>Permanent qualities shape:</td>
<td>Utterances indicate a process and its product — discursive activity and semiotic tools — gestures.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The BT sees his classroom practices as change in meaning formation and learning as experience.</td>
<td>A story about what is taking place in the classrooms. (BT's actions) Possible indicators are sentences like, I don't understand, how can you add? Or semiotic tools such as gestures, facial expressions etc.</td>
<td>A story about a person's actions are considered endorsable if the identity-builder would say that it faithfully reflects the state of affairs in the world. (Sfard &amp; Prusak, 2005a).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The BT engages in classroom practice reflects on his experience and meaning are interpreted by himself.</td>
<td>BT's experience and meaning are interpreted by himself.</td>
<td>BT's story faithfully reflects the state of affairs according to BT. He is his own interpreter.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The BT reflects on his classroom practice counts as endorsable.</td>
<td>BT's story faithfully reflects the state of affairs according to BT. He is his own interpreter.</td>
<td>BT's story faithfully reflects the state of affairs according to BT. He is his own interpreter.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Why does it happen in a certain way? (Learning as change in approach)</td>
<td>Why does it happen in a certain way? (Learning as change in approach)</td>
<td>Why does it happen in a certain way? (Learning as change in approach)</td>
<td></td>
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</tr>
<tr>
<td>- Learning as change in approach</td>
<td>- Learning as change in approach</td>
<td>- Learning as change in approach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identity: e.g., Why don't you understand this simple thing? (Indirect reifying — one’s actions are considered endorsable.)</td>
<td>Endorsable (The classroom practice reflects on the actual state of affairs): A story about a person counts as endorsable if the identity-builder would say that it faithfully reflects the state of affairs in the world. (Sfard &amp; Prusak, 2005a).</td>
<td>Endorsable (The classroom practice reflects on the actual state of affairs): A story about a person counts as endorsable if the identity-builder would say that it faithfully reflects the state of affairs in the world. (Sfard &amp; Prusak, 2005a).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identity: e.g., I could have ... do I have alternatives... (BT reflects on an event that took place in classroom practice)</td>
<td>Identity: e.g., I could have ... do I have alternatives... (BT reflects on an event that took place in classroom practice)</td>
<td>Identity: e.g., I could have ... do I have alternatives... (BT reflects on an event that took place in classroom practice)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identity: The BT reflects on his classroom practices. (Teacher Identity) Learning as experience — learning as change in meaning formation — learning as experience.</td>
<td>Identity: The BT reflects on his classroom practices. (Teacher Identity) Learning as experience — learning as change in meaning formation — learning as experience.</td>
<td>Identity: The BT reflects on his classroom practices. (Teacher Identity) Learning as experience — learning as change in meaning formation — learning as experience.</td>
<td></td>
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</tr>
<tr>
<td>Identity: BT's experience and meaning are interpreted by himself.</td>
<td>Identity: BT's experience and meaning are interpreted by himself.</td>
<td>Identity: BT's experience and meaning are interpreted by himself.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identity: The BT sees his classroom practices as change in meaning formation and learning as experience.</td>
<td>Identity: The BT sees his classroom practices as change in meaning formation and learning as experience.</td>
<td>Identity: The BT sees his classroom practices as change in meaning formation and learning as experience.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Significant (when utterances are endorsed)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Mathematical Classroom</th>
<th>Reflective Thoughts</th>
<th>Endorsable</th>
<th>Wenger (1998)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities in the mathematics classrooms. Reflective thoughts are endorsable</td>
<td>BT’s change in their interactive attitudes and approach in classroom practice is expected. If no change, what does it imply? Selective approach afterwards to suit the needs and to meet the objectives in classroom practice. Revisiting the practice in classrooms. Indications for any change that affects BT’s feelings in terms of membership, community of practice and identity formation. PS: Any anticipated change in the classroom changes BTs’ stories.</td>
<td>Any classroom practice by BT changes any particular situation within the classroom practice. This may have an impact on identity for BT as well as for students.</td>
<td>BT becomes a mathematics teacher in a certain way. He develops certain permanent qualities – Learning as becoming (Wenger, 1998). Shaping of BTs’</td>
<td>Any change is significant as the BTs’ stories changes his attitude and approaches in mathematics classroom. Change in practice that recognises the BT as a certain kind of a person (Professional identity).</td>
</tr>
</tbody>
</table>
3.6 VALIDITY & ETHICS

3.6.1 Validity

Validity checking is essential to confirm and conclude the authenticity of the research (Mertler & Charles, 2008; Cohen et al., 2007). Creswell and Miller (2000) infer that qualitative researchers use a lens revealing the views of people who conduct and participate in the study. Validity procedure in a narrative inquiry involves triangulation (lens of the researcher), clarifying relevant matters with participants (lens of the participants) and readers (lens of people) (Felix, 2014).

Validity of data is an important key to effective research that has a substantial effect on the interpretation of those data as well as identifying its reliability (Mertler & Charles, 2008). In an ethnographic study, internal validity is maintained by reporting a situation through the eyes of the participants. Therefore, the researcher includes multiple methods (describing, interpreting, comparing, etc.) to ensure validity and reliability of the data collected over a period of two years. According to Cohen et al., (2007) this is called triangulation.

Through verifying different data, triangulation techniques in an ethnographic study explain the richness and complexity of human behaviour by studying it from more than one point. A theoretical framework comes from more than one perspective in this study (Gee, 2001; Beijaard et al., 2000; Wenger, 1998). These are compared to confirm the coherence of the facts, which is known as “investigator triangulation” according to Cohen et al., (2007, p. 142). The internal validity is important to understand the meaning of a particular event, issue or set of data that are discussed in this study. Accurate description is therefore required for internal validity (Cohen et al., 2007). I address internal validity using mechanical means to record, store and retrieve data that are presented in direct quotes and in vignettes (using the model from Graven, 2003, and Wenger, 1998).

A triangulation strategy is often used in this kind of research with data gathered by multiple methods (e.g., observations, one-on-one interviews and focus group interviews) so that one kind of story complements the other stories, if verified correctly. If not, the participants change their approaches and in my view that too complements the practice. This strategy thus yields a richer and more balanced picture of the phenomenon, and also serves as a cross-validation method.
(Elliot & Timulak, 2005). I find this method is applicable in this study, as I observe the classroom practice of the selected number of BTs before and after I interview them. This helps BTs to understand the situated meanings of their classroom teaching and then analyse this later. Cohen et al., (2007) consider these as multiple interpretations and perspectives on single situations and events that become a multi-layered and complex reality.

In order to conclude this section, I quote Zhang and Wildemuth (2009) on representing and interpreting the voice of others:

The goal is to identify important themes or categories within a body of content, and to provide a rich description of the social reality created by themes/categories as they are lived out in a particular setting… [so that the results] can support the development of new theories and models, as well as validating existing theories and providing thick descriptions of particular settings or phenomena (cited in Felix, 2014, p. 187).

3.6.2 Ethical issues

The risks and concerns are greater in qualitative research compared to quantitative research (Corbin & Morse, 2003; Patton, 2002). In this regard, Felix (2014) observes that narrative inquiry involves real people, sharing their true stories with researchers, who then take these stories to a larger audience. Therefore, this author argues that such research is bound to involve several ethical considerations. Corbin and Morse (2003) say:

Because participants are asked to tell their stories about some topic, they are sharing personal, often intimate aspects of their lives. As such, there are certain risks associated with revealing matters of a personal nature. One risk is that there might be a break in confidentiality/anonymity, with possible consequences of a social, financial, legal, or political nature (p. 336).

These authors further observe that at the start of an unstructured interview, participants are not always aware of the course that an interview might take or what secrets they might divulge, as trust develops between the interviewer and the interviewee. According to them, “It is this very essence of trust and conversational intimacy that creates both the potential threats associated with unstructured interactive interviews and at the same time makes them potentially therapeutic as well as essential as data collection tools” (p. 338). Interviews thus assisted me to gather the data from the participants, who also found this as sharing their intimate aspects of their lives with me.
I sought informed consent from the participants and their schools (Cohen et al., 2007). Consent from the Ministry of Education and Training, school administration and participants was officially sought after sharing my plan with them (Appendix 7, 8 & 9). The participants were informed about the researcher, the purpose of the research and their right to withdraw from being participants at any time of the research without any obligation to the researcher (Dawson, 2006). I also explained the nature, purpose and significance of the study with an emphasis on their voluntary participation in this study. Measures were taken to ensure that the video recorded lessons were as naturalistic as possible. These were done by frequent visits to the class prior to the observation to familiarise myself with the learners. Ethical clearance was requested from Rhodes University to obtain approval from the Ministry of Education, Lesotho. The responses from the participants are treated confidentially and their real names were also kept anonymous in the study. Once the collected data had been used and presented in the research, the original transcripts in electronic form will be kept safely at Rhodes University for a period of 5 years. I strictly followed the confidentiality, anonymity and privacy of the participants with respect. The raw data gathered during my study were appropriately stored at the end of the study under lock and key to secure the anonymity and privacy of the participants.

I was also aware of my position of power as the observer in participants’ classrooms. Jack used to introduce me as the researcher to the students whenever I visited the classroom (Ref: Jack Ob). Jim once confided in me that he was tense on the first day of my observation, but later he was fine. This conversation was not recorded and as he shared this only after the event, I could not eradicate this tension he had. Cohen et al., (2007) observe this tension as the “tension between invasion and protection of privacy” (p. 209). Peter did not mention how he felt about my presence in his classrooms, and he did not introduce me to his students. In short, there were three different scenarios regarding my presence in the classrooms. These different experiences might have caused some bias in the analysis that perhaps compromised the understanding of the classroom situation that I observed. I am also aware of its impact on the validity and reliability of the study (Cohen et al., 2007).

There was a threat of my being an insider, and becoming one of the participants. On the other hand, being an ‘old-timer’, I was able to share my experience with participants, be one of them
and gain their confidence (Cohen et al., 2007). My participation in the discussion during the focus group interview created a free, flexible and open situation for participants with informal conversation (Cohen et al., 2007; Spradley, 1979). However, I also acknowledge that this approach might have misguided them into a trap of imitating me.

My position as the deputy principal at Ha-Rasta High School also caused a risk, regarding two of the BTs who volunteered to participate in the study. There was a power issue between myself and these participants that I could not ignore. There was a possible threat of being biased in such a situation which calls for a discussion on the concerns and pitfalls in the coming section.

### 3.6.3 Concerns and pitfalls

Ethnographic study is an unfolding and evolving type of study. As a result, a distinctive and definite approach cannot be designed (Punch, 1998) because this can be monotonous for the participants due to a prolonged period of time. There is also a concern about repetition of some of the activities. All stories reveal the truth (Sfard & Prusak, 2005a). However, it was possible for the participants to be selective in their narratives (Xu & Connelly, 2010; Cohen et al., 2007).

Cohen et al., (2007) are also concerned with who owns the data in addition to the prolonged period of study. One of the challenges regarding the prolonged period of study was the financial restraints that I experienced during the field work. I needed to budget the expenses carefully for the study. These involved expenses in the form of telephonic communication, stationery, recording and printing and the expense of transport when meeting with the participants concerned. If not budgeted for, these requirements could have an adverse effect on the study.

The field work was planned for a period of two years, which could have an impact on the lives of the research participants, which may not be predicted. Therefore any pitfalls regarding the time could not be avoided. My assumption is that BTs should gain from this study due to their reflective thoughts. Their participation in the study perhaps empowered their own growth in shaping their professional identity in becoming mathematics teachers.
3.7 SUMMARY OF RESEARCH DESIGN

The Table 3.8 below shows a summary of the study in a chronological manner.

Table 3.8: Summary of the study

<table>
<thead>
<tr>
<th>Phase</th>
<th>Technique/methods</th>
<th>Purpose</th>
<th>Type of data generated</th>
<th>How data is analysed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.Year 2011</td>
<td>Literature collection &amp; Pilot study</td>
<td>Gathering information on past research. The preliminary study conducted to understand the feasibility of the study.</td>
<td>Reading past works</td>
<td>Exploring various views</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Observations and interviews</td>
<td>Overall analysis on data collected</td>
</tr>
<tr>
<td>2.Year 2012-2013</td>
<td>Observation Interview (one-on-one, informal chats, focus group interview) Questionnaire Journal</td>
<td>Collecting the live data. Analysing the BTs’ classroom practices. Comparing the activities. Listening to their story. Identifying</td>
<td>Observations and interviews Video recording of interviews and observations Hard copies of journals, records of work, lesson plans (not used).</td>
<td>Interpretive analysis Describing the contents, coding and interpreting Direct quoting and interpreting Data is used to identify learning as changing.</td>
</tr>
<tr>
<td>3.Year 2014-2015</td>
<td>Thesis writing</td>
<td>Reporting the findings</td>
<td>Chronologically recorded data</td>
<td>Narrative method</td>
</tr>
<tr>
<td>4.Year 2015</td>
<td>Submission</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

3.8 CHAPTER SUMMARY

In this chapter I described the methods and methodologies of analysis in detail. This included the literature on methodology and identifying analytic tools.

A detailed model of the analytic tool and the indicators was discussed in sections 3.5.1 to 3.5.4 and which I demonstrated in Table 3.7. I also discussed the issue of validity and ethics.

In order to conclude this section, I provide Table 3.9 that shows how each method of data collection (mainly observation and interview) relates to the research question of this study. This helps the readers to understand the appropriateness of the data for the research question.
Table 3.9: A model for linking data to the research question (How do BTs shape their professional identity in their first three years of teaching)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Method of data collection</strong></td>
<td></td>
</tr>
<tr>
<td>Classroom observation/Interview (e.g. Jack Ob 1.011: <em>We said that</em>, this is an acute angle)</td>
<td></td>
</tr>
<tr>
<td><strong>2. Selected transcribed utterances from the data are categorised &amp; analysed</strong></td>
<td></td>
</tr>
<tr>
<td>Mathematizing &amp; Subjectifying (e.g. Mathematizing: <em>This is an acute angle</em>; Subjectifying: <em>We said that</em>)</td>
<td></td>
</tr>
<tr>
<td><strong>3. Selected subjectifying utterances are further analysed</strong></td>
<td></td>
</tr>
<tr>
<td>Reifying, endorsable and significant (e.g. Direct reification: <em>We said that …</em>)</td>
<td></td>
</tr>
<tr>
<td><strong>4. Selected reifying utterances are examined in detail</strong></td>
<td></td>
</tr>
<tr>
<td>Meanings and sense making actions (e.g. Use of the utterance, ‘we’ indicates inclusiveness. The context is a reminder to the students - what is previously said by the teacher).</td>
<td></td>
</tr>
<tr>
<td><strong>5. Meanings/sense making (final stage of analysis, linking to identity)</strong></td>
<td></td>
</tr>
<tr>
<td>Linking to the research questions (e.g. Use of the term, ‘we’ is a way of engaging with students - <strong>Personal identity</strong> - that builds a relationship between teacher and the students that may enhance mathematics learning - <strong>Teacher identity</strong>).</td>
<td></td>
</tr>
</tbody>
</table>

I use a similar model to extract the meaning and identity formation from such analysis in Chapter 4 and 5.
Do not worry about your difficulties in mathematics. I assure you that mine are greater (Albert Einstein)

CHAPTER 4

VERTICAL ANALYSIS

4.1 INTRODUCTION

In this chapter, I analyse the data collected from three participating BTs’ lessons. The analytic model discussed in Chapter 3 (Section 3.6; Table 3.7) assisted me in answering the research questions tabled in this study (Section 1.5). Three lessons from each BT are analysed according to the following categories:

- How the lessons have started;
- How some of their selected utterances identify their classroom approaches (as guided by the research questions). The interplay between subjectifying utterances and mathematizing utterances when they occur, the subjectifying utterances are examined further. These utterances when making sense to the BT or to the students become significant. These utterances are the indicators of learning process for BTs.
- How their lessons are concluded; and, finally,
- How their significant classroom utterances are linked to the broader study within the framework of Wenger’s (1998) theory of learning. Learning as changing practice and approach are considered to shape the professional identity.

The term ‘identity’ in this study mainly focuses on identity as negotiated experience on participant-BTs’ sense making of classroom practice and learning (Wenger, 1998). This becomes their narratives on ‘telling identities’ (Sfard & Prusak, 2005a). Consequently, learning is considered as socially shaped activities of these BTs in their classroom practice. Learning mathematics is conceived as a process of becoming a participant in a community communicating mathematically (Heyd-Metzuyanim, 2011). These views are crucial in order to realise learning and teaching mathematics as the interplay between mathematizing and subjectifying.

The utterances are subjectifying when linked to mathematical ideas, actions or concepts. For example, in one of the lessons, Jim said, **but are you aware that this one is in meter and that one in kilometer?** (Jim Ob 1.065). In this example, utterances; **this one is in meter and that one in kilometer** are mathematizing utterances due to the words *meter* and *kilometer* that he used. The
utterances; *are you aware that this one is in* are subjectifying because these complete the mathematizing utterances in a meaningful manner. The utterances; *are you aware that* … suggest that the interlocutor (BT) has better information on certain mathematical ideas compared to the students. The message could be that the teacher is an expert in mathematics knowledge in this context. Therefore, the BT is recognised as a certain kind of mathematics teacher. This is related to his teacher identity. I intend to follow a similar line of argument in order to understand how BTs learn to become mathematics teachers, hence the shaping of professional identity.

Furthermore, subjectifying utterances indicate the problem solver’s (teacher or students) own moves that activate mathematics learning (Heyd-Metzuyanim & Sfard, 2012). Therefore, these utterances identify a BT’s particular ways of approaching and initiating the classroom mathematics activities. This approach could be a learning process that shapes his professional identity.

Subsequently, I present a vertical analysis of each BT’s classroom practice and narrate their stories of their journey to become an old-timer through their subjectifying, reifying and identifying utterances. While analyzing the utterances vertically, it is also possible to interpret some of the findings horizontally within the context of the broader study. The advantage is to provide an insight to the link between what is going on in mathematics classrooms to the shaping of BTs’ identities. Furthermore, I explore the possible link to students’ mathematics learning (if interplay between mathematizing and subjectifying has been identified) with BTs’ subjectifying utterances.

4.2 PARTICIPANT 1 - Jack

4.2.0 Who is Jack?

Jack is working at Town High School. He graduated from LCE and holds a diploma in Education. He teaches Mathematics and Science at JC level. He identified himself as a certain kind of person in terms of teaching in the classroom. In his words:
When I talk about myself to some teachers at work, I always say to them, no I am a kind of person who loves students. And then I have ... time for students ... but then my problem is, I am staying very far from the school and then walk very long distance (Jack Int 4.109). When comes to (pause) the community outside, aye, not much to say. I don’t have much to say to the community about myself but then I think what I share with the people in the community is about what I want to achieve, what I want to have, ya (Jack Int 4.111).

Jack shared his dream with me (like he did with other people in the community) and said that he wanted to pursue his career to become a lecturer one day. At some point in the future, he wants to be a lecturer at NUL. Such dreams nourished him to grow confident in terms of improving classroom practice through reflecting on his limitations as a teacher. The way he shared his dream to be a lecturer and a master of mathematics showed a designated identity that illustrated confidence.

Jack reflects on his teaching experience

Jack’s identification with his career and a vision to study further become part of his actual identity too (Sfard & Prusak, 2005b). The illustration of his teaching career (present), experience (past) and vision (future) are closely linked to each other as he portrayed them. He said:

When I am looking at 2012, ok, that was my first year of teaching ... as an individual, you know the graph is not ... what can I say? (Jack Int 4.146). Yes, it is not smooth ... You know, if you are treating different topics, you may excel in this one, you may have problem in this one, in exams you may have a problem in this one. But what I have seen is that, they all need special attention. No topic, there is no topic, which is better than the other one. They are all the same, so ah, I tried to work on that. Making sure that ... let me have a level, not fluctuations. (Jack Int 4.148).

Jack narrates his views on mathematics content with emphasis on certain utterances (there is no topic, which is better than the other one). He continued the narrative: One other thing that motivated me is that I was teaching the JCs, last year. And then at the beginning, I thought I was not going to make it. But at the end of the day, I end up having some C’s and B’s (Jack Int 4.150). He was referring to the mathematics performance of his students in the JC examination, who obtained good credits. He produced many credits that included B and C (The passing grades start from A. A to C are considered as credits. The minimum grade is E to pass a subject at JC level. If a student is awarded the grade F, G or H, that meant that the student had failed to achieve the minimum pass mark). The good performance of his students motivated him very much. He continued his plan:
I am trying to make sure that I am not going to experience the same problem because. Now, if I told that (it is a problem), that will be my problem. I will be creating a problem and, which will also be a problem to me ... So I am trying to eradicate that. I am handling. I have two B’s. I am teaching maths. That means, next year I will be having three B’s, (and) three C’s (Jack Int 4.170).

His dream to become an experienced mathematics teacher in terms of producing better examination results was working for him (next year I will be having three B’s, three C’s). He was planning to change his teaching style in a certain way in order to produce the best outcome for the students (I am trying to make sure that...). He was beginning to see himself as a mathematics teacher.

4.2.1 Lesson 1 (Angle)

4.2.1.1 Introduction and overview of lesson 1

Jack started the lesson with specific instructions. He was teaching the topic Angles in Form A. He introduced various kinds of angles based on the angle measures. His expectation was that the students had prior knowledge on this topic. However, he later found that his assumption was wrong. He explored various angles (acute, obtuse, straight and reflex angles). By the end of the lesson, he concluded that he had achieved the objectives of the lesson.

4.2.1.2 Designing the lesson

The coming section analyses Jack’s classroom practice in order to understand how these utterances created meaning that indicated mathematics learning. The following vignette presents how Jack introduced this lesson.

Then, about measuring acute angles, and today we are going to look at, how do we measure obtuse angles? And, we have seen that there are steps that we should follow when measuring different kinds of angles. ... So the step that we are following is that, before you can measure an angle, the first thing that you should do, you have to decide now what type of an angle is this, right? Therefore, people look at this angle. What type of an angle is this one, yes? (Jack Ob 1.005).

See the sequence of the utterances that Jack used in this introductory monologue: Today, we are going to look at, there are steps that we should follow, for example, the first thing, and you have to decide. These subjectifying utterances are continuous, and logically followed from one
sentence to the other, and are intertwined with mathematizing actions. The sequence of utterances activates students’ curiosity. I present a model below in Table 4.1.

**Table 4.1: Mathematizing and subjectifying are intertwined** Key: *Today, we are going to look at ...*

<table>
<thead>
<tr>
<th>Transcription</th>
<th>My interpretation</th>
<th>Subjectifying</th>
<th>Mathematizing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack Ob 1.005. Jack: …., you have to decide now what type of an angle is this. Therefore, people look at this angle. What type of angle is this one?</td>
<td>Jack introduced the topic by providing a brief account on angles. You have to decide, now. Therefore, people, look at this …</td>
<td>What type of an angle is this? What type of an angle is this one?</td>
<td></td>
</tr>
</tbody>
</table>

These utterances indicated how Jack tried to unpack the topic Angles (*therefore, look at this..., what type*). He asked questions, suggested answers and guided them through various steps to explore the angles. Jack then elaborated on the meaning of an acute angle and described how to construct these angles. His effort to introduce the lesson was seamless though it might not be the same from students’ perspective. However, the utterances such as; *you have to decide now*, initiated students’ participation (Cobb *et al.*, 1996).

**4.2.1.3 Identifying utterances**

Table 4.2 demonstrates how he proceeded with the lesson.

**Table 4.2a: Mathematizing actions in progress** Key: *Then you look around*

Jack Ob 1.011: I said we should speak aloud, ok, next time you answer. We said that this is an acute angle because, an acute angle is divided as an angle, which is less than a right angle and we know that right angle is equivalent to 90 degrees. So we said that … you make sure that the centre of the protractor is elevated just like this. The centre of your protractor is elevated and … the protractor line should be along the line, along the arm BC like this. And then you look around the line to see if you come across the scale where … the scale starts with zero, right? Then from here you start reading until you come to the other half and then, what is the size of the angle shown here?

The most striking feature in my view was the frequent use of terms; *we, you and your*. Jack uttered the words like; *we said* and *we know* which gave a feeling of togetherness among the students and him in the classroom. Simultaneously, he showed authority by uttering; *then you*
look around, if you come, from here you start and until you come to the other half etc. These utterances are instructional, and they guided the students towards the desired goals of the lesson. That requires further analysis. My comments are in brackets.

**Table 4.2b: Mathematizing in action** Key: and we know that ...

<table>
<thead>
<tr>
<th>1st level subjectifying</th>
<th>2nd level subjectifying</th>
<th>3rd level subjectifying</th>
</tr>
</thead>
<tbody>
<tr>
<td>About specific performance</td>
<td>About performance</td>
<td>About the actor</td>
</tr>
<tr>
<td>We said that, (Reminder) this is an acute angle because it is less than a ... (volunteering) you make sure that ... (Insisting)</td>
<td>And then you look around … to see if you come across … Then from here you start reading until ...</td>
<td>and we know that … (Judgmental)</td>
</tr>
</tbody>
</table>

The first impression of these utterances is that the mathematizing actions are concomitant with subjectifying utterances, and this is a unique act. Note the use of utterances: I, we and you. Jack used these with specific objectives (instruction, authoritarian – I said -, inclusiveness – we know - and what is expected from students –you make sure -).

The utterance such as, because it is less than a ... qualify to be the first level of subjectifying, as it addressed a specific task. From there, he reminded them of what was happening earlier (we said that ...). I categorise these as the second level of subjectifying that indicate the nature of the task. When he uttered, and we know that ..., it was an instinct, though he had a flawed judgment with lack of evidence from the students. However, his assumption was based on the previous lesson. These utterances were interwoven with mathematizing actions (we know that right angle is equivalent to 90 degrees). In my view, these subjectifying utterances emphasised mathematizing actions that assisted the students to link the previous lesson with the current one and made sense for them.

However, Jack’s assumption on what students know or what they do not know (we know that …) was not based on any evidence that he had gathered from them. Was he rushing through the topic? It is possible, because students did not provide an answer immediately (Ref: Jack Ob 1.009. Jack: Yes, this is an acute angle, why this is an acute angle? Yes sir) and he decided to volunteer the answer. Does that mean that he overlooked their lack of prior-knowledge when uttering; and we know that …? Maybe that was a reminder for the students.
I analyse some of these utterances in Table 4.2, to understand if these reify and signify in the discourse of identity. My observations are indicated in brackets.

**Table 4.2c: Mathematizing and reifying actions** key: *You make sure that* ...

<table>
<thead>
<tr>
<th>Indirect reification (Providing information on what has to be done regarding something)</th>
<th>Direct reification (describing a person): What does Jack observe about him or about others?</th>
<th>Direct reification: Jack’s conclusion in a certain way.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I said we should speak aloud, ok, next time you answer (Instruction).</td>
<td>We said that this is an acute angle (Reminding) … and we know that … (Assuming)</td>
<td>You make sure that the centre of the protractor is elevated just like this (Alerting)</td>
</tr>
</tbody>
</table>

The first utterances qualified to be indirect reifying actions that were instructions for students on how they should behave in the class. These utterances did not link to any of the mathematics activity that followed, but showed Jack’s expectations on students’ behaviour in the classroom. Therefore these are categorised under indirect reifying actions. These utterances indicated his authority (*I said …*) and showed how students should respond to a particular situation (*speak aloud*).

Once Jack established his authority, he proceeded with the lesson and indicated that he was part of the community. For instance, he used utterances like, *we know that* ... are significant for two reasons. Firstly, unlike Jim (Ref: Jim’s story) Jack said, *we know that* instead of *you know that*. In other words these words are endorsing Jack’s inclusiveness. Secondly, like any other teacher (my observation), he assumes that the students come with certain background knowledge, which he did not test at this stage. He later justified in his interview: *When measuring angles, there are a few steps that should be followed. I realise that this needed pre-requisite knowledge, which I believe they have* (Jack Int 1.002).

Table 4.3a demonstrates Jack’s way of interacting with students. His purpose was to make sense of the term ‘obtuse angle’. Mathematizing activity then proceeded as expected.
Table 4.3a: Jack’s subjectifying utterances promote mathematizing Key: *By a mere look ...*

<table>
<thead>
<tr>
<th>Transcription</th>
<th>My interpretation</th>
<th>Subjectifying</th>
<th>Mathematizing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack Ob 1.011. Student 7: The inner scale.</td>
<td>(1.014) Do you mean inner circle? Thank you. Your answer is correct.</td>
<td>Who can come over here and draw for us and draw …</td>
<td>… an obtuse angle, … and measure it, measure its size.</td>
</tr>
<tr>
<td>Jack Ob 1.015. Jack: Thank you very much. Who can come over here and draw for us an obtuse angle … Who wants to come? …Yes sir, you draw an obtuse angle to measure and write down its size. You want a piece of chalk? Is that an obtuse angle? By a mere look, is that an obtuse angle?</td>
<td>(1.015) Various levels of instructions. Subjectifying utterances are not directly linked to mathematizing actions (The student drew an angle, but Jack considered that angle was not obtuse - Probing and guiding).</td>
<td>Somebody draw … Somebody, come and draw … Who wants to come? By a mere look …</td>
<td>Is that an obtuse angle?</td>
</tr>
</tbody>
</table>

As the lesson progressed, the mathematics teaching and learning activity reached the core of the lesson. These utterances demonstrated different levels of subjectification that indicated Jack’s approach (probing, insisting, repeating etc.) on interactions with students that linked to mathematizing actions. One student volunteered to draw an obtuse angle on the chalk-board. Due to the elevation of the angle, when looked at from a distance, Jack considered that it is a right
angle. For instance, look at the two utterances: *Is that an obtuse angle? By a mere look, is that an obtuse angle?* The way he uttered this guided the students towards a certain direction, and they said; *no*. Jack’s utterances therefore, require further analysis (Table 4.3c).

**Table 4.3c: Reifying Key: Somebody come and draw ...**

<table>
<thead>
<tr>
<th>1st level subjectifying</th>
<th>2nd level subjectifying</th>
<th>3rd level subjectifying</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who can come over here and draw for us an obtuse angle?</td>
<td>Somebody draw an obtuse angle</td>
<td>Somebody come and draw an obtuse angle and measure it, measure down its size…</td>
</tr>
<tr>
<td>Who wants to come?</td>
<td>Who wants to come and,</td>
<td></td>
</tr>
<tr>
<td>Yes sir, you draw an obtuse angle.</td>
<td>Is that an obtuse angle?</td>
<td>By a mere look, is that an obtuse angle?</td>
</tr>
</tbody>
</table>

Table 4.3c illustrates Jack’s ‘emotional hues’. For instance, look at the following utterances; *who can come over here and draw? ...*, *somebody draw an obtuse angle* and *somebody come and draw an obtuse angle*. The first utterances meant to invite a volunteer to draw an obtuse angle. In other words, he was looking for a participant. These utterances specified the purpose (*draw for us ...*). However, he observed that no one accepted his ‘invitation’. Therefore, he insisted with authority (*Somebody, draw an obtuse angle*) that was categorised under the second level. It seemed that the students were unable to form the ‘meaning’ of the term, *obtuse angle*. Then Jack instructed in a concluding tone (*Somebody come and draw an obtuse angle and measure it*). Finally, a student volunteered to respond. He drew and measured the angle. Jack’s immediate response (*Yes sir, you draw an obtuse angle*) was specifically encouraging the student. Although these utterances were undoubtedly associated with mathematizing, they did not inspire the students to understand the meaning of obtuse angle, as Jack later observed.

Even though the student drew the angle, Jack realised that the angle was not obtuse (*Is that an obtuse angle?*). Then he uttered; *by a mere look, is that an obtuse angle?* The tone hinted that the angle was not obtuse, and the students responded, *no sir* (Jack Ob 1.016).

Look at the following utterances: (a) *you draw an obtuse angle*, (b) *is that an obtuse angle?* (c) *By a mere look, is that an obtuse angle?* These utterances: (a) demonstrated instruction, while (b) guided the students to consider an answer and (c) led them to assume that the angle is not obtuse.
Therefore, other students concluded that the angle was not obtuse. Due to the way students made sense of these utterances, I consider that Jack’s utterances are reifying because these were leading the students in a certain direction. What do these utterances indicate? Did Jack misjudge the measurement of the angle that was drawn by the student? He later confessed that he could have given a chance for the student to explore the angle on the board (Jack Int 1.008). His thoughts are thus significant as he learned how he could have approached the concept of obtuse angles. I consider his reflective thoughts were a sense making process that may help him shape his teacher identity. I draw readers’ attention to Figure 4.1 (a rough sketch of the angle as it was drawn by the student).

![Figure 4.1: An angle drawn by one student](image)

Jack’s utterances and the tone guided the students to consider the possible options (acute, right and obtuse angles). He could have easily concluded the size of this angle by measuring it physically, rather than by a mere look. In his words, he could have given a chance for the student to explore the angle on the board (Jack Int 1.002). However, this particular incident is not considered as Jack’s ‘certain approach in the classroom’. He confessed; I wanted to save time. I assumed that the student will draw the obtuse angle as I have instructed (Jack Int. 1.010). Even though his particular decision made sense at that moment for him, he later realised that he could have given a chance to the students to engage in this activity. These are his special moments that helped him to act in a certain way in future. I consider such moments as shaping his identity.

At this juncture it is essential to look at these utterances from other perspectives in order to understand if these are reifying and identifying.
Table 4.3d: Reifying and identifying Jack’s approach  Key: By a mere look ... 

<table>
<thead>
<tr>
<th>Indirect reifying</th>
<th>1st level reifying</th>
<th>2nd level reifying</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who can come over here and draw for us an obtuse angle.</td>
<td>Who can come over here and draw for us an obtuse angle. Who wants to come? … and write down its size.</td>
<td>Somebody come and draw an obtuse angle and measure it. Who wants to come and …</td>
</tr>
<tr>
<td>Yes sir, (encouraging) you draw an obtuse angle to measure and write down its size.</td>
<td>You want a piece of chalk? Is that an obtuse angle?</td>
<td></td>
</tr>
<tr>
<td>You want a piece of chalk?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The utterances (Somebody come and draw, you draw an obtuse angle) are examples of specific actions that suggested what was going on in the classroom and his way of communicating to students. He said, yes sir. He uttered these in an encouraging tone (yes) and with respect (sir). When Jack asked, you want a piece of chalk, it demonstrated an assisting hand that created confidence for the student. These are the first level of reifying as these utterances encouraged the student to participate and to explore the task that Jack had assigned.

These utterances progressed to; (1) who can come over here and draw for us an obtuse angle? that progressed to, (2) somebody come and draw an obtuse angle and measure it, and then to (3) who wants to come? At first, Jack invited a volunteer to come and perform the task, but in the next utterances, he insisted that someone should come and draw the obtuse angle, as instructed. Look at the verbs he selected that implied different meanings: Who can come, somebody come, and who wants to come. The first utterances were addressed to the whole class. It was a free invitation for any student to participate. The second one was used in a tone that encouraged the students to come forward in order to perform the task (drawing the obtuse angle). However, no one volunteered. The final utterance was slightly twisted and manipulated through an additional word, wants, with a hope that one student might volunteer. Ultimately Jack succeeded and one student came to perform the task. In that sense, his effort was endorsable and is significant, but did not demonstrate any pattern. Subsequently the mathematics lesson continued without much confusion.

The lesson progressed to the next level. It was not clear if all students understood the ‘meaning’ of obtuse angle. Table 4.4 explores the next stage of the lesson (acute angles and reflex angles).
Table 4.4a: Mathematics learning in progress Key: Therefore what can we do?

<table>
<thead>
<tr>
<th>1st level subjectifying</th>
<th>2nd level subjectifying</th>
<th>3rd level subjectifying</th>
</tr>
</thead>
<tbody>
<tr>
<td>We are saying that …</td>
<td>Do you think we can still follow the same procedure? (Students say, no)</td>
<td>The answer is No (emphasis), why are people saying no? … (Teacher must be convinced).</td>
</tr>
<tr>
<td>Saying No? Therefore, what can we do? …</td>
<td>Come on man (encouraging)</td>
<td>Let us give him a chance (considerate and authoritarian)</td>
</tr>
<tr>
<td>Now let us give him a chance.</td>
<td>Who wants to help him? (Invitation).</td>
<td>That is correct. (Students clap the hands). Did you see what he has done?</td>
</tr>
</tbody>
</table>

The conversation from 1.020 to 1.024 demonstrated that mathematics learning was taking place as Jack expected. Students learned to measure an acute angle and an obtuse angle, and were able to calculate a reflex angle (Table 4.4a). The subjectifying utterances from Jack complemented mathematizing. Table 4.4b explores these utterances in order to see how these identify Jack’s classroom practice in this lesson.

Table 4.4b: Subjectifying and identifying Key: Let us see what he will come up with.

While students engaged in exploring the task, Jack had made a few observations and comments. Each utterance that he made indicated the way he created the meaning in the mathematical actions. The students then responded accordingly. These utterances were categorised in different levels of subjectifying actions.
Consider the following utterances: *We are saying, do you think we can, and why are people saying no.* The use of the terms, *we* and *you* created an atmosphere for the students and teacher to feel that they are together to address a certain task. As these utterances moved from one level to another, Jack created a collaborative atmosphere (*do you think, we can*) in the classroom. When the students answered *no*, he wanted an explanation that activated their thinking.

These utterances showed Jack’s approach (encouraging, inviting, clarifying, demanding, appreciative and considerate) of negotiating a meaning (Yackel & Cobb, 1996). Students observed that reflex angles cannot be measured directly using the protractor. Therefore, there is a need for them to measure or calculate the reflexive angles using other methods. Even though he accepted their ‘no’, he had to take the students to the next stage by asking; *therefore, what can we do?* He was specifically seeking an answer to the task at hand (how to measure the reflex angle). As a teacher, it was his responsibility to probe so that the students identify the answer. He encouraged the first volunteer to come forward (*Come on man*) and invited other members by uttering; *who wants to help him?* When a student started working on the task, Jack alerted others and said; *now, let us give him a chance.* He then stirred the curiosity of the class by uttering; *let us see what he will come up with.* Finally, he concluded the issue by saying; *let us give him a chance!* This showed his authority.

I categorised these repeating words in the 3rd level of subjectifying because these utterances emphasised the objective (*give him a chance*). When he said, *now, let us give him a chance*, he was seeking attention from the students. When he uttered these words for the second time, he removed the word, *now!* This implied that he was giving an instruction. These utterances showed how important it was for the class to follow what the student was doing so that they could conclude on the procedure of measuring the reflex angle.

When the student performed the task correctly, he wanted to clarify if others made sense from this action (Ref: Jack Ob 1.024: *Did you see what he has done*?). I analyse these further.
Table 4.4c: Reifying and endorsable Key: Did you see what he has done?

<table>
<thead>
<tr>
<th>Indirect reifying</th>
<th>1st level reifying</th>
<th>2nd level reifying</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saying, No? Therefore, what can we do?</td>
<td>Who wants to help him? (Invitation).</td>
<td>Let us see what he will come up with.</td>
</tr>
<tr>
<td>Come on man (encouraging).</td>
<td>Now, let us give him a chance.</td>
<td>Let us give him a chance.</td>
</tr>
<tr>
<td>Who wants to help him?</td>
<td></td>
<td>Did you see what he has done?</td>
</tr>
</tbody>
</table>

The utterances such as; what can we do; come on man and, who wants to help him? etc. qualified to be indirect reifying as these utterances addressed specific actions that indirectly linked to mathematizing. These utterances also demonstrated how Jack responded to a certain situation and tackled certain tasks. Students welcomed this approach that created a positive attitude for this lesson. When he repeated, let us give him a chance, Jack was performing the duty as a teacher and was seeking attention from the class towards the student, who was tackling the given task. Once the task was completed, Jack ensured that the students followed the steps that this student displayed (Did you see what he has done?).

Based on these observations, how should I describe Jack? He was a teacher who knew how to motivate the students, how to gather ‘something’ from them and to make sure that they were involved in ‘mathematics learning’. Jack is identified as a certain kind of a mathematics teacher. That is why I considered the utterances such as; let us give him a chance, did you see what he has done, as significant, and started shaping a pattern on Jack’s classroom practice that endorsed and signified these utterances.

The lesson proceeded with an elaboration on how a reflex angle should be calculated.
Jack started his ‘conversation’ in order to elaborate the procedure of calculating the reflex angle. The student successfully completed the task, and he was applauded by his peers. However, some students failed to understand the procedure. Therefore, Jack had to explain this. There was no unusual event that took place while explaining the procedure. Students gained knowledge through repetition (Niven, 2011) and by Jack’s explanation. The utterances fitted logically whereby subjectifying and mathematizing utterances intertwined (he knows that angles are always measured in degrees). I explore these utterances in order to identify their significance.

Consider the utterances that were shown above. Jack appreciated the efforts of students, reminded them of a few concepts and what they have learned previously. At some stage, he assumed that they knew the concept (we know that). I find these utterances significant for two reasons. This was not the first time he assumed that the students knew a certain concept, but this time, there was no need to clarify as they worked together. Secondly, his utterances were inclusive of him. When he excluded himself, he elaborated and interpreted the student’s action. Jack is conversant and engaged in a close conversation (look at how smart he is) with students as if he is mediating an event.
When he started the conversation, he said, *let us talk about it*. The utterances indicated his decision to elaborate the procedure of calculating the reflex angle that was already demonstrated by one student and therefore qualified to be an indirect reifying action. As he proceeded with the explanation, he formed an opinion on this student’s actions (*And look at how smart he is…*), interpreted and concluded correctly (*He has measured the angles because he knows that …*).

Jack had to describe and explain the student’s actions to conclude his performance on this task. His actions were justified based on what the student did on the chalk-board. He asked a question (*So what did he do?*) and concluded correctly with an explanation (*He measured the inside angle*). Therefore, I categorised these utterances in the first level of reifying and identifying. At the end of the conversation, he even appreciated the student’s effort (*look, how smart he is*). This was a natural end of the task according to him, and as a teacher, he could not say more than this. He whole-heartedly appreciated the student’s successful effort to perform the task. These reifying utterances should be read together with what he said previously, (*Remember we said that …, so he measured*). He was reminding them what they had learned earlier and justified their action. The comment was inclusive (*we*) and referred to what had happened (*we said that*) rather than assuming (*we know that*)

This assumption (*we know that*) can be considered as a limitation that sounded judgmental and indicated how Jack addressed certain challenges when considering students’ prior-knowledge. However these are the learning steps and opportunities to shape his identity. In his first interview, I did raise this issue, and he responded;

*At this moment, I do not have any definite strategy to identify their problems that they might have because their pre-requisite knowledge vary … The students were about to identify the measure of angles and the type of angle that represents. When measuring angles, there are a few steps that should be followed. I realise that this needed pre-requisite knowledge, which I believe they have. … (Jack Int 1.02)*… *It should be tested and assessed by me, though it was not fully or correctly evaluated* (Jack Int 1.06).

His reflective thoughts (*I realise that …*) were endorsable. His classroom practice is thus becoming significant. This is an indication that Jack is a person, who approaches teaching in a certain manner in order to achieve his goal as a teacher (*It should be tested and assessed by me*). A few examples were executed by students afterwards, and Jack concluded the lesson.
4.2.1.4 Conclusion of the lesson

Jack suggested two different ways of measuring the reflex angles (Jack Ob 1.036: *So there are 2 methods of calculating reflex angles, that is this one of extending the arm and this one of finding the inner angle and then subtracting it from 360*). When he asked which one was the best approach, many of them agreed that both approaches were equally good (Jack Ob 1.038. Students: *Two of them, two of them*). Even though Jack had certain concerns (Some students did not have prescribed text books that might have compromised their active participation in the learning), the lesson ended as he planned.

4.2.1.5 Linking the lesson to the identity

Jack concluded the lesson satisfactorily. I have observed a number of approaches that he followed in this lesson. For instance, he volunteered information, insisted on particular points so that the students would not repeat errors. He reminded them of what had happened earlier in order to link the concept and apply it with the activity. However, it was also noted that he made assumptions about their prior knowledge.

Managing time was a major limiting factor for Jack that compromised his teaching as he observed afterwards (Jack Int 1.010: *I wanted to save time. I assumed that the student will draw the obtuse angle as I have instructed*). This was endorsable because it could change his future approaches regarding time management in classrooms (Learning as practice - meaning). Jack had been actively engaged in students’ mathematics learning (Learning as doing - practice). He consistently described the procedure and the students had to listen and follow, though this could be interpreted as teacher centred. Niven (2011) considers this approach as a means to gain knowledge.

At some stage, students were given a chance to explore the questions on the chalk-board. Simultaneously, Jack guided them and they followed his instructions. See the utterances that Jack made; *We said that this is an ..., you make sure that the center of the protractor ...* (Jack Ob 1.011). The use of the term, *we* showed him to be part of the community. On the other hand, the utterance *you* demonstrated his authority. Using these particular utterances passed a certain meaning onto the students that may have an impact on them as well as on Jack. Therefore, this is an indication of learning as making sense (Meaning). At this juncture, I need to point out that
the vertical analysis that I follow in this chapter could be the starting point to analyze these horizontally. Therefore, time to time, I may link the findings to identities as necessitated in this study.

Consider the utterance; *we know that right angle is ...* (Jack Ob 1.011). The utterances *we know that* seemed to be judgmental. The knowledge that Jack owns for him and for his students were not established so far, though it could refer to the assumed or required prior knowledge of the students. These are the initial stage of Jack **learning to become** a mathematics teacher hence shaping his **professional identity** (Wenger, 1998). In Jack’s words:

> The students were about to identify the measure of angles and the type of angle that represents. When measuring angles, there are a few steps that should be followed. I realise that this needed **pre-requisite knowledge**, which I believe they have … At this moment, I do not have any definite strategy to identify their problems that they might have because the **pre-requisite knowledge** vary (Jack Int 1.002).

These utterances illustrated how Jack identified the need to assess students’ prior knowledge as well as his limitation on this matter. This understanding is the learning process for him in order to ‘become’ a mathematics teacher as he wished to be, in future. A change in practice is required in this sense (*Learning as practice*).

The questions asked by the teacher mostly required yes/no responses from the students. This was a typical classroom activity whereby teacher centred learning had taken place through a ‘chalk and talk’ style. Their response fitted the approach he had chosen regarding the dissemination of the topic. He explored many examples that were imitated by the students. Towards the end of the teaching exercise, students were able to attempt the questions successfully. Many of them measured the angles correctly. When there was an error, Jack came forward to correct it. By assisting students, he was trying to be part of the community (*Learning as belonging – community*).

Within the context of Jack’ classroom experience which I narrated, it will be interesting to see what changes took place in his next lesson that I observed.
4.2.2 Lesson 2 (Rotation)

4.2.2.1 Introduction and overview of the lesson

Jack started this lesson with a reminder of what they had learned previously (*we talked about rotation*). He then linked this to what he would be teaching on that day (*today we are going to learn how to find the centre of rotation*).

The advantage of such a beginning is that the classroom practice and students’ responses could be predictable. When these preliminaries were over, he prepared the ground for the activity by saying: *So today, we are going to learn about how we find the centre of the rotation. You are going to do it yourself but I am just going to do the whole set little bit so that you have an idea of what we do, ok?* (Jack Ob 2.007). This story reveals how Jack engaged in the teaching process.

4.2.2.2 Designing the lesson

Table 4.6 addresses the way Jack started the lesson.

**Table 4.6: Jack starts the lesson** Key: *Do you still remember ...?*

<table>
<thead>
<tr>
<th>Jack Ob 2.001:</th>
<th>In the previous day, we talked about the rotation, isn’t it?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack Ob 2.003:</td>
<td>And we have learned how to rotate a figure through a certain given angle … Do you still remember that?</td>
</tr>
<tr>
<td>Jack Ob 2.005:</td>
<td>So I promise you that today we are going to learn how to find the centre of rotation like we agreed that a rotation is defined whereby the direction, the angle and also the centre (of rotation).</td>
</tr>
</tbody>
</table>

Consider the utterances: *we talked about, we have learned, and we are going to learn*. These utterances repeatedly demonstrated his inclusiveness by uttering the word ‘we’. In this manner, mathematics learning was taking place in a community of which he was part.

In the coming section, I present the conversation that occurred between Jack and his students as he drew a diagram on the board. The Figure 4.2 below demonstrates a diagrammatic representation that was drawn by Jack (rough diagram) in order to explain how to find the centre of rotation of Δ ABC when transformed to the image, Δ A'B'C'. He drew these triangles roughly with a focus only on the procedure.
It was noted that the two triangles were congruent or proportional to each other. The transformation under discussion was rotation. The sub-topic was to identify the centre of rotation. His utterances (I am just going to do the whole set little bit so that you have an idea) suggested that these diagrams were only a representation. It was not clear if students considered the characteristics of rotation in order to tackle the task. Jack succeeded in describing and demonstrating the procedure to establish the centre of rotation.
Table 4.7a: Jack’s subjectifying and mathematizing utterances

<table>
<thead>
<tr>
<th>Key: You don’t know</th>
</tr>
</thead>
</table>

Jack Ob 2.010. Jack: This (Δ ABC) is the image of the triangle A¹B¹C¹. So this triangle ABC, by mere look, in fact has been rotated. We don’t know which angle or I can just roughly estimate (Can I roughly estimate? – Students say, no).

Jack Ob 2.012. Jack: All right, no problem. You don’t know through which angle has the triangle ABC, through which angle has it been rotated, we don’t know (Students say, yes).

Jack Ob 2.014. Jack: And we don’t know through which centre, right? (Students say, yes).

These utterances showed Jack’s assumptions on what they knew (Jack included) and what they did not know, but his assumptions (I can just roughly estimate) were not fully accepted by students. In response, Jack acknowledged their comments (All right, no problem) although he changed his mind. I explore these utterances further.

4.2.2.3 Jack demonstrates the key concept of the lesson

Table 4.7b: Subjectifying utterances indicate Jack’s assumptions

<table>
<thead>
<tr>
<th>Key: We don’t know.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>1st level Subjectification: About specific performance</th>
<th>2nd level Subjectification: About routine performance</th>
<th>3rd level Subjectification: About the actor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack Ob 2.010. Jack: … by mere look, in fact, has been rotated. We don’t know which angle or I can just roughly estimate.</td>
<td>Jack Ob 2.012. Jack: All right, no problem. You don’t know through which angle has the triangle ABC, through which angle has it been rotated, we don’t know.</td>
<td>Jack Ob 2.014. Jack: And we don’t know through which centre, right?</td>
</tr>
</tbody>
</table>

When Jack drew two triangles (ABC and A¹B¹C¹), he mentioned that Δ ABC was mapped onto Δ A¹B¹C¹ through rotation (By mere look in fact, has been rotated). It seemed to Jack that the triangle had been rotated. He took it further and suggested that we don’t know through which angle, the object had been rotated. He even volunteered to estimate the angle of rotation. However, the students stopped him from taking it further. According to them, rotation of angle cannot be concluded by a mere look on the object and the image (My interpretation). Jack accepted their suggestions without any objection (All right, no problem).
Jack acknowledged that they (including him) don’t know the angle of rotation, and it cannot be calculated by a mere look at those triangles, and therefore commented; we don’t know. He also approved the students’ observation (by repeating the utterances) that the angle of rotation could not be calculated by a mere look. These three utterances (alright, no problem, you don’t know and we don’t know) thus qualified to be in the second level of subjectifying, and demonstrated Jack’s way of assuring the students that they could tackle this challenge together.

Jack’s next utterance (And we don’t know through which centre, right?) shows that he recognised his incorrect pre-judgment. Therefore, he concluded that the centre of rotation needed to be identified. When he uttered the words a third time (and we don’t know), these clearly indicated that they are at the same level of agreement.

Jack’s utterances determined the course of mathematizing actions that were about to take place. He also formed a meaning from students’ responses (yes, no) and assured them how they are going to proceed with the lesson. These utterances are analysed further in Table 4.8c.

Table 4.7c: Jack’s utterances are reifying Key: You don’t know.

<table>
<thead>
<tr>
<th>Indirect reification (Forming an opinion about actions of someone or self or something)</th>
<th>Direct reification (describing a person): What does Jack observe about him or about others?</th>
<th>Direct reification Jack’s conclusion in a certain way</th>
</tr>
</thead>
<tbody>
<tr>
<td>By mere look, in fact has been rotated. And we don’t know through which centre, right?</td>
<td>We don’t know which angle or I can just roughly estimate. All right, no problem. You don’t know through which angle has the triangle ABC, through which angle has it been rotated</td>
<td>We don’t know. And we don’t know through which centre, right?</td>
</tr>
</tbody>
</table>

The conversations that were categorised under indirect reification suggest an opinion on the way to making sense. Firstly, Jack said; by a mere look, the triangle ABC had been rotated. The next stage was to identify the angle of rotation. When he suggested that the angle of rotation was unknown at that stage (We don’t know which angle), the purpose of this comment was to arouse curiosity among the students. It was a calculated move that he made to assist the students to assume the size of the angle before measuring it. He then asked if he could roughly estimate the angle, but the students said, no.
Jack acknowledged students’ responses and accepted that they did not know the angle of rotation. They refused his suggestion to estimate the angle. In my opinion, estimation provides an opportunity to confirm how close the exact answer could be (once they measured the angle), and that is why he asked if he could estimate the angle. However, he accepted their decision (All right, no problem). Identifying the situated meaning of the students’ response had an impact on his counter response (All right, no problem. You don’t know). These utterances thus qualify to be in the first level of reification that endorsed his next move, whereby he initiated and negotiated meaning (Niven, 2011). Jack then repeated the utterance; we don’t know in a concluding tone. He did not say ‘you’, instead he said we. He continued with his conversation and concluded that we don’t know through which centre. These utterances (we don’t know) that he repeated three times are reifying due to the repetition.

What does this tell us about Jack’s way of making sense of his practices? He is a person who could arouse students’ curiosity, be part of the community, seek an opinion and change the strategy if there is a need. He is able to identify the situated meanings and is able to take the students towards a designated destiny, as required. He demonstrated and explained how to find the centre of rotation and to measure the angle of rotation. He explained how to identify the centre of rotation by joining the corresponding vertices of the triangles (A to A¹, B to B¹ and C to C¹). Using the perpendicular bisectors of the newly formed line-segments, the centre of rotation can be identified (the perpendicular bisectors would meet at one point). The angle of rotation is thus identified (Ref: Jack Ob 2.016).

Jack’s descriptive utterances are dominated by a teacher-centred approach until he completed the task of finding the angle of rotation. The monologue was smooth with a neutral tone. At the end of the task, he gave the students a few assignments for group work. This can be considered as a move to gain knowledge through practice and repetition of activities (Niven, 2011). He monitored their work by moving from one group to the other. Many students were actively involved in the assignments that were given to them. This time he emphasised that the size of the image be exact to the object:

Make sure that triangles are congruent that means they are equal ... Make sure that you draw the diagram as it is. It should look exactly the way it is in the textbook. Make sure that all sides are equal. Sides on the image and the sides on the object are equal (Ref: Jack Ob 2.039).
4.2.2.4 Jack concludes the lesson

Mathematizing actions were concomitantly taking place with appropriate subjectifying utterances that Jack used (make sure ...). Students were able to follow what he had been demonstrating. The final stage of the lesson was to practice some examples by them (Jack Ob 2.038) and he instructed: You are going to do it in groups of five, those groups of yours that you are used to. Students grouped themselves and started working. They also started instructing each other on what and how to draw. Their utterances included; you want to prove, leave him alone etc., that attracted some laughter among them. Jack warned the students to reduce their voices and to focus on the work. However, students continued asking their friends to borrow their protractor or to bring it to them. Jack identified a meaning from this situation. He said:

They have chosen their teams (due to various interests they might have), … as a teacher I think you know your students ... so we are trying to improve those who are not performing well ...(and) if they have good relationships with one another they can be able to learn better, that’s what I think (Jack Int 2.014).

Jack achieved the objectives of the lesson. Then he gave them some assignments for practicing at home.

4.2.2.5 Linking the lesson to the identity

Jack followed two approaches for this lesson. Firstly he demonstrated one example using a rough sketch representation, whereby he used an authoritarian style of teaching that students obediently accepted. He engaged in describing the process of finding the angle of rotation. Secondly, he grouped the students in order to practice a few tasks and gave them clear instruction on how to perform those tasks. This approach initiated peer learning (you want to prove). In this regard my first question was to reflect on his classroom practice (Jack Int 2.001). Jack said:

I could see that I couldn’t monitor it well especially when it comes to some of the aspects that I find ... they are few who are involved ... in a group of five or six people we find 2 or 3 people are just only concentrating, the rest are just watching like they are just watching a movie ... so I do think that this type of teaching that is the group work, I have to improve it somehow ... making sure that all of them, their mind are all set with what they have been doing. And again one other thing that I may point out is that this group work, it doesn’t give all the students an opportunity to be handling like when we are dealing with geometry while you have to handle different mathematical instruments like the compass whatever. Some of them don’t have such a chance so they become less motivated ... Even though it may be in groups I do think they should be instructed somehow if the other one draws line the other one bisects it the other one do that and then so that everybody has a task to share (Jack Int 2.006).
These utterances reflected a true picture of how Jack observed students’ learning activities and their participation in group work. He was concerned with the limited number of students who were participating. He also observed that certain topics (like geometry) could not be taught through group work, as it is time consuming and makes some of them passive. Simultaneously, this approach helped many students to tackle the assignment, whereby they engaged in sharing, brainstorming, instructing and correcting each other. They enjoyed exploring the assignment during the group discussion while Jack acted as the facilitator and guide. In my view, his approach helped him to negotiate meaning from students’ actions and his sense making created new opportunity to learn new tactics (learning as becoming). I asked him to comment on his approach in this classroom compared to the previous lesson (Section 4.2) that I had observed. According to him:

_It was different when it comes to the assessment... They differ in assessment like here, pupil are given a concept. It is being delivered ... in a demonstration manner. The previous one also demonstration but then what is different, is the way the assessment is carried out. Ya. That is the difference. Again here, I had a chance to go to a very minimum group of people and made them aware of a certain concept and shift to the other one, ... I didn’t have a chance to go to (all groups) … Then you have a small group and that means we have small number of people. The concept delivered is easily handled (Jack Int 2.010)._

Jack acknowledged that both lessons used the demonstration method that was dominated by the ‘chalk and talk’ style followed by group-work for them. Due to limited time, he could not monitor all their work and as a result, he could not disseminate ‘certain concepts’ to everyone. In this regard, I asked him what difference this could bring in his teaching approach, if he had to repeat this lesson (Jack Int 2.011). Jack pointed out that he could have given them a chance to explore the task at hand. Secondly, he realised that the classroom was noisy as they engaged in discussion and he had to control their excitement. Lastly they have to know the functions and the benefits of the group work (Jack Int 2.012).

I asked Jack to comment on the strengths and limitations of this particular lesson. In his opinion, classroom teaching is perfect only when it is carried out perfectly (Jack Int 2.020). According to him, the teacher centred approach has its own strengths but one of the limitations is that teacher centred teaching is _too formal_. On the other hand, if the students are involved in group work and peer-learning, then they understand each other and save time (Jack Int 2.020). His main concern was: _If you want to teach pupil a certain thing ... you have to come to their level so sometimes it_
becomes a problem for a teacher to come to the level of the students (Jack Int 2.020). In my view, there is no identity crisis in his concern but an opportunity that he creates from such learning moments.

Jack needs to work out a formula to combine various approaches that might contribute to a balanced atmosphere in the classrooms. The right combination of the approaches that he employed in the classroom may bring an expected result for him. Considering his reflective thoughts, I found that he is beginning to learn how to become a successful mathematics teacher through his experience in the classrooms and his understanding of the situated meanings. I link this to Wenger’s Learning as experience (Meaning). Within that ‘learning’ he may make sense of his classroom practice and shape his identity as a mathematics teacher.

Jack’s willingness to reach out to the members of the mathematics department by inviting them to his classroom is fascinating. This was another identity opportunity in my view. Such opportunities enhance his learning to become an experienced teacher. In his own words:

*We scheme together … but we may not teach the same topics at the same time … then in actual fact I have never find myself going to someone asking for some help like saying … how could I be helped. No! I haven't done that. I don’t know why. I don’t have valid reason that makes me to approach them but there is one Me’ (Sesotho word for lady) in the staffroom, who is teaching physics, yes that is the person whom I always approach because we are sitting desk to desk. We are always facing each other like that, so whenever I want to do something that I feel troublesome or whatever, I always ask her. That is the person whom (I can approach). We have good interaction. As for others, I do think we still have good interaction. The problem is that we are using different staff rooms so they are that side, I am this side. There is that bridge between, that’s the main problem, but when it comes to like friendship, setting tests for the external classes, we set something (together) – (Jack Int 2.034).*

I asked him about the impact of having two separate staff rooms on his working relationship with other members of the community. He agreed that; ... community is affected somehow, I see ... because I will have to go to them time after time whenever I want ... I am always going there, coming back, then sometimes you find that people are in the middle of the speech which has been ‘uncomfortable for all’ (Jack Int 2.038). This may suggest that the community of practice within the department or the school community is compromised. This also created an identity crisis within the department for him. He further added;
At times the conflict resulted in confusion on setting the question papers etc. In order to find a solution, we sit down trying to discuss the other way or rearrange it another way, ... because two of them have covered the topic that I have not covered therefore when I asked, they say, they have forgotten to inform me such things because now the year is going to the end. The syllabus would have all been done ... somehow ... it won’t bring any tension ... I did talk to that teacher (Jack Int 2.044).

These utterances demonstrated Jack’s concern with such incidents within the school community (identity crisis), as well as his wish to address this concern (opportunity). It also demonstrated Jack’s way of creating a cordial working atmosphere and his way of approaching his colleagues when there was a need. This was an example of Jack’s way of interacting with members within the school community that shaped the communities of practice identity for him at school.

Jack also had a ‘tough time’ teaching some students. In his words;

*Trying to squeeze a big thing in one year brought more challenges for all. All in all, I don’t know what is going to happen but I tried my level best. I am even trying. I am not going to stop because ... I want to make sure that they are well polished so that I will wash my hands and sit aside and then expect whatever may happen* (Jack Int 2.045).

Jack talked about his work at Town High School. He was a privately paid teacher and therefore was not comfortable about that situation because he felt that he was not part of the community. It could mean that he either received lesser salary or failed to have a permanent monthly income. When other members talked about their salary on ‘pay day’ he felt like an outcast and started wondering, *when am I going to have it? I sometimes have that tension* (Jack Int 2.050). This frustration shaped him to be a different person within the school community as he appeared to be ‘un-equal’ within the teaching community. Was he experiencing a different identity at school? How did this affect his profession? The next classroom observations may answer these questions.
4.2.3 Lesson 3 (Statistics)

4.2.3.1 Introduction and overview of the lesson

My classroom observation of Jack’s teaching was taken to a new level. This was my final observation of Jack’s classroom teaching for the year 2012. It appeared to me as if he was rushing to complete the syllabi that he had planned at the beginning of the year. The final term of the year is very crucial for mathematics teachers as they need to prepare their students for the term-end examination. Within this context, I asked Jack to justify the reason for choosing the topic, statistics (Jack Int 3.001). He justified in the following way:

This is how I select topics, we will be having a scheme from LSMTA then among the scheme, … looking at the time factor like how long will this topic take if I teach it this way, then if the time is limited ... then I will teach an alternative teaching approach (Jack Int 3.002).

In short, he stated that the topic would be chosen as guided by LSMTA. They also consider the topics that were already covered and the time required for the topic to be completed (Jack Int 3.002). The other factor is the kind of students in the class. Considering all these factors, he had chosen the topic Introduction to Statistics, which is short, easy and interesting. The following vignette demonstrated his general concern on this matter:

I am a person who talks fast normally, so with them I always slow (down) because I want to ensure that they have all understood ... If they are given the work and then they are doing it individually, I will always go to every child, ... but I am happy because they are improving ... I do have a belief that maybe I am following the right direction with them (Jack Int 3.073).

Jack considers himself as an approachable person (Jack Int 3.075) with whom students are free and comfortable (Jack Int 3.077). He learned that the students study better in a lively atmosphere (Jack Int 3.079). These observations made him believe that he is following the right direction. These utterances demonstrated his confidence as a teacher and the purpose of being a teacher (I want to ensure that they have all understood, I will always go to every child). He assessed and identified their progress that indicated the right direction that he has taken.

In the next section, I explore his classroom practice to understand how he tried to make sense of his approach.
4.2.3.2 Designing of the lesson

Jack started assessing students’ prior knowledge on the topic by asking a few questions. Interestingly, he received various responses from them. Once he was satisfied with students’ prior knowledge, he started the lesson. I provide the vignette below that demonstrates the sequence of the subjectifying utterances:

*So yesterday, we did the statistical information on the table I gave you. So today, we are going to look at collecting and recording the data. How can we collect and record data? Remember, what I said about data. I told you that data is nothing but basic information and it is a special way of getting information in the form of number. Therefore, we are talking about data.* (This) simply means you make all information. So today, we deal with collecting and recording data and then you are going to look at various ways in which individuals can collect data (Jack Ob 3.005).

These utterances were categorised into three levels and require further discussion:

**Table 4.8: Jack introduced the topic** Key: *Remember, what I said …*

<table>
<thead>
<tr>
<th>1st level: About specific performance/task</th>
<th>2nd level: About routine performance</th>
<th>3rd level: About the actor</th>
</tr>
</thead>
<tbody>
<tr>
<td>So yesterday, we did …</td>
<td>Remember, what I said about data.</td>
<td>So today, we deal with…</td>
</tr>
<tr>
<td>So today, we are going to look at…</td>
<td>I told you …</td>
<td>then you are going to look…</td>
</tr>
<tr>
<td></td>
<td>Therefore, we are talking …</td>
<td></td>
</tr>
</tbody>
</table>

There was nothing unusual about these utterances that linked his previous lesson to the one that he had planned for that particular day. These utterances linked the past (*yesterday we did*) with present (*today, we deal with*) that reminded and indirectly connected to mathematizing. Therefore, I consider these utterances under the first level subjectifying. The utterances *so today we deal with, and then you are going to look at …* specify the plan he designed. These are thus categorised under the third level of subjectifying action. These actions were not necessarily significant but were subjected to discussion as they showed how Jack started his lesson.

The use of the utterances, *I, we* and *you* are significant as it indicated how Jack passed on some messages to the students. For instance, utterances like, *we did, we deal with,* and *we are going to look at* specifically included Jack as part of the community. Simultaneously the utterances, *remember what I said about data. I told you …* demonstrated Jack’s position and authority as a
teacher and the students’ positions as the recipients of the message. He then concluded that; you are going to look at various ways in which individuals can collect data.

4.2.3.3 Identifying Jack’s utterances

At this juncture, as part of the lesson, Jack introduced two imaginary students who were involved in a data collection activity. I present the vignette below that illustrates his narrative:

Table 4.9: Jack starts the lesson with a story Key: Do you think ...?

| Jack Ob 3.005: … I got some examples of two students who were asked to collect data. They were asked to stand by the road-side, and then to record the type of vehicle that passes across the road. That is what we look at. So we are going to start. Let us look at how the first student collected the data from the road. Let us look at the first student. The first student was standing along the road and then apparently … standing. What did she saw (see)? She saw a car, and another car and she saw a lorry. Then after the lorry, she saw a motor bike. After the motor bike, she saw a car again. And then, she saw a bicycle. And finally she saw a motor bike again. So this is the types of vehicles the first student has seen and this is how he has collected the data like, he has already collected data that I have shown here. And then look at how the first student has collected the data. What if there are four buses at the same time? Do you think the student will have time to write, four times? |

Jack started the lesson with a long monologue and ended with questions that required a response from students. He narrated the story as if the actors in this story had truly existed. They performed the task as if he had instructed them to do so (data collection). These imaginary students counted the number of vehicles on the road on a particular day and time. The type of vehicles and the numbers were recorded. His role was to report the findings, justify their conclusion, and interpret their data to the class. This was the starting point of a new approach in the sense that he used a story telling style in order to teach how to record data. Secondly, he analysed their report and narrated the story to the class, to which they listened, with enthusiasm.

The following utterances take the class to the next level that tactically established the relevance of the topic to daily life. The main assumption when quoting these utterances was that these intertwined the subjectifying and the mathematizing, shaping one another. It is not easy to test if learning took place in this classroom by exploring these utterances because these are dominated by Jack’s monologue, followed by students’ responses that were limited to single words like yes or no etc. The teaching approach was the same (chalk and talk) as the previous ones. The significant difference was that Jack used a story telling structure to disseminate the procedure of
data collection and recording. In this lesson he was identified as a good story teller. At the end of
the story, he allowed the students to explore a couple of assignments, in which he played the role
of a guide. I proceed with his narrative.

**Table 4.10a: Jack continues the story** Key: *Do you see the problem?*

| Jack Ob 3.005 -14. Jack: And then look at how the first student has collected the data. What if there are
| are four buses at the same time? Do you think the student will have time to write four times? So do you see
| the problem, he might make a mistake, right? So this is what the first student made (Writing on the
| board) Let us see the second student. How did the second student collect the data? How did the second
| student collect the data? The second student has done this report. She has made some preparations
| before. How did she prepare? She has decided, ok, let me try to draw a table. That will show the type of
| car that will pass along the road, right? Then she drew the second table with first column, second
| column and then the third column. And then she told herself that the first, the first column is the
| column of vehicles right? Then she writes, this column will contain the vehicles. Then she noted the 5
| vehicles that bypassed the road. And then she wrote the car, motorbike, then a bicycle and maybe a bus.
| You see! (He drew a table as shown below). |

As Jack continued with his narration, these utterances illustrated the way the data were collected
and recorded. It gave a lively picture of the main character, her way of collecting data and
recording afterwards. Jack narrated the story in a grandmotherly tone (*So do you see the
problem*) and occasionally asked the question that would lead the students to respond
accordingly. When I asked him to comment on the teaching strategy that he had chosen for this
lesson, he said: *I choose the teaching strategy depending on the type of topic I am teaching* (Jack
Int 3.008). Through these invented characters, he demonstrated how the second student’s data
was different from the first one, and that dramatically linked the story of data collection to the
recording of the data. He even interpreted the thinking of that student (*ok, let me try to draw the
table*). These imaginary characters followed his instruction as required. The students listened to
the story in a relaxed mood. They followed the story and responded appropriately without
distracting the flow of the story. Occasionally, Jack would raise a few concerns as if he was
talking to himself, and found answers by himself.

Jack’s story telling style had a convincing tone and he portrayed it in a dramatic manner.
Students were immersed in the story as if asking ‘what next’, and his questions were
appropriately answered by them. Jack focused on the second student’s data collection and her
recording, which established the objectives of the lesson. Figure 4.3 below demonstrates the way the imaginary student tried to record the data that she had gathered.

<table>
<thead>
<tr>
<th>Stage 1</th>
<th>Stage 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>The student recorded the data using the tally marks.</td>
<td>The student counted the tallies and recorded</td>
</tr>
<tr>
<td>Vehicles</td>
<td>Tally marks</td>
</tr>
<tr>
<td>Car</td>
<td>III</td>
</tr>
<tr>
<td>Lorry</td>
<td>II</td>
</tr>
<tr>
<td>Motor bike</td>
<td></td>
</tr>
<tr>
<td>Bicycle</td>
<td></td>
</tr>
<tr>
<td>Bus</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 4.3 Key: Ok, let me try to draw a table*

I selected a couple of utterances for a sample analysis of Jack’s narrative as shown below:

**Table 4.10b: Jack’s story was reifying**

<table>
<thead>
<tr>
<th>Indirect reification (Forming an opinion about actions of someone or self or something)</th>
<th>Direct reification (describing a person): What does Jack observe about him or about others?</th>
<th>Direct reification Jack’s conclusion in a certain way</th>
</tr>
</thead>
<tbody>
<tr>
<td>And then look at …</td>
<td>So do you see the problem … Let us see the second student. And then she told herself …</td>
<td>She has decided, ok, let me try to draw a table. You see!</td>
</tr>
<tr>
<td>And then she told herself …</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These subjectifying utterances that I had chosen (Table 4.10b) demonstrated various levels of reifying actions, within the context of mathematizing and mathematical learning. These utterances are not repeated and not enough to indicate any pattern in Jack’s approach or their impact on him and the students. They reify because at one stage, he started living with the character and the interpretation he had (*She has decided*) on the girl’s thinking (*ok, let me try to draw a table*). Throughout the lesson, his monologue style was consistent which made the story sensible for the students.

Jack’s narration followed the rules of a story. It had a beginning and the sequences were linked through the utterances like ‘and, then’ etc. At times, he would ask questions that were answered by him. The narrator (Jack) obviously captured the attention of the audience (students), who followed him eagerly. The indirect reifying utterances (*And then look at, then she told herself*) demonstrated what was expected by the imaginary character. Jack interpreted the actions of the
character in a tone that sounded genuine. The utterances like *do you see the problem* were pronounced in a tone that required an appreciative response from his audience, which he received without any challenge. After concluding the story of the first character, he introduced the main character, who recorded the data statistically. She was the heroine of the story. Consider these two utterances, (*do you see, let us see*) that brought a different ownership of the characters that he had introduced. The first character was pushed out of the main stream and was dis-owed by Jack (*do you see*), but he welcomed the second character, heroine of his story (*let us see*) and invited his audience to be part of the welcoming.

While narrating the story, Jack started internalising the heroine’s way of thinking and the way she made sense of her actions (*And then she told herself*). The narrator was not only following her actions but also interpreting them for the audience. Finally, he concluded the story with an appreciative tone (*You see!* in a justifying manner.

What is significant about this story telling approach? Jack’s way of linking the story to the core of the lesson (data collection and recording) was unique, influential and teacher-centred. Among the participant BT’s, this was the first time I observed this particular approach that was a dramatic and colourful way of presenting a concept in a story line. I observed that this approach had an impact on students. Story telling is an art and children in most communities grew up listening to the stories told by elders or peers. These stories were significant in a way that shaped the identity for any member in a community. Story telling thus played a cultural and social role in any community that influenced children to grow with values, like their heroes and heroines.

The approach that Jack had taken was significant in its own way. There was an innocent nature in him that might have made him choose this approach. The topic itself was not difficult. He could have started the lesson straight away without any difficulty but he had chosen this approach. He was imaginative. He had a knack of storytelling. In my opinion, this was a unique approach in mathematics classrooms. He was able to take the students through different story lines and he reached the destination as desired.

I made the following observations regarding Jack’s classroom practice on this day:
Jack continued displaying how this imaginary student continued her work. He described the procedure of recording the data statistically, which was the core of the lesson. In this classroom practice, the dissemination of the lesson was the same as the previous one (teacher-centred - chalk and talk style) whereby the teacher describes a sample that can be imitated by the students. The only difference was that he wrote the screenplay as if he was the narrator. He portrayed the picture of a student, who performed a particular task in a particular manner. At the end, the message was to imitate that ‘good student’ because it ‘is easy for a student to record this data’ (Jack Ob 3.016). Figure 4.3 shows two stages of data recording. Based on the table that was drawn by the imaginary student, Jack started asking questions. When one tells a story, asking questions is essential in order to clarify if the listeners are following the narrator. The utterances that he made and the response that he received were intertwined with mathematizing that perhaps demonstrated mathematics learning. With the assistance of the students, Jack concluded the data recording as shown below in Figure 4.4:

<table>
<thead>
<tr>
<th>Vehicles</th>
<th>Tally marks</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td>III</td>
<td>3</td>
</tr>
<tr>
<td>Lorry</td>
<td>II</td>
<td>2</td>
</tr>
<tr>
<td>Motor bike</td>
<td>IV</td>
<td>5</td>
</tr>
<tr>
<td>Bicycle</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bus</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*Figure 4.4: Conclusion*

Jack concluded the story as he planned. The ending of the story did not necessarily indicate that mathematics learning took place. The story displayed the concept of recording data. The story was also a tool to explain how the heroine of the story collected certain data and used a mechanism to record these data. The purpose of this approach was to indicate that the students could imitate this method. However, these are my interpretations. The story of the girl who collected and recorded the data ended here. His presentation had a cognitive and mathematical side of the story, which described how to record any data using tally marks. I interpret these
narratives and the approach that he used as a way to introduce a method of data recording. There is a need to explore the next sequence of events in light of this teaching approach.

At this juncture, Jack decided to give the students a task that was pre-planned. In his words;

*I am going to give you a puzzle. I got some small papers that are folded. They have the numbers from one to six, ok? Those numbers ... represent shoe sizes of different pupils from a certain Secondary school, right? (Jack Ob 3.035). Then we are going to collect those data and record it (these) as the second student has collected (Jack Ob 3.037).*

These utterances indicated what should be done with the assignment that was given to the students. Jack expected the students to follow his example (as narrated earlier) even though that did not happen as he wished. I present the following utterances in Table 4.11 as shown below:

**Table 4.11: Mathematizing in action** Key: *How many columns are you going to have?*

<table>
<thead>
<tr>
<th>Jack’s utterances</th>
<th>Students’ responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack Ob 3.039: So tell me, how many columns are you going to have?</td>
<td>Jack Ob 3.040. Students: Six.</td>
</tr>
</tbody>
</table>

Jack’s utterances (*how many ...*) indicate a mathematizing action that required a response from students. Their answers however demonstrated that they did not have a clear understanding on what was happening. In short, mathematics learning was not taking place. Jack’s question (*how many columns are you going to have?*) attracted various responses from students (*six, five, three, four*). This indicated that students did not figure out how many columns are needed for recording the data. Jack specifically illustrated (Ref: Table 10b) how the imaginary student recorded her data by drawing a specific number of columns. The expected answer was three. When students had thrown about various numbers as answers, Jack realised that the students had no idea of what was going on.

Students seemed to be absorbed in the story but failed to understand the mathematical concept. He observed that the students perhaps did not know what row and column meant. Jack had to
draw a couple of tables to demonstrate rows (horizontal tables) and columns (vertical tables). He did not obtain the correct answer until someone uttered three at a later stage, and then he accepted it without further elaboration. Once Jack wrote shoe size in the first column and recorded the relevant data, students then guessed the next step, connecting the appropriate tally marks to the total number (Jack Ob 3.055-058). Once the number of columns was concluded, he instructed the students to start working in groups. They were given some folded papers, on which he had written some information (shoe size). The task was to record the information using tally marks.

As Jack moved around and monitored the work, he observed a few errors made by students. He assisted them to rectify those errors. Students thus started making sense of the concept and procedure (Jack Ob 3.066. Jack: I said the sizes are from one to six, right? That means you should have from 1, 2, 3, 4, 5, 6 ... There is no problem with three, five, six but you have to put them in order, starting from one, two, three, four, five, just like that. Does it make sense?). Similar practice continued until the end of the lesson. Students listened to Jack’s interpretations and amended their work accordingly. They began making sense of the procedure that needed to be followed while recording the data. Jack continued his act that is explored and shown below:

Table 4.12: Subjectifying and mathematizing Key: What is that you are writing?

<table>
<thead>
<tr>
<th>Jack’s utterances</th>
<th>My comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack Ob 3.086. Jack: What is that you are writing? Let me see what you have written.</td>
<td>It seemed that Jack was concerned with the way one student answered. Therefore, he scrutinised the work and was satisfied. He found that one student started re-drawing the table and that irritated him (you are wasting time). Jack found that one shoe size was not indicated on the column. The student was concerned about 2 rather than 6, and started looking around for the paper that is written two.</td>
</tr>
<tr>
<td>Ok (looking at their work) you are starting again (?) You just cancel. You are wasting time. You just cancel here and here. And then, you start working here again. Are they all? (Counts) One, two, three, four, five. Where is the other, sixth? (Jack Ob 3.087. Student 8: Where is two?)</td>
<td></td>
</tr>
<tr>
<td>Jack Ob 3.088. Jack: Where is sixth? I said it should be six numbers. How many ones? One. Twos, two. Threes, one. How many now? And how many fives? One five. Then, what is the total number? Five... Search for it</td>
<td>Jack insisted that the student should search for the paper that was written 6. Students in the group started looking for the paper. Jack started counting the numbers that were written on the papers and started questioning them. One student indicated the answer as 1 using his finger. Students recorded correctly. Jack instructed the students to search for the missing paper.</td>
</tr>
</tbody>
</table>
Table 4.12 demonstrates what took place in the classroom. Students were actively involved in reading, interpreting and recording the data as Jack had instructed earlier. He was satisfied with the progress that the students made. He then decided to conclude the lesson.

4.2.3.4 Conclusion of the lesson

Jack concluded the lesson by indicating what they had done, *(today we have done collecting and recording data)* and what will be done in his next lesson *(tomorrow we are going to do some work on data collection)*. He considered that the lesson ended satisfactorily, although some students did not complete the assignment due to the time factor. The table below shows Jack’s utterances that I examined in detail.

**Table 4.13a: Jack concluded the lesson** Key: *This is one way of collecting and recording data.*

<table>
<thead>
<tr>
<th>Jack’s utterances</th>
<th>My comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack Ob 3.090: Ok, time up. It is time up. So tomorrow we shall continue because I see that some of you have problems with collecting data, right? So tomorrow we are going to do some work on data collection. But on and all, today we have done collecting and recording data. This is one way of collecting and recording data. Then we shall proceed tomorrow. Thank you.</td>
<td>Jack concluded the lesson and stopped the students from the activity. He had observed that the students were not able to complete the task. Therefore he promised to continue the lesson later.</td>
</tr>
</tbody>
</table>

The concluding section followed the pattern on what was done at present, and what will be done in the coming lesson. These utterances require further analysis.

**Table 4.13b: Concluding the lesson** Key: *This is one way of collecting and recording data*

<table>
<thead>
<tr>
<th>Indirect reification (Forming an opinion about actions of someone or self or something)</th>
<th>Direct reification (describing a person): What does Jack observe about him or about others?</th>
<th>Direct reification Jack’s conclusion in a certain way</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ok, time up. It is time up. So tomorrow we shall continue … But on and all, today we have done collecting and recording data. Then we shall proceed tomorrow. Thank you.</td>
<td>Because I see that some of you have problems with collecting data, right?</td>
<td>So tomorrow we are going to do some work on data collection. This is one way of collecting and recording data. Then we shall proceed tomorrow. Thank you.</td>
</tr>
</tbody>
</table>
The utterances quoted above indicate how Jack concluded the lesson. Such utterances (*Ok, time up*) are usual in many of his classrooms. These utterances were categorised under indirect reification and showed that he had formed an opinion about the outcome. He promised them that he would continue the lesson in the next lesson (*I see that some of you have problems with collecting data*). This observation endorsed Jack’s future plan which is significant in identifying the way he made sense of his actions and its impact on students’ mathematics learning (*So tomorrow we are going to do some work on data collection*).

### 4.2.3.5 Linking the lesson to the identity

The situated meaning that Jack made out of his approach (as well as from the students’ response) is as follows:

Jack concluded that the way he conducted the lesson had only partially achieved the aim of the lesson. Therefore there was a need for him to continue the lesson in order to achieve it fully as he had originally designed. What does this mean to him and his students regarding the teaching approach? When he uttered *then we shall proceed tomorrow*, Jack was bringing hope in the minds of students as well as ensuring them that they will explore the topic further. I asked him if he would change this particular approach of teaching in the future and he responded:

> *I don’t know but actually because the same procedure that I used in A4, this one that I am teaching, I used in A3 and it worked faster in A3 because they are ... more able than this one, so I still think I will do it but I will have to improvise somehow* (Jack Int 3.012).

The significance is that Jack identified the importance of this approach that he employed in this class, which indicated future actions that he might take to improve it further (*Learning as experience*). His story illustrated anticipated change (*think I will do it*). Change in practice in the next mathematics lesson was then expected by Jack, which made sense for him (*Teacher Identity*).

In light of the events that were explored, I consider that Jack’s identity discourse took various paths. His identifying activities were *mathematizing* (*I see that some of you have problems with collecting data*). In one way, his descriptive procedure of recording the data was not free from the teacher-centred teaching approach. He could have achieved the goals by probing the students through asking questions that are related to the focus of the lesson. Students were pre-occupied
with the story about the girl who collected the data but they ignored the way she performed it. This perhaps compromised their mathematics learning. In this context, Jack’s Mathematics Identity did not cohere with that of the students as they had different experiences in the classroom. Jack’s demonstration of the procedure (Figure 4.3) was partially ignored or rejected by the students and therefore, they failed to answer the assignment afterwards. Once Jack recognised this, he decided that he would continue the lesson the next day (tomorrow we are going to do some work). This made his experience significant.

4.3 PARTICIPANT 2 - Jim

4.3.0 Who is Jim?

Before proceeding with the story, I portray a picture of Jim, as a person and as a teacher in order to understand the way he approaches teaching. He is young and enthusiastic. He obtained a general BSc degree in Mathematics and Physics but did not have any formal training in education. He had a dream to pursue a bright future and successful career as a teacher. During the first half of 2011, he accepted an offer at Ha-Rasta High School as a mathematics teacher. The expectations from newly employed teachers regarding the academic performance of the mathematics students were very high at this school.

I asked him how he became a mathematics teacher. In his own words:

I grew up just like any other boy. After school, we are used to run after the cattle as a herd-boy. On Saturdays, I would go and look after the animals, so basically the two (work and study) co-existed... I was brought (up) by my grandmother. She knew that she had a brilliant grandson. At the beginning of the year, we would go to the bookshop with her. She would make sure that I have the Maths book, before anything else... that is how she contributed to me being who I am today (Jim Re 1.133). When I was in high school ... I got influence from my Maths and Science teacher... I used to be a brilliant boy then, so I was building much confidence as a young and growing mathematician. I have realised that I can be able to passing information to other people... I think that was building me as a student into the person that I am today (Jim Re 1.120).

This narrative indicates two things about Jim. He realised that he has a certain way of passing on relevant information to others. Secondly, he trusted his teachers and therefore considered himself to be a good teacher who could be trusted by his students. According to Jim, these are the most crucial qualities that identified a person to be a teacher. How did he find his workplace?
When I came to my school here, Ha-Rasta, one thing was clear that they were for long time, even now, were striving for excellence in maths and science. They are working hard (and he will become one of them). The maths and science department are putting more effort because they are striving ... that is what I have seen interesting, what I have become part of (Jim Re 1.137).

He elaborated the attitude and the approach the students at this school have towards mathematics:

I love Mathematics although I have seen that in team-teaching, the way they approach Mathematics has been a problem for them since they were in primary schools. When we meet such students at higher level, and trying to make them pass mathematics, it is actually a problem (Jim Re 1.163). Since I came here, I had a boy. The home is very good and enjoying being a married man and when you are going to your work, you are ok, you are happy, your mood is going to influence the way you approach things from each day as it comes. In that regard, I feel very blessed (Jim Re 1.167).

According to this narrative, Jim is passionate about teaching mathematics because he loves mathematics. It also seems that being with his wife and the child makes him emotionally settled, and therefore he can focus on his teaching career. With this background, I analyse Jim’s story.

4.3.1 Lesson 1 (Simplifying and comparing fractions)

4.3.1.1 Introduction and overview of Jim’s first lesson

In this lesson, Jim narrates the story of his teaching that I observed in one of his classes. He was teaching ‘Fractions’ in Form A. He had already covered the basics of ‘Fractions’ in a previous lesson. Jim intensively engaged in mathematics teaching in this lesson. Through this story, I illustrate how he initiated his journey to become an experienced mathematics teacher.

4.3.1.2 Designing of the lesson

On this day, Jim started the lesson with an introduction that described the topic. He then asked some questions and explored the subtopic as he had planned.

After demonstrating a few examples, Jim gave three assignments for students to work out on the chalkboard. The aim of the lesson was to engage them in the process of simplifying the fractions (e.g. \(\frac{3}{6}\)), and then comparing two fractions (e.g. \(\frac{2}{5}\) and \(\frac{3}{4}\)) in terms of the values. He designed these
sections using the prescribed text book, Prism 2000 Book 1. The introduction of terms such as numbers, concepts, examples etc. has demonstrated mathematizing actions that took place in the classroom. Once the students tackled these assignments, Jim introduced the next concept (comparing the fractions). The final stage was to compare two fractions with different units. At this stage, he encountered some challenges that consumed a major part of the double lesson. These challenges possibly created a crisis in his teacher identity. The assignments included three concepts (simplifying, comparing and units) that needed special consideration.

Jim started the lesson with an introduction of the subtopic ‘simplifying fractions’. He described the procedure using the example \( \frac{3}{6} \). He also demonstrated the fraction using shaded rectangles in order to explain the meaning of \( \frac{3}{6} \). The following utterances illustrate the beginning of the lesson; *if you want to simplify the function, what do you do? You look at the common factor. What is the common factor between 3 and 6?* (Jim Ob 1.022). The Table 4.14 explores these utterances:

**Table 4.14: Subjectifying utterances intertwined with mathematizing**

<table>
<thead>
<tr>
<th>Transcription</th>
<th>My interpretation</th>
<th>Subjectifying</th>
<th>Mathematizing</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>If you want to simplify the function, what do you do? You look at the common factor. What is the common factor between 3 and 6?</em></td>
<td>In order to simplify a fraction, the first step is to identify the common factor of the numerator and the denominator.</td>
<td><em>If you want to … What do you do? You look at…</em></td>
<td>Simplify the function (fraction). The common factor. What is the common factor between 3 and 6?</td>
</tr>
</tbody>
</table>

Many students understood the process of simplifying the fractions. The mathematizing utterances such as *simplify, common factor* etc., were emphasised through the subjectifying utterances (e.g. *if you want to, look at*). Then he suggested; *somebody is going to simplify this for me* (Jim Ob 1.030). These utterances indicated a strategy that he had been using throughout his lesson that activated students’ reasoning skills (and students’ learning attitude). Jim was concerned with the time consumed for establishing the concept of simplifying the fractions (Jim Int 1.027: *... seems like I took too much time*). However, the lesson progressed to the next stage (comparing
fractions) without any confusion as students answered the questions correctly and they were able to simplify the fractions, with some of them demonstrating the answer on the chalk-board.

The transition of the lesson from *simplifying the fraction* to *comparing two or more fractions* was smooth without much concern or challenge. It implied that the *meaning* that Jim tried to pass onto the students and the meaning they formed were the same in this particular context. He used the examples from the textbook, but at times changed the numbers (e.g. compare \( \frac{2}{5} \) and \( \frac{3}{4} \)), explained the procedure explicitly, and demonstrated these using symbols that represented greater than (>), lesser than (<) and equal (=), as shown in the vignette below:

*Ok now, at times ... we may need to compare the fraction and put that as greater than, less than or equal, like, this ones are equal, right (?). So we need to compare and check, which is greater between two. Ok now, suppose we have ... 2 over 5 (\( \frac{2}{5} \)), and 3 over 4 (\( \frac{3}{4} \)) Then we need to compare which one is greater than the other one. And so you put greater or lesser ... (Jim Ob 1.043). Or equal ... Now, what we do? What you have to do is to make the denominator to be equal \( \frac{2}{5} \) and \( \frac{3}{4} \). Then you are going to compare the numerators. Ok (?), ok. Who can do this for us? So you will have to make the denominator the same or do it your way. Let us see what he is going to do. We need to compare the numerators. Ok, do you have someone who could do this? (Jim Ob 1.045).*

**4.3.1.3 Jim proceeds with the lesson**

I analyse these utterances as shown below in Table 4.15

<table>
<thead>
<tr>
<th>1st level subjectifying</th>
<th>2nd level subjectifying</th>
<th>3rd level subjectifying: About the actor</th>
</tr>
</thead>
<tbody>
<tr>
<td>About specific performance</td>
<td>About performance</td>
<td></td>
</tr>
<tr>
<td>Now, what we do?</td>
<td>What you have to do is to make the denominator to be equal. We need to compare numerators.</td>
<td>You will have to make the denominator the same or do it your way.</td>
</tr>
<tr>
<td>Ok, who can do this for us? Let us see what he is going to do</td>
<td></td>
<td>Ok, do you have someone who could do this?</td>
</tr>
</tbody>
</table>

Jim described the task (1.043) and clarified the procedure. He also asked questions to arouse curiosity among the students (*What we do*). He re-phrased the task and elaborated the procedure (*what you have to do is to make the denominator to be equal*). Then he invited a student to perform the task on the chalkboard (*who can do this for us*?). When a student volunteered, he
encouraged him by saying, *let us see what he is going to do*, and provided an assisting hand by commenting *we need to compare the numerators*. These utterances are categorised under the first two levels of subjectifying. Even though a pattern was not identified, a trend was formed through these utterances. For instance, the utterance that is categorised under the first level (*now, what we do*) referred to a specific task. The next utterances then provided an answer: *what you have to do* … These are categorised under the second level of subjectification.

There are two sets of utterances that caught my attention; *do it your way*, and *do you have someone who could do this?* I consider these utterances indicating a good strategy for the students working in groups as they were given the choice. I categorise these in the third level of subjectifying. The utterances such as *what we do* and *who can do this for us* etc. indicated Jim’s specific performance. Therefore these are qualified to be in the first level of subjectifying utterances. What also captured my attention was the use of ‘*we*’ and ‘*us*’ in these utterances that displayed Jim as part of this community. Simultaneously, he switched to the word *you* showing his authority (*what we do? What you have to do is …*). However, when Jim asked *what we do*, he created a dramatic situation in order to arouse excitement so that they find an answer to his question. Jim did not wait for their answer and said; *what you have to do is to make the denominator to be equal.*

The utterances (*You will have to make the denominator the same or do it your way*) indicate Jim’s way of guiding students in a particular direction. Utterances like *do it your way* provided freedom for the students to unfold the task in their *way* and the opportunity to explore the question in any manner they wished. Through these utterances, Jim tried to negotiate a meaning of the mathematical concept (Niven, 2011).

Jim asked questions and then answered without waiting for students to respond. He demonstrated an example and described the procedure, though many students could not find the answer. This was a concern for him, and therefore, he asked them to try on the chalkboard. He perhaps considered this approach as building social skills (sharing, leading etc.) among them. These utterances (Jim Ob 1.045) need further analysis (Table 4.16) in order to conclude if these are reifying and signifying.
Jim instructed the students to compare the fractions. These utterances (what you have to do is to make) are categorised as indirect reifying action. I consider the utterances, do it your way as critical as they accommodate the freedom of choice for students to unfold the task as they choose. I categorise this under indirect reifying actions as well as under direct reification. During the interview, he explained; I think they do have a certain prior knowledge of what they were doing. Actually, all of them can relate to what somebody is doing ... for them is just to repeat what they have seen before” (Jim Int 1.066). This is what he meant by suggesting do it your way. Repetition can build knowledge (Niven, 2011). Jim wanted them to recall their prior knowledge in order to answer a particular question. These thoughts were endorsable (they do have a certain prior knowledge) that indicated the changes he was expecting from them. From this point of view, his approach was significant.

The utterances such as what you have to do and we need to compare are examples of indirect reification as they indicate the required action (what has to be done). The reifying utterances then move on to the next category (So you will have to make ... or do it your way. Let us see what he is going to do) indicate the required performance and his particular approach. Jim talked about the students (you, your, he) and their action (make, do) that included him (we, us) as part of the recipients. Such words frequently surfaced from other utterances too (We need to compare).

The utterances (You will have to make the denominator the same or do it your way... we need to compare) are categorised under the 2nd level reification and present an insight into Jim’s way of teaching. The manner in which he insisted (do it your way) is significant because it created freedom for the students to choose their own strategy and grasp the correct message. Thus the meaning Jim created was passed onto the students and they understood it.

<table>
<thead>
<tr>
<th>Indirect reification (Providing information on what has to be done regarding something)</th>
<th>Direct reification (describing a person): What does Jim observe about him or about others?</th>
<th>Direct reification: Jim’s conclusion in a certain way.</th>
</tr>
</thead>
<tbody>
<tr>
<td>What you have to do is to make the denominator to be equal. Do it your way. We need to compare numerators.</td>
<td>So you will have to make the denominator the same or do it your way. Let us see what he is going to do.</td>
<td>What you have to do is to make the denominator equal ... We need to compare the numerators.</td>
</tr>
</tbody>
</table>

Table 4.16: Jim’s utterances are reifying

Key: Let us see what he is going to do...
In conclusion, Jim preferred the students to learn the concept in their own way and build on the previous one (Jim Int 1.039) because according to him, they have got their own pre-requisite knowledge of doing this (Jim Int 1.061). Furthermore, Jim decided not to impose onto them so that they think and say what they have learned before (Jim Int 1.061). He preferred the students to have some basic knowledge (Jim’s input) and then carry on with learning by themselves (learners’ input). This partially contradicted his action as he provided a clue to the necessary measures that were taken by him (What you have to do is to make the denominator to be equal). He could not choose a different approach (such as heuristic) in order for students to explore the task further.

Figure 4.5 shows the work that was done by one of the students in comparing two fractions. The question is a modified version from the textbook (Prism 2000 Plus, Book 1).

\[
\frac{2}{5} \div \frac{3}{4} = \frac{2 \times 4}{5 \times 4} = \frac{3 \times 5}{4 \times 5} = \frac{8}{20} > \frac{15}{20} \text{ My comment: In order to obtain 20 as the common multiple } \frac{2}{5} \text{ is multiplied by 1 in the form of 4/4. He repeated the similar procedure for the next fraction } \frac{3}{4} \text{ and multiplied by 1 in the form of 5/5. However, he used the sign ‘>’ but others pointed out the error and he corrected it to } \frac{8}{20} < \frac{15}{20}.
\]

Answer: \( \frac{8}{20} \) is lesser than \( \frac{15}{20} \)

Figure 4.5: The answer to the question according to student 8

Once the student completed the task, Jim explained the procedure for others to grasp the concept as shown below:

\textit{Ok, so now, if … that fraction which is 15 over 20 which is greater than } \frac{8}{20} \text{, so we are going to collect our original fractions, } \frac{2}{5} \text{ and } \frac{3}{4}. \text{ So which one is greater then? This one is helping you to see which one is greater. Now, which one is greater between two? (Jim Ob 1.053). So you are saying } \frac{2}{5} \text{ is smaller than } \frac{3}{4} \text{ (Jim Ob 1.057).}

Then he decided to give them a few assignments from the textbook as shown below:

Question: Copy and put signs >, < or = between each pair of fractions to make true statements.

(a) \( \frac{3}{5} \div \frac{4}{5} \) (b) \( \frac{7}{8} \div \frac{5}{8} \) (c) \( \frac{3}{4} \div m \text{ and } \frac{6}{8} \text{ km} \) (Ref: Prism 2000 Plus, Book 1. Programme in Secondary Mathematics, 2000, p.72).
According to Jim (Ref: Jim Int 1) students understood the concept and knew that the denominator must be the same in order to compare two or more fractions. Students followed the approach that Jim demonstrated while answering the questions ‘a’ and ‘b’. It appeared as if they were using the same ‘language’ when engaging with the concept ‘Fractions’. So far in my view, the mathematical discourse that emerged in this mathematics classroom was as Jim expected (Ref: Jim Int 1). However, there was a twist in the story when the students attempted to answer question ‘c’ that challenged mathematics learning as well as creating a crisis in Jim’s teacher identity.

I present a few selected utterances in Table 4.17 in order to analyse how these utterances assisted Jim to engage in mathematics learning.

**Table 4.17: Subjectifying utterances in mathematics learning**  
Key: *Now let us jump to ‘c’.*

<table>
<thead>
<tr>
<th>Transcription</th>
<th>My interpretation</th>
<th>Subjectifying</th>
<th>Mathematizing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Ob 1.061. Jim: Ok. Thank you very much. Now let us jump to ‘c’… We have $\frac{3}{4}$ meters and $\frac{6}{8}$ kilometers. Is that one difficult? (Students whisper and Jim laughs).</td>
<td>Comparing $\frac{3}{4}$ meter with $\frac{6}{8}$ kilometer included two different concepts (simplifying the fractions with units of distance).</td>
<td>Thank you very much. Now let us jump to ‘c’. Is that one difficult?</td>
<td>Is that one difficult? (Referring to $\frac{3}{4}$ meter and $\frac{6}{8}$ kilometer). We have $\frac{3}{4}$ meters and $\frac{6}{8}$ kilometers</td>
</tr>
<tr>
<td>Jim Ob 1.064. Student 10: Sir, we have to compare these denominators. The denominator is to be the same.</td>
<td>Student identified that the task was to compare fractions and therefore, denominators have to be the same.</td>
<td>we have to compare …</td>
<td>These denominators. The denominator is to be the same.</td>
</tr>
<tr>
<td>Jim Ob 1.065. Jim: But are you aware that this one is in meter and that one in kilometers? …</td>
<td>These utterances indicate that Jim is guiding the student towards a desired direction.</td>
<td>But are you aware that …</td>
<td>This one is in meter and that one in kilometers?</td>
</tr>
</tbody>
</table>

The Table 4.17 demonstrates the selected utterances that are identified and classified into subjectifying and mathematizing utterances. The utterances such as *is that one difficult* (subjectifying) indicate Jim’s concern about the difficulty of the task for the students. As the lesson proceeded, Jim said; *but are you aware …* that guided the students to take the hint
subjectifying utterances are concomitant to mathematizing) that meter and kilometer are not the same.

The prescribed textbook carries some information for guiding the students to answer questions like (c). The information emphasised that when the *units of measurement* are different one cannot conclude that one fraction is greater or smaller than the other one. In such cases (fractions with different units of measurement), “(we) have to use the same unit for all numbers before a meaningful comparison can be made” (Prism 2000 Plus, Book 1, 2000, p.72). There was no evidence indicating that Jim or his students followed this information. I explore these further to describe Jim’s particular approach.

Table 4.18: Jim guides the students to a particular direction  
*Key: Is that one difficult?*

<table>
<thead>
<tr>
<th>1st level Subjectification</th>
<th>2nd level Subjectification</th>
<th>3rd level Subjectification</th>
</tr>
</thead>
<tbody>
<tr>
<td>About specific performance</td>
<td>About performance</td>
<td>About the actor</td>
</tr>
<tr>
<td>Jim Ob 1.061: Thank you very much. Now let us jump to ‘c’. (Appreciation)</td>
<td>Jim Ob 1.061: Now, I want us to do that on the board. Is that one difficult? (Considerate). Jim Ob 1.065: <strong>But are you aware that</strong> this one is in meter and that one in kilometers?</td>
<td>Jim Ob 1.063: And so why don’t you … (try) (Encouraging).</td>
</tr>
</tbody>
</table>

Some of Jim’s utterances necessitate further discussion (*Thank you very much ..., is that one difficult? And so why don’t you ...*). The first utterances showed appreciation of the work that was done by the students. The next ones demonstrated his considerate nature regarding the difficulties students experienced within this particular context (he found them whispering to each other). The last ones displayed his way of encouraging the students so that they learn the concept by practicing. However, he could not anticipate any confusion, tension or disorder in the classroom when he decided to *jump to c*. Even though he found the question to be difficult, he encouraged them to try by themselves. According to him, the students participated, contributed, interacted and communicated effectively in this classroom. In his words; *they are very much aware of what is going on, and that is what I like about them* (Jim Int 1.212).
These subjectifying utterances complemented mathematizing actions and highlighted his particular way of engaging with teaching. Figure 4.6 presents the work of one student.

\[
\frac{3}{4} \text{ m} \quad \frac{6}{8} \text{ km} \\
\frac{3 \times 4}{4 \times 4} \quad \frac{6 \times 2}{8 \times 2} = \frac{12}{16} \quad \frac{12}{16}
\]

In order to obtain 16 as the common multiple, \( \frac{3}{4} \) is multiplied by 1 in the form of 4/4 and \( \frac{6}{8} \) is multiplied by 1 in the form of 2/2. Considering the numerators are the same (12), the student concluded that the fractions are equal. He did not consider the values of meter and kilometer in relation to these fractions. Hence he concluded that, \( \frac{3}{4} \text{ m} = \frac{6}{8} \text{ km} \).

Figure 4.6: The answer to question c by student 10 Key: We have to compare ...

The answer (Figure 4.6) showed that students followed the example as Jim demonstrated earlier. However, they ignored the units and compared the fractions (Questions, a&b). The challenge for Jim was to unfold the issue of units. Simultaneously, I observed that the students ignored the ‘units’ as they had not been the part of the fractions.

Jim needed to convince the students why it was necessary to convert one unit to the other before comparing the fractions. This was not an easy task as the students could not understand the need for that particular action before comparing the fractions. Table 4.19 displays the next stage.
Table 4.19: Jim tries to negotiate a meaning Key: So you have to say ...

<table>
<thead>
<tr>
<th>Transcription</th>
<th>My interpretation</th>
<th>Subjectifying</th>
<th>Mathematizing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Ob 1.071. Student 13: We can’t (compare) meters and kilometers. We have to convert kilometers into meters or meters into kilometers.</td>
<td>We can’t … (We can’t compare meter and kilometer before converting one unit to the other). The student seemed to understand the way fractions with different units are compared.</td>
<td>We can’t …</td>
<td>Convert kilometers into meters or meters into kilometers.</td>
</tr>
<tr>
<td></td>
<td>Jim confirmed the student’s view.</td>
<td>Ok, firstly you want to …</td>
<td>Convert meters or kilometers.</td>
</tr>
<tr>
<td>Jim Ob 1.079. Jim: So you have to say, one kilometer equals to how many meters?</td>
<td>Jim extended a helping hand by trying to create meaning (Teacher identity).</td>
<td>So you have to say …</td>
<td>One kilometer equals to how many meters?</td>
</tr>
</tbody>
</table>

At this juncture, some students knew the correct procedure for solving question c (Table 4.19). Jim previously stated that this one is in meter and that one in kilometers (Jim Ob 1.065) and tried to guide the students towards a desired direction. Other utterances (so you have to say, one kilometer equals to how many meters) demonstrated Jim’s intensive engagement in assisting them. The challenge was then to identify if the meaning created by Jim was in line with the meaning that students created. According to his observation, it is interesting the way the students thinking (Jim Int 1.113). I thought that the problem was not comparing the fraction, but it was with the conversion of one unit into another (Jim Int 1.132). Table 4.20 demonstrates how he proceeded with the lesson.
Table 4.20a: Jim clarifies the procedure Key: And you know that 750 meters is actually 750/1.

<table>
<thead>
<tr>
<th>1st level: About specific performance</th>
<th>2nd level: About routine performance</th>
<th>3rd level: About the actor</th>
</tr>
</thead>
<tbody>
<tr>
<td>What he did here …</td>
<td>So that means you are comparing</td>
<td>I think we have to make them same.</td>
</tr>
<tr>
<td>He converted …</td>
<td>So actually you are comparing</td>
<td>That means we can compare…</td>
</tr>
<tr>
<td>He found that …</td>
<td>That means our answer is …</td>
<td>You know that …</td>
</tr>
</tbody>
</table>

Through these utterances it was apparent that Jim revisited the procedure for comparing these two fractions so that the students could learn by listening. These processes included clarifying (What he did) the student’s mathematical steps, interpreting (He converted, He found that) his actions and concluding (That means our answer is) the answer. Through these utterances, Jim fine-tuned the meanings that the student created. Jim’s intention was to ensure that they followed the appropriate procedure in order to find the answer. He then categorically linked (That means we can compare) the concept to the next stage with an understanding and expectation (You know that) that the students grasped the concept. The frequent use of the utterances like I think, that means, you know etc. indicated the meaning he created and the way he passed these meanings onto them.

The utterances require further analysis in order to understand how Jim negotiated meanings (actually you are comparing, that means our answer is) and how he passed these meanings onto the students.
Table 4.20b: Reifying and identifying Jim’s actions

Key: That means ...

<table>
<thead>
<tr>
<th>Indirect reification (Forming an opinion about actions of someone or self or something)</th>
<th>Direct reification (describing a person): What does Jim observe about him or about others?</th>
<th>Direct reification Jim’s conclusion in a certain way</th>
</tr>
</thead>
<tbody>
<tr>
<td>That means our answer is … He did… he converted… he found… (Jim forms an opinion on what is happening)</td>
<td>So after that conversion he found that … (Jim explains how student concluded the task).</td>
<td>I think we have to make them same…You know that … That means we can compare and you know that 750 meters is actually 750/1.</td>
</tr>
</tbody>
</table>

The most significant stage was the introduction of 750 meters as 750/1 (Jim Ob 1.098). The lesson took a turn by bringing the idea of whole number that convinced the students (at a later stage) to realise that 750 m is greater than $\frac{3}{4}$ m. The meaning that students formed was different from the meaning that Jim tried to establish. He tried to explain how this student concluded (So after that conversion he found that, he converted). Jim later observed: if I say 750 whole, then they would have said yes (Jim Int 1.173), it is a matter of language, I think (Jim Int 1.175).

Students grasped the concept only when Jim mentioned the idea of comparing the fraction by considering 750 as a whole number in order to consider $\frac{3}{4}$ as lesser than 750. The argument was that, if 750 is a whole number and $\frac{3}{4}$ is a fraction (less than 1), then $\frac{3}{4}$ is less than 750. Therefore, $\frac{3}{4}$ m is lesser than $\frac{6}{8}$ km.

These utterances (Jim Ob 1.098) demonstrated how Jim endorsed students’ actions that were reifying. His classroom practice in this regard was also significant as he realised the need for an appropriate design when multiple objectives are explored within a single task (Jim Int 1.156: We just make sure that they know how to do the conversion… so I think that issue has to be addressed on its own). Table 4.21 shows a twist in this lesson.
Table 4.21a: Common knowledge and practices

<table>
<thead>
<tr>
<th>1st level Subjectification: About specific performance</th>
<th>2nd level Subjectification: About routine performance</th>
<th>3rd level Subjectification: About the actor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Ob 1.114. Student 16: I am saying that ¾ meters is equal to 750 meters.</td>
<td>Jim Ob 1.110. Jim: How are they equal? (Seeking explanation)</td>
<td>Jim Ob 1.111. Student 16: We normally know that ¾ is 750 meters (Common knowledge)</td>
</tr>
<tr>
<td>Jim Ob 1.115. Jim: … Because they are not equal (Conclusion)</td>
<td>Jim Ob 1.115. Jim: How? Can you show us? …</td>
<td>Jim Ob 1.116. Student 16: They are not equal, how sir?</td>
</tr>
</tbody>
</table>

Even though these utterances are closely associated to mathematizing actions, there were some concerns for Jim. Therefore, he started probing. For instance, when one student insisted that ¾ meter is equal to 750 meters, Jim asked; how, can you show us? It implied that even though the student’s conclusion was wrong, he should elaborate why he says so.

Jim uttered how are they equal (Jim Ob 1.110. Jim) to which, the student responded we normally know that (Jim Ob 1.111). He was referring to a common understanding that ¾ is equivalent to 750. This was an indication of students’ flawed prior knowledge. On the other hand, Jim assumed that it was a common knowledge among the students that meter and kilometer have different values. He positioned himself with respect to what students understood and he responded, how, can you show us, because they are not equal (Jim Ob 1.115). It was now the student’s turn to ask, they are not equal, how sir (Jim Ob 1.116). These utterances also indicate a different mathematics identity for Jim (because they are not equal) as well as for the students (we normally know that). In my opinion these different identities created a crisis (how, can you show us).

These utterances are revolving around mathematizing, but mathematics learning was compromised. Students tried to figure out why ¾ m and 750 m are not equal. They all seemed to acknowledge that 750 meters is a converted version of $\frac{6}{8}$ km. The discussion at this juncture was about ¾ and 750 m. Jim repeated rather than elaborating why 750 m and ¾ m are not equal (how are they equal? Can you show us? Because they are not equal).
Table 4.21: Jim’s utterances are significant Key: And how are they equal?

<table>
<thead>
<tr>
<th>Indirect reification (Forming an opinion about actions of someone or self or something)</th>
<th>Direct reification (describing a person): What Jim observes about him or about others?</th>
<th>Direct reification Jim’s conclusion in a certain way</th>
</tr>
</thead>
</table>

These utterances are significant for two reasons. Firstly, students argued that the fraction (\(\frac{3}{4}\) m) is equal to 750m (Ref: Jim Ob 1.114). Secondly, when a student mentioned that they normally know \(\frac{3}{4}\) is equal to 750 meters, it is a common knowledge among the students according to him. This particular student was surprised (Ref: Jim Ob 1.111&116) to find that Jim ignored this knowledge. Returning to identifying a pattern, Jim’s utterances (Because they are not equal) were judgmental even though he tried to convince them why these are not equal (Jim Ob 1.117). He also took a position in a concluding tone without convincing the students why he considered that they are not equal. In both situations (1.114, 1.116) Jim found that the student’s argument (how are they equal?) was incorrect.

The utterances such as how are they equal, can you show us are categorised under indirect reification as these indicate Jim’s opinion that is different from the students’. In this context, the utterances (Jim Ob 1.111) were misleading because if students normally knew that \(\frac{3}{4}\) and 750 are equal, that means their concepts on whole numbers and fractions are flawed. Jim could not convince them that \(\frac{3}{4}\) meter is NOT equal to 750 meters at this stage. These reifying utterances are therefore significant as Jim endorsed later in the interview (Jim Int 1.132). He also observed that the decision of introducing two concepts in one question at that stage was pre-mature (Jim Int 1.156) and was a time consuming exercise according to him (Jim Int 1.189). In this regard, Jim admitted later that the question (that he copied from the textbook) was prematurely designed in the textbook, and he overlooked the difficulty students might have regarding this question (Jim Int 1). Even though many students finally accepted the conclusion that \(\frac{3}{4}\) m is less than \(\frac{6}{8}\) km, they were not convinced that the answer was correct. Jim later observed that it was too early for them to attend to these tasks (I wanted to start with the one which got the same denominator, ...
which is simpler ... I should have started with the simpler one, Jim Int 1.077. And somehow, it was difficult. Actually, it was a bit difficult. I think the problem came too early, Jim Int 1.092). In this regard, Jim realised that the question was about comparing the fractions, not about comparing lengths. This was also a learning moment for him as he reflected that it was a bit difficult. I think the problem came too early.

4.3.1.4 Jim concludes the lesson

Jim concluded the lesson by giving a few assignments for the students to work out (Ref: Jim Ob 1.185: Ok, now, let me give you some work to do. Now you are going to convert this one, ‘f, g’, ok?). From his narrative, I infer that Jim’s lesson did not end as he expected. Mathematizing actions were actively taking place in his classroom. Mathematics learning was also taking place in three different ways: Jim demonstrated a few examples, described and explained the procedure. Students grasped the concept by imitating him. Lastly they learned the concept either through his or peers’ demonstration. To conclude this lesson, I quote Jim’s reflective thoughts:

*I like being a facilitator, not somebody just takes a chalk and gives (ideas) to the students. At times, you tend to return to the students. Sometimes you just go there (to the classroom) and get something from you (the students). So, if you are (a) facilitator, you want to learn. You are not making them to learn. Help them to learn* (FG Int 1).

These utterances indicated Jim’s dream to be a facilitator in mathematics classrooms. According to him, attaining this would assist him to become a mathematics teacher in the future.

Note: My presence might have caused tension in the classroom. Even though we did not discuss this issue during the interview, in my view, my presence with the camera had an impact on Jim’s way of uttering certain words in the classroom. This did not repeat in other classroom observations afterwards (Ref: Section 3.6.1).

4.3.1.5 Linking Jim’s story to the identity

I present the following observations prior to my conclusion of Jim’s story.

Jim covered the subtopic, simplifying the fractions, through the utterances 1 - 42 (Jim Ob 1.001-042). He proceeded with the next section (comparison of two fractions) afterwards (Jim Ob 1.043-060). Finally, he jumped to ‘c’ (Jim Ob 1.061) without anticipating any challenges related to this question. Later, he realised that his decision to link units while comparing the fractions was premature. From utterances 1.063 to the end of the lesson, Jim and the students repeatedly
discussed only question ‘c’ and that consumed a major portion of the lesson. Even though Jim repeatedly described the concept, he was aware of the unsuccessful outcome of this section. In short, he did not achieve all the objectives that he had planned for this lesson. The classroom practice on this day brought some changes in his approach that assisted him in realising that he should not have rushed them to explore two different concepts simultaneously.

Jim’s experience in this class possibly assisted him to understand how he should approach certain topics in future. In this section, I discuss the significance of his story and how he formed the meaning of his teaching approach from this lesson.

Jim identified question ‘c’ as **mathematically significant** because of its real life application (units of distance) and because he had observed that students failed to follow the appropriate rule (Heyd-Metzuyanim & Sfard, 2012; Sfard & Prusak, 2005; Tanner & Jones, 2000). Through this approach, he was trying to **negotiate a meaning** that some of the students accepted (Ref: 1.065). Jim later acknowledged that there was a **problem**. He should have rectified the attitude of students (Jim Int 1: *actually, it was a bit difficult*) while exploring this particular task. Jim rushed to question ‘c’ (Jim Int 1.092), even though similar examples were previously demonstrated.

Jim’s particular approach demonstrated how he addressed ‘Fractions’ in this lesson. He guided the students towards a desired direction for achieving certain goals by interpreting and explaining the concepts (*So that is what I was saying*). The most significant action was the introduction of 750 meter as 750/1. Jim realised and endorsed this in the interview (Jim Int 1.173, 1.175). In other words, he did not prepare the students to unfold the task using more examples. This implied that his ‘practice in the mathematics classroom’ did not meet the expected goals of the lesson that raises the question of timing to introduce a new concept, as Jim reflected:

*Ok, ... I just gave the example randomly, thinking that this one will be easier ... (pause) because they already have the concept of comparing two fractions ... I thought, if they make ⁶⁄₈ to be meters or ³⁄₄ to be in kilometers, they should be able to do a simple comparison because they couldn’t just compare them as they are.* (Jim Int 1.086).

There was a challenge before them that required a solution to a particular mathematical problem. Jim thought that students were able to do this as he expected. The meaning that students formed and the meaning that Jim assumed did not match each other. In my opinion, this was an
indication of different mathematics identities for Jim and his students. Jim’s particular way of expressing the meaning perhaps confused the students which indicated a need for change in practice in the future. The utterances like *So after that conversion he found that ...*, *what he did here, he converted ...* (Jim Ob 1.98), suggested that he tried to explain students’ particular performance and tried to create meanings from these actions. He did not confirm if other students formed the same meaning from this particular example or through his elaboration and so needs to work on these issues. Jim later acknowledged that there was a *problem*. He should have rectified the misconception students had. As he said, *actually, it was a bit difficult*. Negotiating the meaning in this classroom compromised students’ learning capability.

Comparing the first two fractions was easy for the students. As they answered the first two mathematical questions correctly, Jim concluded that they had learned the concept, though he did not verify this. **Mathematics identity** for Jim and his students was thus compromised. According to him, he did not fully achieve the objectives of the lesson in this manner.

Jim realised that having only one particular kind of attitude and approach to teaching mathematics is not sufficient to reach out successfully to all his students (Jim Int 1). He also identified a need to improve his teaching approach. Jim was not yet convinced of his inclusive membership (*I tried to show*) in the classroom community. He was also not sure of his exclusion (*do it your way*) from the classroom community. From this classroom practice, he learned *not to jump* too fast (Ref. Jim Ob 1) when introducing new concepts.

In brief, he was beginning to understand how meaning should be negotiated in classrooms, while engaging with mathematics learning.
4.3.2 Lesson 2 (Introduction to Algebra - collecting like terms)

This section illustrates my second observation of Jim’s classroom teaching.

4.3.2.1 Introduction and overview of Jim’s second lesson

Jim’s story continues through his narrative. In this section, I observed his teaching in a Form A class. The topic ‘Letters for Numbers’ (Introduction of collecting like terms) is an introduction to algebra. He used the prescribed textbook Prism 2000 Plus, Book 1 for classroom activities.

Through this story, I illustrate how he continued his learning to become a mathematics teacher.

4.3.2.2 Designing of the lesson

Jim started the lesson by introducing the topic. The approach he had chosen included group work in order to promote peer learning. Table 4.22a below demonstrates the crucial utterances that illustrate his plan for this lesson.

Table 4.22a: Subjectifying utterances complement mathematizing actions Key: What we are going to do.

<table>
<thead>
<tr>
<th>Utterance</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Ob 2. 001: Ok, what we are going to do, in your group today you are</td>
<td>Instructing students to learn how to collect like terms</td>
</tr>
<tr>
<td>going to learn how to collect the like terms. You know I haven’t taught</td>
<td></td>
</tr>
<tr>
<td>you that, right?</td>
<td></td>
</tr>
<tr>
<td>Jim Ob 2.003: Ok, you are going to help each other and then how to collect</td>
<td>Instructing students to work together and discuss their work</td>
</tr>
<tr>
<td>the like terms in your groups. Now, I want to … the very simple, very</td>
<td></td>
</tr>
<tr>
<td>simple example… Then you discuss in your groups, when something is done,</td>
<td></td>
</tr>
<tr>
<td>I will be coming around and checking all the groups. So you can continue</td>
<td></td>
</tr>
<tr>
<td>and I will be coming around to check what you are doing. You can start</td>
<td></td>
</tr>
<tr>
<td>now, but make sure that you talk to each other, right?</td>
<td></td>
</tr>
</tbody>
</table>

Jim started the lesson by instructing the students to form groups so that they could engage in discussion in groups. He also emphasised the goal of the topic (to collect the like terms). He then indicated that he will be coming around and checking the progress of their work.
4.3.2.3 Jim’s identifying utterances

Table 4.22b below explores the subjectifying utterances as shown:

**Table 4.22b: Jim introduces the topic** Key: *You are going to learn how to collect the like terms*

<table>
<thead>
<tr>
<th>1st level subjectification</th>
<th>2nd level subjectification</th>
<th>3rd level subjectification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>About specific performance</strong></td>
<td><strong>About performance</strong></td>
<td><strong>About the actor</strong></td>
</tr>
<tr>
<td>Ok, what we are going to do … Ok, you are going to help each other …</td>
<td>In your group today you are going to learn how to collect the like terms. Then you discuss in your groups, I will be coming around and checking all the groups.</td>
<td>You know I haven’t taught you. So you can continue and I will be coming around to check what you are doing … But, make sure that you talk to each other, right?</td>
</tr>
</tbody>
</table>

These utterances demonstrate a close link between mathematizing and subjectifying utterances. For instance, when Jim said *you are going to learn how to collect the like terms*, the message carried the desired objective of the lesson. He instructed the students on what has to happen regarding the tasks that were assigned to them. He indicated the objective of the lesson (*Ok, what we are going to do …*) and the way these assignments would be executed (*Ok, you are going to help each other …*). These utterances specify exactly what has to happen in the classroom and are categorised under the 1st level of subjectifying.

The utterances indicate the plan and how it should be executed. Jim then carried on describing the rules of the ‘game’. Once the objective of the lesson was given (*You are going to …*), he elaborated the procedure (*Then you discuss …*) that specified his role (*When something is done, I will be coming around and checking all the groups*) as a facilitator and a guide. He repeated the instruction and concluded afterwards *you can continue* (Jim Ob 2.003).

These subjectifying utterances demonstrated Jim’s plan for the day. The utterances such as *Ok, what we are going to do, you are going to learn, and you know …* are categorised into 1st, 2nd and 3rd levels of subjectifying respectively. These utterances indicated the nature of the task and how it would be executed. He also reminded them that once completed, he would assess the work done. The subjectifying utterances such as *you are going to help each other …* (1st level subjectifying) emphasised the approach that Jim considered for this lesson. The utterances like
make sure that you talk to each other (3rd level subjectifying) confirmed how students should work on this task. These utterances helped students to understand the procedure (e.g. you are going to help each other). I explore this further.

Table 4.22c Mathematizing and reifying Key: You are going to learn

<table>
<thead>
<tr>
<th>Indirect reification (Forming an opinion about actions of someone or self or something)</th>
<th>Direct reification (describing a person): What does Jim observe about him or about others?</th>
<th>Direct reification Jim’s conclusion in a certain way</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Ob 2.001: What you are going to do …</td>
<td>Jim Ob 2.001. You are going to learn …</td>
<td></td>
</tr>
<tr>
<td>Jim Ob 2.003: Ok, you are going to help each other … make sure that you talk to each other, right ()?</td>
<td>Jim Ob 2.007: What do you think? d plus d? (d + d).</td>
<td>Jim Ob 2.003: Make sure that you talk to each other … I will be coming around to check what you are doing.</td>
</tr>
</tbody>
</table>

The introduction of the topic was successful. Jim designed group work for students to explore the topic. His aim was to move from group to group and monitor the work (I will be coming around to check ...). He emphasised how they will engage in the process (you are going to help each other, make sure that you talk to each other). Quoting him: ‘I allow them to interact with one another ... I want them to do things by themselves, then we discuss them’ (Jim Int 2.002). Incidentally, he added that this lesson was different from the first lesson that I had observed (Ref: Jim Ob 1) earlier because ‘it was somehow teacher centred’ (Jim Int 2.004). On the other hand, ‘this time we tried to implement the peer learning’. These utterances endorsed the approach that he was executing in the classroom practice. He elaborated his understanding of peer learning as followed; ‘I just gave them some exercises and some examples to learn from one another ... so they were learning from each other ... I was not the one who was teaching them’ (Jim Int 2.004).

Jim had given about ten minutes for students to explore the task and then he started moving around and assessing the work (Jim Ob 2.007: What do you think? d plus d; Jim Ob 2.009: How many are they all together?). He later endorsed the outcome of this approach by observing that; ‘they were learning from each other, which was very good because even those people that I knew couldn’t talk in class, they were actually active, so it was very positive’ (Jim Int 2.010).
Jim knew that there is a need to have specific instruction in order to attain the desired goal (ok, you are going to help each other ... make sure that you talk to each other). These utterances indicated the way the task had to be executed. One of the advantages of this approach, according to Jim, was that the students could learn the concept by sharing the ideas so that slow learners are motivated or silent participants are included in the discussion (Jim Int 2.010).

The utterances such as what we are going to do (Jim Ob 2.001) referred to specific performances and are therefore categorised under indirect reifying because these utterances guide towards a specific task. He then cautioned the students I will be coming around to check what you are doing (Jim Ob 2.003) which made them focus on the task and interact with each other as expected. These utterances identified a certain way of executing mathematics learning as Jim had planned. If he had not pronounced these utterances, the students might have responded differently (by not focusing on the task completely or ignoring some of the instructions). Therefore these utterances are significant.

For the next ten minutes, Jim managed to meet many groups and monitored their work. Table 4.23 demonstrates how he managed to assess their performance and how he guided them towards realizing certain concepts.

### Table 4.23a: Subjectifying utterances strengthen mathematizing

<table>
<thead>
<tr>
<th>Transcription</th>
<th>My interpretation of what Jim meant</th>
<th>Subjectifying</th>
<th>Mathematizing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Ob 2.029: Now let us talk about this, ‘g’. Ok, when it is just g, you don’t … there is only one g and you write ‘g’, not ‘1’. It is just ‘g’. You know that it is 1g. So you don’t have to write 1g.</td>
<td>Jim assists a group. He indicated that 1g could be written as ‘g’. When it is just g, you don’t have to write 1g. There is only one g and you write ‘g’, not ‘1’ or ‘1g’. Therefore, 1g = g.</td>
<td>Now let us talk about ... You don’t … and you write It is just ... You know that ... So you don’t have to write 1g.</td>
<td>This ‘g’. When it is just ‘g’, you don’t … There is only one g and you write ‘g’, not ‘1’. It is just ‘g’. You know that it is 1g. So you don’t have to write 1g.</td>
</tr>
</tbody>
</table>

Jim clarified the meaning of the terms ‘8q’, 0q and 1g. He aimed to establish the concept that when a variable is written without any coefficient, the coefficient of this variable is 1 (when it is
just g ... You know that it is 1g). He emphasised you don’t have to write 1g. While monitoring the students’ performance, he probed what is the meaning of 8q, what does it mean, 8q means what?’ (Jim Ob 2.019-021). He frequently used utterances like now let us talk about this (Jim Ob 2.029, 040, 077) that indicated his approach to mathematics learning. His utterances required a response from students (What is it, what does it mean?).

Jim was specifically seeking their understanding on the expression 8q. They did not volunteer any answer, therefore, he had to volunteer an answer. He probed further to find out the meaning that they formed from terms like 0q and 1g. Students knew that 0q is 0 (Jim Ob 2.028) although they could not define the meaning of 1g. Jim provided an explanation to convince them that 1g is equal to g, and therefore they should write 1g as g (Jim Ob 2.029: You know that it is 1g, so you don’t have to write 1g). The subjectifying utterances that were pronounced by Jim indicated that mathematizing is in progress. He did not experience any unusual challenges at this stage of the lesson. However, there is a need to explore these utterances further to identify if these signify Jim’s approach and attitude in his classroom practice (Table 4.23b).

Table 4.23b Identifying Jim’s approach Key: Ok, what is the meaning?

<table>
<thead>
<tr>
<th>Indirect reification (Forming an opinion about actions of someone or self or something)</th>
<th>Direct reification (describing a person): What does Jim observe about him or about others?</th>
<th>Direct reification Jim’s conclusion in a certain way</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Ob 2.029: … Now let us talk about this, ‘g’… there is only one g and you write ‘g’, not ‘1’…You know that it is 1g. So you don’t have to write 1g.</td>
<td>Jim Ob 2.029: … there is only one g and you write ‘g’, not ‘1’… So you don’t have to write 1g.</td>
<td>Jim Ob 2.019: Ok, what is the meaning of 8q? … What does it mean?</td>
</tr>
<tr>
<td>Jim Ob 2.029: You know that it is 1g.</td>
<td></td>
<td>Jim Ob 2.029: You know that it is 1g.</td>
</tr>
</tbody>
</table>

The utterances that were categorised under indirect reification indicate that Jim formed an opinion on a ‘certain task’ that was assigned to the students (now let us talk about this …). He seemed to be judgmental (you know that …) as usual about what students know. Their understanding of this ‘knowledge’ is not assessed by him. However, these utterances could also imply his certain way of passing on the information to them. He tried to create meaning for them (you know that) or required some response (what is the meaning of 8q? What does it mean?).
These utterances enhanced students’ thinking capacity, and they shared these with others in the group.

Utterances like *now let us talk about this* are considered as indirect reification indicating how Jim guided students to explore the task. In this classroom, he decided not only to probe students’ learning nature but also to build inquisitiveness among them. He neither generalised the errors that students from one group made nor shared the notions like $1g = g$, $0q = 0$ with others. However, he assisted a particular group when they made some errors. In my opinion, this approach might have compromised the outcome of the lesson for the class.

As the lesson progressed, Jim continued moving from group to group and assessed their work. He systematically explained the procedure of collecting like terms and simplifying the expressions (e.g. $9r - 2r + 5r$). He expected them to continue working. He also expected them to be involved in discussion with the members of their respective group. He did not provide any other guidelines except the one that he gave at the beginning of the lesson (Jim Ob 2.003). The utterance; *I think you should do it this way...* (Jim Ob 2.033) indicated how Jim explained the procedure of simplifying the algebraic expression at a later stage (e.g., Jim Ob 2.033: *You can write 9r − 2r, then answer is written here − = 7r -. Then bring down the answer here -7r-. Then you write this one + 5r- and you get the final answer -12r-.*)

Jim identified an error that a student made while answering the question $3m - m$ (A student wrote, $3m - m = 3 \times m - m = 3m$). He explained that they were subtracting $1m$ from $3m$ (Jim Ob 2.041). While assisting the students on these two tasks, he had a few questions like: *What happened here, how did you subtract?* These required an appropriate response from them. I analyse these utterances further in Table 4.24:
Table 4.24: Jim tries to understand the meaning that students created Key: Yes, let us talk about it

<table>
<thead>
<tr>
<th>Indirect reification (Forming an opinion about actions of someone or self or something)</th>
<th>Direct reification (describing a person): What does Jim observe about him or about others?</th>
<th>Direct reification Jim’s conclusion in a certain way</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Ob 2.033: Now, I think you should do it this way…</td>
<td>You are having two equal signs here …</td>
<td>I think you should do it this way…</td>
</tr>
<tr>
<td>Jim Ob 2.040: Yes, let us talk about it (Ref: 3m-m)</td>
<td>What happened here? How did you subtract?</td>
<td>Yes, let us talk about it.</td>
</tr>
</tbody>
</table>

These utterances indicate Jim’s probing approach in order to understand what is happening (Yes, let us talk about it. What happened here? How did you subtract?). The task was to simplify 3m – m. The student wrote 3 x m – m = 3m. The utterance (let us talk about it) opened a door for new discussion. Students explained how they concluded the answer and Jim then guided them until they obtained the correct answer.

The utterances I think you should do it this way and let us talk about it indicated his concerns and his eagerness to provide them with the correct procedure. He was part of the team (let us talk about it). He also took the responsibility to lead them. Simultaneously he positioned himself at a different level and said; I think you should …. These are clear indications of Jim’s manner of classroom practice. He later said; I want them to do things by themselves, then we discuss (Jim Int 2.002). They were learning freely from each other. They were not dominated (by me). Even those pupils that I knew couldn’t talk in class, they were actually active (Jim Int 2.010). His words aligned with the classroom activities that he practiced on this day.

About ten minutes were left before ending the lesson and Jim continued monitoring students’ work. I present one more example in Table 4.25:
Table 4.25a: Jim seeks clarification Key: But what did you think ...?

<table>
<thead>
<tr>
<th>Jim’s utterances</th>
<th>Student’s response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answer according to student 7 (Jim Ob 2.047: Sir, we add this one -9- plus x plus x plus y).</td>
<td></td>
</tr>
<tr>
<td>Question: Simplify 2x+3x+4y</td>
<td>Procedure: 9xxy 9+x+x = y; Answer: 11 x y</td>
</tr>
<tr>
<td>Jim Ob 2.048: So you mean this x here is the first one and this is the second one and this y is this one?</td>
<td>Jim Ob 2.049, Student 7: Yes ...</td>
</tr>
<tr>
<td>Jim Ob 2.050. Jim: You cannot separate x from 2 ... really, so look at the examples and then try to do these ones again ...How do you get (Seeking clarification)</td>
<td>Jim Ob 2.051. Student 7: Sir, they said we add these two (2x and 3x). Then I said what about 4 and y. They didn’t tell me. They say ...</td>
</tr>
<tr>
<td>Jim Ob 2.052. Jim: But what did you think ...?</td>
<td>Jim Ob 2.053. Student 7: Sir, I thought the same as them.</td>
</tr>
</tbody>
</table>

Jim’s first reaction to the way this group answered the question was how do you (find this answer – Ref: Jim Ob 2.046). From the explanation (Jim Ob 2.047), it was apparent that they did not understand the meaning of like terms and unlike terms. He used the utterance really, which implied that their answer is wrong and which demonstrated his surprise and perhaps annoyance with their response. He pointed out that they cannot separate a coefficient from its variable (2.050). When the student explained (Jim Ob 2.051), Jim’s response was: but what did you think? It was interesting to see how the conversation progressed while Jim tried to address this challenge before him. He finally instructed them to look at the examples and then try to do these once again (Jim Ob 2.050). Some of these utterances are analysed in Table 4.25b:
Table 4.25b: Jim encourages students to learn by themselves Key: *I wanted you to do it ...*

<table>
<thead>
<tr>
<th>Transcription</th>
<th>My interpretation</th>
<th>Subjectifying</th>
<th>Mathematizing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Ob 2.050. Jim: So the letters afterwards, the first one is 2x. You cannot separate x from 2. You cannot take two and leave them from x. Really! So look at the examples and then try to do these once again, two of them. How do you get …?</td>
<td>Really! (Is that so?). Jim neither provided them with answer nor pointed out the error, but instructed them to re-do the assignments. It implied that their answers are wrong, but he did not comment on that. No… I wanted you to do it yourself… Really? So look at the examples and then try to do these once again, two of them. How do you get …?</td>
<td>So the letters afterwards, the first one is 2x. You cannot separate x from 2. You cannot take two and leave them from x.</td>
<td>What types of terms are there?</td>
</tr>
</tbody>
</table>

Jim’s subjectifying utterances empowered mathematics learning. It seemed that if he uttered these differently or did not pronounce certain utterances, the students’ response could have been different. For instance, Jim asked, *how do you get* (the answer 11 x y, if you followed the example?). The student responded: *they said we add these two* (2x and 3x). Then *I said what about 4 and y. They didn’t tell me*. Then Jim asked: *But what did you think* (Jim Ob 2.052). Jim tried to probe by re-phrasing the question in order to obtain a desired response from the students. I analyse this in Table 4.25c.

**Table 4.25c: Jim raises many concerns** Key: *But what did you think ...?*

<table>
<thead>
<tr>
<th>Indirect reification (Forming an opinion about actions of someone or self or something)</th>
<th>Direct reification (describing a person): What does Jim observe about him or about others?</th>
<th>Direct reification Jim’s conclusion in a certain way</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Ob 2.048: So you mean this x here is the first one and this is the second one and this y is this one?</td>
<td>Jim Ob 2.050. Jim: You cannot separate x from 2 … really, so look at the examples and then try to do these once again …How do you get (Seeking clarification)</td>
<td>Jim Ob 2.052. Jim: But what did you think …?</td>
</tr>
</tbody>
</table>

Consider these utterances: *so you mean...*, *how do you get ...*, and *but what did you think*. Jim tried to understand how they concluded the answer (11 x y) to the question, 2x+3x+4y. Jim needed to understand the process that they followed. Therefore he said *you mean this x here is the first one and this x is the second one and this y is this one* (Jim Ob 2.048). As these
utterances guided him to form a specific opinion, these were categorised under indirect reification. After assessing the work, Jim made his next move by pointing out what went wrong (you cannot separate x from 2). Then he described the next step that had to be followed. His utterances implied that he was trying to influence the group’s working pattern towards a particular direction (Look at the examples and then try to do these once again). He required them to use the textbook and engage in peer learning in order to overcome their learning difficulty by following the examples that he demonstrated.

The utterances (Ref. Table 4.25c) followed one after the other and showed Jim’s active engagement in teaching and students’ learning. These utterances are reifying not due to their repeating nature but due to the desired objective that he was trying to achieve. In his words:

They were learning from each other so I was not the one who was teaching them and giving them information (Jim Int 2.004). It was good that they were learning from each other (Jim Int 2.010). It encourages them to learn and discover by themselves (Jim Int 2.012).

I explore students’ utterances in order to understand if the meaning formed by Jim is in line with that of the students’ (Table 4.26).

Table 4.26: Jim tries to make sense of student’s way of learning Key: I thought the same as …

<table>
<thead>
<tr>
<th>Transcription</th>
<th>My interpretation</th>
<th>Subjectifying</th>
<th>Mathematizing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Ob 2.052. Jim: But what did you think …?</td>
<td>Jim was trying to make sense of what the student said.</td>
<td>But what did you think …?</td>
<td>(With reference to the question, 2x+3x+4y).</td>
</tr>
<tr>
<td>Jim Ob 2.053. Student 7: Sir, I thought the same as them.</td>
<td>Student agreed to his peers’ view.</td>
<td>Sir, I thought the same as them.</td>
<td></td>
</tr>
<tr>
<td>Jim Ob 2.054. Jim: You didn’t know what to do with that one (4y). Ok, do you know like terms? When do you say the terms are like terms?</td>
<td>You didn’t know what to do with that one (Didn’t you know what to do with 4y?).</td>
<td>You didn’t know what to do with that one.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ok, do you know …</td>
<td>When do you say the terms are like terms?</td>
</tr>
</tbody>
</table>

When Jim sought clarification (2.050: how do you get …) on their wrong answer (11xy), student 7 responded: Sir, they said we add these two. Then I said; what about 4 and y. They didn’t tell me, they say … The students frequently used the word, ‘they’ (they said, they didn’t tell me) in
in order to justify the activity in which the group was involved. Jim then asked; what did you think …? His intention was to understand how this student interpreted the concept of the ‘like terms’. For Jim, that was equally important to what the student was learning from others. For instance, when the student said I thought the same as them. it helped Jim to understand that the group had the same understanding.

Jim’s question (what did you think …?) requires further analysis. His utterances required a mathematizing action from student 7. These utterances (Jim Ob 2.053, Student 7: Sir, I thought the same as them) perhaps had given Jim an insight into how students make sense of a concept, and might have an impact on his attitude towards a teaching approach that he may follow in future (learning as experience). In a way, such moments shaped his teacher identity.

4.3.2.4 Conclusion of the lesson

I conclude Jim’s story in this chapter by displaying the following utterances (Table 4.27).

Table 4.27: Jim concludes the lesson in a certain way Key: This is actually what we wanted to do.

<table>
<thead>
<tr>
<th>1st level Subjectification</th>
<th>2nd level Subjectification</th>
<th>3rd level Subjectification</th>
</tr>
</thead>
<tbody>
<tr>
<td>About specific performance</td>
<td>About performance</td>
<td>About the actor</td>
</tr>
<tr>
<td>Jim Ob 2.085. Jim: It is the answer because?</td>
<td>Jim Ob 2.089. Jim: … This is actually what we wanted to do.</td>
<td>Jim Ob 2.089. Jim: Thank you very much. This is actually what we wanted to do.</td>
</tr>
<tr>
<td>Jim Ob 2.086. Student 10: Because the alphabets are not the same.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This is actually what we wanted to do are the utterances that probably concluded the lesson as Jim confirmed that the students have an understanding about the like terms and unlike terms (Jim Ob 2.086). These also showed that he achieved the objectives of the lesson. He discussed the assignments, explored the students’ thinking and concluded that they performed the task satisfactorily. Students appropriately responded (the alphabets are not the same) to Jim’s utterances (It is the answer because …). As these utterances referred to a specific task, they are categorised under the 1st level subjectification. These were followed by confirming the performance (Jim Ob 2.089) and concluding the lesson with appreciation.
The utterances such as *as you know you can* (encouraging), *thank you very much* (appreciation) etc., are significant as these encouraged the students to continue the way they were performing the tasks. If these utterances were eliminated from the conversations, or if Jim did not utter these words, they would carry a different message. Therefore, such utterances proved to be significant for Jim. The utterances like *let us talk about this one* ... were frequently used on various occasions and indicated a togetherness of the community. Jim concluded the lesson (Jim Ob 2.089 *Thank you very much. This is actually, what we wanted to do*) satisfactorily.

In the coming section, I explore how this lesson is linked to the broader study.

### 4.3.2.5 Linking this lesson to the identity

The lesson was well-planned with an objective to make the group work effective. Even though *mathematizing* terms such as substitute, variables, coefficients were not frequently used in this class, the concepts of basic algebra, examples of expressions, like terms and unlike terms were used and frequently discussed. As Jim expected, by the end of the lesson, students grasped the topic well. In this regard, I observe the following:

- From the beginning of the lesson, Jim followed a single pattern, whereby students were engaged in mathematics learning through group discussion. He interacted with students and assisted them where necessary (*Learning as doing - practice*).
- Some utterances indicated that the students learned through discussion and with the assistance from their group (*they said, they didn’t tell me*).
- Jim extended his assistance and elaborated on the concepts such as like terms and unlike terms (Jim Ob 2.033: *I think you should do it this way*...).
- My presence with the camera seemed to have no impact either on Jim or on the students.
- Many students were able to answer Jim’s questions which helped him to understand their line of thinking in the classroom (*Learning as experience – meaning*).
- His approach for this lesson (group work) was different from the lesson that I had observed previously (lecturing). This possibly helped him to understand the advantage and limitations of these two approaches. This in turn provided a new teacher identity for him.

Jim identified various challenges regarding students’ understanding of ‘like terms’ and ‘unlike terms’ that might have compromised their learning to collect the like terms. For instance, some students answered the question, $2x + 3x + 4y$ as $11x y$. However, many students correctly answered $12g + 2g – 13g$ as $g$, even though some of them wrote the answer as $1g$. 
Jim asked some questions (*But what did you think ...?*) in order to **negotiate a meaning** of students’ actions in this lesson. During the interview, he emphasised that his approach (group work) helped the students to engage in learning effectively. He instructed them to talk to each other (Jim Int 2) and insisted that they should work together. This approach helped them to enjoy learning though some of them were good listeners rather than contributors (*I thought the same as them*). Unlike the previous lesson that I observed, Jim provided an opportunity for the students to engage in peer learning. He was thus able to understand how students tried to make sense of the topic. His approach also empowered him to make meaning out of this practice. In my view, this was a contributing component for shaping his **teacher identity**.

Jim realised that using this particular kind of classroom practice enhanced students’ attitude and approach to mathematics (**Students’ mathematics identity**). He may follow this approach in classrooms in future (Jim Int 2). According to him, he was part of the classroom community. **Practicing and participating** for Jim and his students in this classroom activity was obvious and effective due to the following reasons:

1. The activity was designed in a way to accommodate all students to learn from each other. Appropriate instruction was given by Jim at the beginning of the lesson (Table 4.22).
2. Students actively engaged in learning by discussing with members of the group as well as by exploring the textbook for relevant examples (Table 4.23).
3. Jim was occupied with monitoring the progress of their work. He asked questions in order to clarify the work done. He also asked questions that activated their reasoning skill (Table 4.24).

The classroom practice that Jim designed for this lesson had assisted him in understanding the meaning they formed on this topic. From the narrative, subjectifying utterances interplayed with mathematizing actions that illustrated Jim’s emerging **teacher identity, mathematics identity and community of practice identity**. Jim began to understand why it is necessary to provide opportunities for students to learn mathematics by participating and practicing (Jim Int 2). The questions that he asked the students motivated them to identify the procedure to unfold the task (collecting the like terms). Therefore, he achieved the objectives of the lesson fully as he had planned. It would be interesting to see if Jim would **develop** this approach in order to make the practice more effective in future. I asked Jim if he shared the idea of peer learning with his
colleagues. He answered affirmatively and said that he would encourage members in the department to try it at least once to see what students could accomplish (Jim Int 2.014).

Jim’s attitude suited the approach that he took in this classroom in order to meet the objectives of the practice for the lesson. He moved from group to group, monitored and assessed their work, suggested a few changes and corrected them when necessary. He sought clarification on certain aspects of performance by probing. In my view, mathematics learning was taking place in the classroom. Jim may need to practice more, so that he learns more (learning to become identity).

One of the key points as he reflected afterwards was that he started to understand the way students learn mathematics in classrooms (students’ mathematics identity). The larger number of students in a group hindered effective learning by all members within that group (The groups were just too big, Jim Int 2.06). He also hinted that next time, he needs to break the groups into smaller sizes so that mathematics learning would be more effective (Jim Int 2.06).

4.3.3 Lesson 3 (Line bisectors)

4.3.3.1 Introduction and overview of Jim’s third lesson

In this chapter, I present Jim’s story through his narrative and his classroom practice that portrayed how he learned new strategies in teaching.

4.3.3.2 Designing of the lesson

The topic was line bisectors. The lesson was pre-planned. According to Jim, the scheming of the topics was done at the beginning of the term.

Jim demonstrated how to construct a perpendicular bisector and angle bisector (Ref. Jim Int 3.002). Simultaneously, he asked a few questions that seemed to activate the students’ enthusiasm, although he did not wait for their response. In this chapter, the key focus is on the questions that he asked rather than exploring how he disseminated the concept. The way Jim explained the procedure of constructing the line bisectors did not differ from his previous teaching approaches (Jim’s story 1). He justified: I used the chalk style or call it demonstration
method … because I knew that it was a new concept all together (He was referring to the topic) … so I had to do a demonstration … see how to do it and then they do it (Jim Int 3.002).

In this chapter, I explore some of these utterances that are closely linked to mathematics learning in order to find out if Jim’s approach was significant.

**Table 4.28: Jim explains the procedure** Key: *What do I mean?*

<table>
<thead>
<tr>
<th>Transcription</th>
<th>My interpretation</th>
<th>Subjectifying</th>
<th>Mathematizing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Ob 3.004. Jim: Ok, we are going to draw two points using a ruler. Now the line we have, we call it a perpendicular bisector to the line AB. What was happening? Who knows what was happening? What I am saying is, this one is the perpendicular bisector to AB. What do I mean?</td>
<td>While describing the process of constructing the perpendicular bisector to line AB, he asked a few questions. One student answered his question.</td>
<td>Ok, we are going to draw … What was happening? Who knows what was happening? What I am saying is, What do I mean?</td>
<td>Two points using a ruler. Now the line we have, we call it a perpendicular bisector to the line AB. this one is the perpendicular bisector to AB.</td>
</tr>
</tbody>
</table>

Jim followed a *chalk and talk* style in order to ensure that the students learn this topic effectively. The students did not have any prior knowledge on construction. Therefore, this approach, according to him, suited the lesson.

**4.3.3.3 Jim starts the lesson**

Jim was *confident* about the approach he had taken for this lesson. The subjectifying utterances were intertwined with mathematizing and helped him to build the concept of the perpendicular bisector, as shown below:
Students answered Jim’s questions. He described how the perpendicular bisector of a line could be constructed (Jim Ob 3.008) and then he introduced its properties. The approach he had chosen was probing and clarifying by asking general questions (what was happening, what do I mean, do you know what it means). Jim asked the questions and expected a response from students in order to understand what meaning they formed (Table 4.29a). These utterances initiated an action in order to obtain a particular response from students. The question placed an obligation for them to answer. If the response did not cohere with the expected answer, Jim had to volunteer an explanation (It means that the angle here is 90 degrees). I examine these utterances further:

Table 4.29a: Jim tries to make sense of perpendicular bisector Key: What I am saying is ...

<table>
<thead>
<tr>
<th>Utterances Initiated by Jim</th>
<th>Response from student</th>
<th>Jim’s evaluation/conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Ob 3.004. Jim: What was happening? Who knows what was happening? What I am saying is, this one is the perpendicular bisector to AB. What do I mean? Anybody (?)</td>
<td>Jim Ob 3.005. Student 1: It is the line between AB (between A and B).</td>
<td>Jim Ob 3.008. Jim: Ok, do you know, what it means? It means that the angle here is 90 degrees. All these angles here (are 90 degrees).</td>
</tr>
</tbody>
</table>

Jim repeated by rephrasing the question (what was happening) until he got the response from a student (It is the line between AB). This approach identified Jim as a guide which helped him to create a meaning from the situation whereby students had to think accordingly. Thereafter, he elaborated and concluded the relevant concept (this one is the perpendicular bisector to AB). He described the procedure of constructing the perpendicular bisector and then needed to confirm if students understood it, and asked what was happening. These utterances addressed the specific performance (of constructing the perpendicular bisector) and qualified to be in the first level of subjectifying. The next utterance what I am saying is qualified to be the second level of subjectifying. The final level of this sequence was when he repeated the question (what do I mean?). Finally, Jim uttered these words the line we have, we call it a perpendicular bisector to
the line $AB$ (Jim Ob 3.004) that guided them to understand the meaning of the perpendicular bisector.

Jim’s next task was to evaluate if the students followed his elaboration. One of the students answered that the line (perpendicular bisector) is the line between $AB$. The significance of these utterances was that Jim repeatedly raised some questions which activated the student’s response accordingly. These questions (Jim Ob 3.004) are therefore reifying. The response from the student was an indication for him to confirm that the meaning he passed on to them cohered with the meaning that they formed. Jim then concluded the concept: *Ok, do you know, what it means? It means that the angle here is 90 degrees* (Jim Ob 3.008).

Gee and Green (1998) in this regard consider how initiatives, responses and evaluations work in classroom practice. On various occasions, Jim pronounced the word *ok* that could be interpreted in many ways within the situational contexts (Sfard & Prusak, 2005). Are there any patterns assembled from such utterances that link to situated meanings (Gee & Green, 1998)? I examine these utterances further.

On various occasions, Jim used the utterance ‘ok’ with different meanings based on the situations. These utterances may not have any direct impact on mathematizing or mathematics learning, but they carried particular meaning in a particular situation as implied by Jim. Gee and Green (1998) argue that meanings are negotiated between people in and through social interaction. Situated meanings do not reside in the minds of the speaker. Words such as *ok* (in this context) are therefore significant and endorsable (Sfard & Prusak, 2005). In my view, Jim’s way of uttering *ok* influenced mathematics learning or students’ behavior in general, as shown below:
Table 4.30: The utterance *ok* carries different meanings for Jim. Key: *Ok. Do you know, what it means?*

<table>
<thead>
<tr>
<th>Utterance affiliated to the word ‘ok’</th>
<th>What Jim meant</th>
<th>Situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Ob 3.001: That means we draw a line that cuts that that line, that horizontal line in the middle, <em>ok</em> (?).</td>
<td>Do you understand?</td>
<td>Jim was seeking confirmation.</td>
</tr>
<tr>
<td>Jim Ob 3.001: <strong>Ok</strong>, suppose we have straight line here, let us call it AB.</td>
<td>Ok. Let us continue.</td>
<td>He began a sentence with <em>ok</em>, indicating that a new theme is discussed.</td>
</tr>
<tr>
<td>Jim Ob 3.001: <strong>Ok</strong>, you didn’t tell me …</td>
<td>Ok, I understand, but I am concerned.</td>
<td>He listened to the explanation and accepted it (student came late and entered into the classroom and explained why he came late).</td>
</tr>
<tr>
<td>Jim Ob 3.002: <strong>Ok</strong>, I said we are going to make an arc.</td>
<td>Ok, as I said …</td>
<td>He began a statement with the word, <em>ok</em>.</td>
</tr>
<tr>
<td>Jim Ob 3.008: <strong>Ok.</strong> Do you know, what it means?</td>
<td>Ok, let me ask you.</td>
<td>He concluded the statement with a question.</td>
</tr>
<tr>
<td>Jim Ob 3.011: You have done it already. <strong>Ok.</strong></td>
<td>Is that so?</td>
<td>Jim appreciated the student’s fast performance.</td>
</tr>
</tbody>
</table>

Within the first twelve conversations that Jim had, he uttered the word ‘ok’ 6 times. Each time this word carried a different meaning as shown in Table 4.30. If reifying is identified by repeating the words, then the repeating of the word *ok* showed reifying. The other utterances that are affiliated to this word are also thus reifying. The significance of these utterances according to my view is not about the repetition, but the situated meaning that is created by this particular word as shown in this Table 4.30.

Jim continued teaching. While uttering *what I would like to do, I am going to ask you to draw that line AB, say just make it 6 cm in your book* (Jim Ob 3.010) he also demonstrated the length of the line AB by extending his hands in opposite directions. He added further: *go to the other point and do the same. It will make the arcs to intersect. So make sure that your compass is not dancing. The fingers should be steady. Make sure that it is not opening like that because, it is going to get it wrong* (Jim Ob 3.012). These utterances are analysed in Table 4.31:
Table 4.31a: Subjectifying utterances enhance mathematizing actions

<table>
<thead>
<tr>
<th>Transcription</th>
<th>Interpretation</th>
<th>Subjectifying</th>
<th>Mathematizing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Ob 3.012. So make sure that your compass is not dancing. Make sure that it is not opening like that because it is going to get it wrong.</td>
<td>So make sure that your compass is not dancing (meaning it should not change the position. The fingers should be steady). Make sure that it is (the arms of the compass) not opening like that …</td>
<td>So make sure that your compass is not dancing. Make sure that it is not opening like that … because it is going to get it wrong (referring to the construction).</td>
<td></td>
</tr>
</tbody>
</table>

These utterances enhanced mathematizing. Students actively participated in the construction of the perpendicular bisector. Jim was concerned with the steadiness of the arms of the compass (if the students’ fingers shake) which will influence their drawing of the line. This is why he kept on insisting make sure that your compass is not dancing. He even cautioned the consequence (because it is going to get it wrong). These utterances require further analysis (Table 4.31b).

Table 4.31b: Jim is concerned about the way students use the resources

<table>
<thead>
<tr>
<th>1st level Subjectification About specific performance</th>
<th>2nd level Subjectification About performance</th>
<th>3rd level Subjectification About the actor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Ob 3.012. Make sure that it is not opening like that …</td>
<td>So make sure that your compass is not dancing.</td>
<td>So make sure that your compass is not dancing (Jim is in a humorous mood).</td>
</tr>
</tbody>
</table>

Jim described the procedure of constructing the line bisector. As the students tried to construct the line bisector, he moved around to evaluate their activity. He assisted them, made some comments in a humorous manner (make sure that your compass is not dancing) and clarified certain processes. These utterances not only activated learning but also entertained them. He also alerted the students with his concerns such as, how to hold the compass (Make sure that it is not opening like that because it is going to get it wrong). He continued providing them with tips on how to hold their fingers while drawing the arcs with the compass. In order to understand how students accepted these utterances, I analyse these further in Table 4.31c:
Table 4.31c: Subjectifying utterances reify Key: *because it is going to get it wrong.*

<table>
<thead>
<tr>
<th>Indirect reification (Forming an opinion about actions of someone or self or something)</th>
<th>Direct reification (describing a person): What does Jim observe about him or about others?</th>
<th>Direct reification Jim’s conclusion in a certain way</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Ob 3.012: Because it is going to get it wrong.</td>
<td>(You) make sure that it is not opening like that …</td>
<td>So make sure that your compass is not dancing.</td>
</tr>
</tbody>
</table>

Jim’s sense of humor enhanced students’ learning that brought a pleasant atmosphere into the classroom. Heyd-Metzuyanim and Sfard (2012) point out that the words are not the only means of identifying a person or his action. In this classroom practice, Jim had demonstrated some identifying mechanisms that hinted at a particular way of his approach. He cautioned them on the appropriate use of the arms of the compass. Such precautions were well accepted by them. Therefore, these utterances are significant.

As the lesson continued, Jim introduced the construction of acute angles. I provide the vignette below that will examine these utterances:

*Now, I want us to do something else ... I need your attention please... you are going to draw an acute angle. Can you find us the size of an acute angle? How do you decide an acute angle? ... Anybody who volunteers and tell us how big is an acute angle? (Jim Ob 3.015).*

Table 4.32a: Jim introduces new idea key: *I need your attention please...*

<table>
<thead>
<tr>
<th>1st level Subjectification About specific performance</th>
<th>2nd level Subjectification About performance</th>
<th>3rd level Subjectification About the actor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Now, I want us to do something else ... I need your attention please… you are going to draw …</td>
<td>How do you decide …</td>
<td>Can you find us …</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anybody who volunteers and tell us …</td>
</tr>
</tbody>
</table>

Jim introduced the construction of angle bisector (*you are going to draw* – 2nd level of subjectification). Before getting into the details on how to construct the angle bisector, Jim planned to assess students’ prior knowledge on different types of angles. He asked if they knew something about acute angles (*How can you decide, Can you find us the size of an acute angle?*). These questions were not addressed to any particular student. Therefore anyone could respond to these questions. It also implied that all students had an equal chance to answer. These utterances indicated Jim’s intention to encourage the students to participate, therefore these are categorised
in the 3rd level of subjectification. Through progressive sequences of utterances, he engaged the students in mathematics learning, and secured their attention (I need your attention, please). These utterances require further analysis as shown below in Table 4.32b:

**Table 4.32b: Mathematizing actions are identifying in this lesson**

<table>
<thead>
<tr>
<th>Indirect reification (Forming an opinion about actions of someone or self or something)</th>
<th>Direct reification (describing a person): What does Jim observe about him or about others?</th>
<th>Direct reification Jim’s conclusion in a certain way</th>
</tr>
</thead>
<tbody>
<tr>
<td>Now, I want us to do something else … I need your attention please…</td>
<td>How do you decide an acute angle? … Can you find us the size of an acute angle?</td>
<td>You are going to draw an acute angle. Anybody who volunteers and tell us how big is an acute angle?</td>
</tr>
</tbody>
</table>

Let me consider the following utterances: Now, I want us to do something else, I need your attention please, you are going to, can you find us? How do you decide? Anybody who volunteers and tell us? The utterances such as I want, I need exclusively reify the purpose of the lesson by activating students’ attention. These utterances imply that Jim was seeking certain information to execute a specific action and therefore fall under indirect reification. The utterances like, can you find us, how do you decide are addressed to the students with an expectation that they would respond to his questions. These are considered as first level direct reifying. Lastly, when Jim said you are going to draw an acute angle, it was an indication of what was going to happen in the classroom regarding the activity to which he was referring. These utterances are pronounced in a sequence that could not be isolated from each other. These were significant due to the indication towards the next possible action from the members in that classroom. Jim pronounced these utterances in such a way that the students waited eagerly as expected. He successfully managed to have their full attention. He also had the response from the students (acute angle is an angle less than 90 degrees - Jim Ob 3.016). Jim appreciated this and confirmed; it means that the angle here is 90 degrees (Jim Ob. 3.017).
4.3.3.4 Conclusion of the lesson

The lesson progressed well and the students, according to Jim, enjoyed the lesson. However, in my opinion, there was no evidence to conclude that the students knew why this construction works, which could imply that the students learn the concept without knowing how it works. This may also have a negative impact on Jim’s learning experience. I conclude this section by exploring one more section in Table 4.33:

Table 4.33a: Jim concludes the lesson. Key: If they are not equal, you know that you made mistakes

<table>
<thead>
<tr>
<th>Transcription</th>
<th>My interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Ob 3.050. Jim: The two angles are supposed to be equal, must be equal, actually. So if they are not equal, you know that you made mistakes somewhere. Your compass, when you are constructing you must not move, ok?</td>
<td>The two angles … must be equal (Once an angle is bisected, the newly formed two angles must be equal). If they are not equal … made mistakes somewhere (If the new angles are not equal, then you should know that you did not bisect the angle correctly). Your compass … you must not move, ok? (While using the compass, you should be steady with your fingers and the arms of the compass should not be shaking).</td>
</tr>
</tbody>
</table>

| Jim Ob 3.052. Jim: When you are trying to make the arc, they shouldn’t move. Shouldn’t move because they are going to mess up your construction, ok (?). Now, that is it for the day. | When you are trying to make the arc, they shouldn’t move (When you construct arcs, be careful not to move your fingers from the arms of the compass or else, it will mess up with your construction). |

These utterances require further analysis as shown below:

Table 4.33b: Jim’s concluding utterances caution the students Key: You know that ...

<table>
<thead>
<tr>
<th>1st level Subjectification About specific performance</th>
<th>2nd level Subjectification About performance</th>
<th>3rd level Subjectification About the actor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Ob 3.050: If they are not equal, you know that you made mistakes somewhere.</td>
<td>You made mistakes somewhere.</td>
<td>You know that you made mistakes somewhere.</td>
</tr>
<tr>
<td>Jim Ob 3.052: They shouldn’t move…because they are going to mess up</td>
<td>When you are trying to make</td>
<td>Now, that is it for the day.</td>
</tr>
</tbody>
</table>


To conclude the analysis of this classroom observation, I consider Jim’s utterances (Jim Ob 3.050, 052). Through these utterances Jim cautions the students (what they should do) while constructing the bisectors. Drawing incorrect arcs or changing the position of the point from which the arc was drawn were common errors that they made. This happened because the arms
of the compass were shaken. Jim therefore emphasised that *they shouldn’t move ...because they are going to mess up ...* These two subjectifying utterances refer to the specific actions or the performed task and therefore are categorised in the first level of subjectifying. Once these utterances (*If they are not equal, you know that, they shouldn’t move...*) are pronounced, they follow the next consequences (*You made mistakes somewhere, because they are going to mess up ...*). These utterances were therefore qualified to be in the second level of subjectifying.

Jim then concluded *If they are not equal, you know that you made mistakes somewhere* that prepared the students for the consequence of certain events as if it happens. These utterances assisted the students to confirm the answer by cross-checking if the line segments or the bisected angles were equal. Therefore, these utterances empowered mathematical learning.

He concluded the lesson and commented *that is it for the day* (Jim Ob 3.052). In the interview, he observed: *they have developed that team spirit. They always try to do something together* (Jim Int 3.77). This indicated that Jim was satisfied with the outcome of the lesson.

### 4.3.3.5 Linking the lesson to the identity

In order to accomplish the objectives of this lesson, Jim tested new strategies such as probing so that he could assess their prior knowledge. He identified his own position as a mathematics teacher (*I want us to do, you know that you made mistakes*), which is significant for him (*Learning as experience – meaning*). While introducing the concept, he asked a few questions (Jim Ob 3.004) that students answered accordingly. The removal of any utterance from the sequence might have brought a different outcome for the students as well as for Jim. For instance, the utterances such as *Now, I want us to do something else ... I need your attention please... you are going to draw* (Jim Ob 3.015) created a learning atmosphere for them. Students were thus mentally prepared to accept the next input from Jim (*Learning as practice*). This means alteration; removal or addition of any utterance could have created a different meaning and different learning outcome.

He explained the procedure of constructing the perpendicular bisector. He also cautioned the students by using his arms to distinguish certain activities (like cutting/intersecting a line) as well as drawing imaginary lines with hands (Ref. Jim Ob 3.027: *Or if you like, just mark it on the arms or just make that arc, which is crossing, which is cutting the two arms*).
Jim was inquisitive, probing, creative and humorous. He explored various semiotic tools as resources in order to establish the mathematical concepts in the minds of the students. He approached the lesson in a particular way that inspired the students to learn mathematics effectively. In his own words: *each individual was able to grasp the concept and was able to individually try to participate in an activity ... because there was nobody helping. It was somehow improving their listening and they are imitating the skill* (Jim Int 3.033). Jim was trying to conceptualise his teaching approach and to understand his own actions (*Teacher identity*) that were imitated by the students. This lesson probably showed Jim’s consistent way of teaching although the lesson was dominated by ‘chalk and talk’. According to him, the students were learning by listening and practicing the activities. Jim’s teacher identity is thus shaped within that framework.

4.4 PARTICIPANT 3 - Peter

4.4.0 Who is Peter?

Peter is a newly employed mathematics teacher at Central High School in Maseru and lives with his family within the school campus. He considers himself as a facilitator and instructor in mathematics classrooms (Appendix 3). According to him, the students see him as a teacher who assists them in learning mathematics. He loves being a mathematics teacher, and is committed to engaging in students’ learning activities (Peter, Appendix 1). His dream is to produce good results in mathematics and is planning to pursue his education further, so that he improves his career as a mathematics teacher. In this regard, his concerns are (Peter, Appendix 2) listed below:

- Inadequate support from the school community (e.g. lack of teaching resources)
- Poor learning atmosphere for students (e.g. lack of books, negative attitude towards mathematics)
- Incompetency among students (e.g. lack of discipline, poor pre-requisite knowledge)

Against this backdrop, I start with Peter’s narratives on his personal dreams and how he saw himself as a mathematics teacher. He said:
I was somebody who liked mathematics, yes, to learn mathematics and I understood my teacher well. He was a very good mathematics teacher. I liked him a lot (Peter Re 1.004). From that experience that I got from my teacher, the way he is teaching, the way he is making me love mathematics ... (I would like to hear my students saying) we are really where we are because of you. That’s what I liked very much. That’s why I ended up choosing to be a teacher you know so that I will have the products from my hands (Peter Re 1.006).

These utterances painted a true picture of Peter’s dream to become a mathematics teacher. He considered his former mathematics teacher to be the role model, and tried to imitate him. He wanted to see his students becoming successful in life so that one day, they could acknowledge his contribution towards their success. What else could a teacher ask for, other than being recognised as a good mathematics teacher?

Changing ways of belonging and changing alignment were challenges for Peter, who considered sharing his views with the members within the school and with the neighbouring schools as crucial. His main ‘worry’ is that even the teachers teaching them (don’t care) but the most important thing is that the teachers themselves, they don’t take their duties (seriously). They ignore their duties as teachers to guide learners to be -better- (Peter Re 1.014). Against this backdrop, I explore his classroom practice.

4.4.1 Lesson 1 (Topic: Gradients)

4.4.1.1 Introduction and overview of Peter’s first lesson

Peter was teaching the topic gradients in Form C. He started the lesson by asking questions in order to assess their prior knowledge of the topic. He needed to know if the students were able to ‘identify’ the slopes. It seemed that the students managed to answer his questions. Peter asked these questions to assess their knowledge of this topic, and was satisfied with the responses. With this understanding, I analyse his first lesson that I observed in 2012.

4.4.1.2 Designing of the lesson

Peter started the lesson by demonstrating the idea of slope using a graph on the chalk-board. Later, he clarified: Let me (explain), first of all I introduced the (topic that) we are talking about … (Peter Int 1.006), Slope, and how to write the equation of the (slope). So my intention ... what I wanted, the students to be able to write the equation of the slope (Peter Int 1.008). Then he
asked a few questions. Students seemed to have the relevant background knowledge on this topic. In Table 4.34, I analyse Peter’s utterances.

**Table 4.34: Subjectifying and mathematizing utterances are intertwined**  
*Key: How can we know ...?*

<table>
<thead>
<tr>
<th>Peter’s probing questions</th>
<th>Students’ responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peter Ob 1.001. Peter: How can we know whether the slope is positive or negative or it is a zero?</td>
<td>Peter Ob 1.002. Student 1: When the slope is straight, the slope is …</td>
</tr>
<tr>
<td>Peter Ob 1.003. Peter: Straight, how?</td>
<td>Peter Ob 1.004. Student 2: When the slope is parallel to …</td>
</tr>
<tr>
<td>Peter Ob 1.005. Peter: Yes, when the slope is parallel to Y axis, that slope is (infinite). It is very correct. Right. What about this one of the zero? How can you tell, when the slope is zero?</td>
<td>Peter Ob 1.006. Student: when the line is parallel to X, X axis …</td>
</tr>
</tbody>
</table>

From the beginning of the lesson, Peter established the approach that he planned for conducting the lesson. He asked questions that required more than ‘yes/no’ as an answer. He managed to arouse the curiosity among the students, and made them respond to his questions. For instance, when Peter uttered, *how can we know ...,* the students had to respond *when the slope is straight ...* The key observation is that the students made sense of the question and responded accordingly using terms such as *slope, straight* etc. Peter further challenged answers that were elaborated by them. The lesson then proceeded to the next stage.

### 4.4.1.3 Peter introduces the theme of the lesson

Selected subjectifying utterances are analysed below:

**Table 4.35a: Subjectifying utterances intertwine mathematizing**  
*Key: How do you know ...?*

| Peter Ob 1.007: When the line, (after a pause, he considered to appreciate the student) very good, girl, when the line is parallel to the x axis, that shows it (gradient) is zero. Right, that is true. When the line is parallel to the x axis, the slope is zero. How about ... the positive and negative? How can you tell when the slope is negative (or) slope is positive? Yes, how can you tell when the slope is negative or when the slope is positive? How do you know when that slope is positive or this slope is negative? Liau, can you try it? |
These subjectifying utterances were intertwined with mathematizing and needed further elaboration. Peter wanted to know if students are able to identify (how do you know…) the sloping of the line (negative or positive). See these utterances: right, that is true; how can you tell; and, how do you know? These utterances demonstrated his approach in the classroom. Firstly he confirmed their observation, and then probed further for seeking clarification that requires detailed analysis:

**Table 4.35b: Subjectifying in mathematics learning** Key: Can you try it?

<table>
<thead>
<tr>
<th>1st level Subjectification</th>
<th>2nd level Subjectification</th>
<th>3rd level Subjectification</th>
</tr>
</thead>
<tbody>
<tr>
<td>About specific performance</td>
<td>About performance</td>
<td>About the actor</td>
</tr>
<tr>
<td>When the line, very good girl</td>
<td>Right, that is true.</td>
<td>very good girl</td>
</tr>
<tr>
<td>When the line is parallel to the x axis that shows it is zero.</td>
<td>When the line is parallel to the x axis the slope is zero.</td>
<td>Liau, can you try it?</td>
</tr>
</tbody>
</table>

These utterances progressed through three levels of subjectification. When Peter voiced these utterances, he was probing the students’ pre-requisite knowledge on the topic, gradients of lines. He was not addressing any particular student until he reached the last stage of the utterances. Then he asked one particular student to try. The subjectifying utterances started with appreciation (very good girl) and ended by asking one student to try it. In between these utterances, he talked about the gradient and repeated the question (how …) in different ways (How can you tell, How do you know?).

Peter asked the question that was correctly answered by one student (Peter Ob 1.006: When the line is parallel to x axis…). He then acknowledged and appreciated the student’s response. In the middle of the utterances (when the line) he paused in order to confirm that the answer is correct (Right, that is true). These utterances progressed through different levels of subjectification. He also appreciated the student (very good girl). Afterwards, he continued with the mathematizing actions (When the line is parallel to the x axis) in order for them to make sense of ‘what is happening with the line’. These utterances re-established the concept that ‘when the line is … the slope is zero’. He then proceeded with the lesson and probed further; yes, how can you tell when the slope is negative or when the slope is positive? These utterances require further analysis.
Table 4.35c: Peter’s probing style Key: How ...?

<table>
<thead>
<tr>
<th>1st level Subjectification: About specific performance</th>
<th>2nd level Subjectification: About performance</th>
<th>3rd level Subjectification: About the actor</th>
</tr>
</thead>
<tbody>
<tr>
<td>How can you tell when the slope is negative (or) slope is positive?</td>
<td>Yes, how can you tell when the slope is negative or when the slope is positive?</td>
<td>How do you know when that slope is positive or this slope is negative?</td>
</tr>
</tbody>
</table>

Peter repeatedly used the utterance how… in three different ways and tones that emphasised the importance of the term ‘gradient’ of a line. He started with how can you tell? Then he repeated the question with an addition of ‘yes’ that I categorised under the second level of subjectifying action. The next utterances had a different tone as he used different words; how do you know when that slope is positive or this slope is negative? The question how can you tell is now transformed into how do you know with an emphasis on ‘that line ... or this line’. Through these utterances Peter indicated that this line and that line had different gradients (negative or positive).

His repeated utterances guided the students to think logically, which indicates their active mathematical learning in the classroom that requires more analysis.

Table 4.35d: Reifying utterances are identifying Key: Yes, how can you tell?

<table>
<thead>
<tr>
<th>Indirect reification (Providing information on what has to be done regarding something)</th>
<th>Direct reification (describing a person): What does Peter observe about him or about others?</th>
<th>Direct reification: Peter’s conclusion in a certain way.</th>
</tr>
</thead>
</table>
| How can you tell when the slope is negative (or) slope is positive?              | Very good girl
Yes, how can you tell when the slope is negative or when the slope is positive? | Right, that is true.
Liau, can you try it? |

I start with the three statements that are significant for three reasons. When Peter uttered the words very good girl, he was appreciating the student’s correct answer to the question (Peter Ob 1.005: How can you tell, when the slope is zero?). That was a necessary response from him in order to develop students’ self-confidence. He appreciated (right – correct) the student with the reason (that is true). This reifying action endorsed Peter’s logical approach in the classroom and
indicated how he made sense of his actions in a **convincing tone**. Therefore these utterances are significant and portray Peter’s particular classroom approaches. In summary, these utterances were **convincing, acknowledging and inspiring** which are indications of his teacher identity.

The next reifying actions had a different projection. The objective of these actions was to understand if the students identify the slopes in terms of the nature of the slope (negative, zero and positive). He was leading the students by repeating the question and he used different words without deviating from the objective. It is of interest to look at the question when he first asked *How can you tell when the slope is negative (or) slope is positive?* The words (*how can you tell*) indicated the purpose of the question, specifically to identify the slope of the line (negative or positive). He repeated these words by adding *yes* with an emphasis that endorsed its importance which did not end there. He repeated the question for the last time (*How do you know when that slope is positive or this slope is negative?*). Repetition itself had established the significance of this question. He re-phrased the question and brought further emphasis with *this slope and that slope*. Students successfully answered the question. At that moment, Peter achieved the goal as he had planned.

Peter used the term ‘*you*’ rather that the term ‘*we*’ in these utterances. Use of this term was also significant and sent a message to the students that this is not about ‘me’ but about ‘you’. It indicated what kind of a person he is. In these conversations, he excluded himself from the students, but successfully guided them to learn the concept that he had designed for the day.

As the lesson progressed, Peter introduced new mathematical terms showing the slope of a line (negative, positive, undefined and zero slopes). He used a limited number of words to clarify certain points (Peter Ob 1.014). In response, students used more than one word and clarified answers (Peter Ob 1.015). The lesson progressed without any challenge as shown in Table 4.36.
Table 4.36a: Mathematizing in progress Key: Can you try?

<table>
<thead>
<tr>
<th>Peter’s probing utterances</th>
<th>Student’s responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peter Ob 1.010. Peter: What about negative? Those are the negative slope, positive slope, undefined slope and zero slope. Suppose, you have an idea, can you try? (Looking at one student). Do you know how to explain?</td>
<td>Peter Ob 1.011. Student 1: When letter represents the… any number (clarifying)</td>
</tr>
<tr>
<td>Peter Ob 1.012. Peter: Any number? (Clarifying)</td>
<td>Peter Ob 1.013. Student 1: Yes (Confirmed)</td>
</tr>
<tr>
<td>Peter Ob 1.014. Peter: How? (Probing)</td>
<td>Peter Ob 1.015. Student 1: We can say, one X, one is the coefficient of X (Student knew the reason).</td>
</tr>
<tr>
<td>Peter Ob 1.016. Peter: One X? (Confirming)</td>
<td>Peter Ob 1.017. Student 1: Yes sir (Confirmed).</td>
</tr>
<tr>
<td>Peter Ob 1.018. Peter: Another example?</td>
<td>Peter Ob 1.019. Student 1: Three X, 3 is the coefficient of X.</td>
</tr>
</tbody>
</table>

Peter asked these questions to clarify certain points and to assess students’ existing knowledge. It was also noted that he did not provide any answer at this stage. He justified the way he addressed this particular situation. In his words:

*My understanding about this learner-centred (approach) is that I take it as a very important way of learning because learners are able to find answers for themselves, not the teacher guiding them towards answers. So it is very wise for the learners to find solutions’ access for themselves. Not the teacher to be the one that gives them the correct answer (Peter Int 1.093).*

With this note, I explore how he demonstrated an example that students followed to identify a pattern regarding the gradient.
Table 4.36b: Peter display an example Key: *It simply means that ...*

<table>
<thead>
<tr>
<th>Peter’s utterances</th>
<th>Mathematical meaning</th>
</tr>
</thead>
</table>
| Peter Ob 1.039: Therefore we have the equation, \( y = 3x - 1 \). Now, you check the values of \( x \) and you substitute here. \( y \) here (Students: 2) which is equal to three multiplied by what (Students: One), minus one. So 3 multiplied by 1 is (Chorus: 3). This is 2 (He writes 2 indicating that that is \( y \)) equals three minus 1, ok? That is two equals, two. | \( y = 3x - 1; \) if \( x = 1 \), Then \( y = 3 \times 1 - 1 \)  
\( = 3 - 1 \)  
\( = 2 \). Therefore, \( y = 2 \) |
| Peter Ob 1.039: Let us go to b. \( y \) equals 3x-1 (He writes this on the board). What is the value of \( y \)? (Peter Ob 1.040. Students: 8) | \( y = 3x - 1 = 8 \)  
\( = (3 \times 3) - 1 \)  
\( = 9 - 1 \)  
\( = 8 \) |
| Peter Ob 1.041. Peter: That 8 equals 3 multiplied by, what is the value of \( x \)? (Students: 3). Three minus one. So three multiplied by 3? (Peter Ob 1.042. Students: 9) |                                                                 |
| Peter Ob 1.043. Peter: minus? (Students: One), one. |                                                                 |

I present the following utterances: *This equation shows that, after substituting the values ... we have 2=2 and 8=8. So, what does this mean? It simply means that those two points lie on the lines* (Peter Ob 1.043). These utterances demonstrated that Peter successfully substituted ‘\( x \)’ with a number and calculated the value of ‘\( y \)’. At this juncture, he introduced a new term, ‘collinear’ and linked the gradient of the line to the coordinates. The significance of these utterances was that he successfully described the concept and introduced new terms that illustrated the properties of line (in connection to 2D graph, coordinates and the gradient of the line). He provided extra time to copy the information from the chalk-board. While they were working on these, he monitored their work, probed further, clarified their answers and assisted them accordingly.

As the lesson progressed, Peter linked the equations that represented specific lines on a graph. He repeated the connection between the gradient and the coefficient of ‘\( x \)’ (*The coefficient of \( x \) is equal to the gradient* - Peter Ob 1.056) so that the students identify the gradient of a line from the given equation of that line. Did he achieve this goal? I explore selected utterances that disclose what is going on in this classroom.
Table 4.37: Peter repeats the question Key: *What is the gradient of that line?*

<table>
<thead>
<tr>
<th>1st level Subjectification</th>
<th>2nd level Subjectification</th>
<th>3rd level Subjectification</th>
</tr>
</thead>
<tbody>
<tr>
<td>About specific performance</td>
<td>About performance</td>
<td>About the actor</td>
</tr>
<tr>
<td>Peter Ob 1.056: What is the gradient of that line? What is the gradient of that line? Very good. That is the gradient of that line.</td>
<td>Hey.. What is the gradient of that line? That is the gradient of that line.</td>
<td>Hey.. What is the gradient of that line? What is the gradient of that line?</td>
</tr>
</tbody>
</table>

Peter asked the question repeatedly (*What is the gradient of that line?*). When he asked the question for the first time, it carried a normal weight with a neutral tone. He expected a fast response from the students because they had already observed and concluded that the gradient of a line is equal to the coefficient of ‘x’ in the equation of that line. However, students failed to respond. Peter then repeated the question once more with an additional utterance, ‘hey’ as if he was irritated. This was perhaps uttered in an accusing or impatient tone. When he repeated the question a fourth time, one student answered 2. The student linked the gradient with the equation, as Peter stated previously, and he responded immediately, *very good*, as if he was relieved and acknowledged by saying *that is the gradient of that line*. In my view, the subjectifying utterances were intertwined with mathematizing, but did not inspire mathematics learning. The repetition of the question indicated Peter’s emotional hues that had no impact on students probably because they struggled to find an answer.

Peter now moved on to the next concept, exploring the y intercept. He described the concept using a few examples. He also asked questions (Peter Ob 1.059. Peter: *Where does this line cut y axis?*). Through these utterances, he established that *y intercept is the point where the straight line cuts the y axis* (Peter Ob 1.059). All these utterances intertwined the mathematizing actions from Peter’s perspectives, though he realised later:

*I didn’t draw the straight line there. I could have drawn the straight line but due to the lack of material that we used I didn’t make a straight line* (Peter Int 1.050).

I consider these thoughts as endorsable because, at this stage, the subjectifying utterances intertwined with mathematizing actions and explored a specific mathematical concept, as shown below:
So this Y intercept, is equal to 5 (in the equation, \( y = 2x + 5 \)). So is there any relation between y intercept and this number I have written (5)? Is there any relationship? Is there anything ... between those two numbers? What is it? (Peter Ob 1.059). It is similar to the other number. It is similar, ok? This number, this number here crosses that number, is always the y intercept (Peter Ob 1.060).

4.4.1.4 Conclusion of the lesson

The first chapter of Peter’s story ends here. At the end of the long descriptive teaching, students said that they understood the concept (Peter Ob 1.061). Thereafter, he gave some assignments for the students to work out, which they did successfully. Peter confirmed this by asking questions (Ref: Prism 2000 Plus, Book 3). The students answered correctly as shown in Table 4.38:

Table 4.38: Peter concludes the lesson Key: What is the y-intercept of the each of the lines?

<table>
<thead>
<tr>
<th>Peter’s questions</th>
<th>Student’s answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peter Ob 1.066. Peter: What is the y intercept of b (Question b, ( y = 3x + 6 ))?</td>
<td>Peter Ob 1.067. Student 6: y intercept of b is 6.</td>
</tr>
<tr>
<td>068. Peter: That is true. What is the y intercept of c (Question c, ( y = 5x - 7 ))?</td>
<td>069. Student 6: Seven</td>
</tr>
<tr>
<td>070. Peter: 7? (With a smile), Let us look at the sign.</td>
<td>071. Student 7: Negative seven.</td>
</tr>
</tbody>
</table>

He demonstrated a couple of examples and instructed the students to explore more questions. He moved from one student to another, talked to them, assessed them and corrected their work. He said; I feel very good, I feel very good when the learners are able to find the solution because I think that it will also help them to find the solutions in the exam situations (Peter Int 1.099).

This indicated his intention to interact with the students so that mathematics learning takes place actively. He introduced various terms and concepts such as gradient, collinear coordinates and y intercept within a short period. However, he clarified that the students were familiar with these terms (Ref: Peter Int 1.028: Yes, because it was not my first time to teach this topic on this, I taught this topic last year when they were in form B, so I was expecting them to know the variables and source).
Students’ correct answers stated that they are able to identify the gradient and y intercept from the given equation of a line. They did not get the opportunity to practice the exercise from the textbook and Peter exhausted the time that was allocated for this lesson.

4.4.1.5 Linking the lesson to the identity

Peter completed the lesson as he planned and according to him, it was successful. He probably felt very good when students learned to calculate the gradients and the y intercept of a line. While reflecting on the classroom experience, he narrated his concerns:

> I want these learners to remove this negative attitude towards mathematics and also to make the performance of mathematics to be somehow good at school because from last years the performance of mathematics was not good at all. So my vision is to make the results of mathematics to be very good (Peter Int 1.088).

This story illustrated his designated identity (my vision is). This lesson was a learning experience for him because he identified a stigma students had regarding learning mathematics. He wanted to remove this. He wanted to create a different meaning for students through new practices.

He also designed what the students should learn and how far they should learn on that particular day. He also considered this topic as important for the students as shown below:

> Alright, I think this topic is very important because it is like I said it is done in 2 dimensions both in x and y axes, and then the students were able to identify, to be able to know how to deal with the variables. And then graphically this is very important because it can be sometimes applied in real life situations whereby you talk about the something that is two dimensional (Peter Int 1.043).

Peter is determined to change the attitude of students by creating new meaning for them. In order to motivate students’ mathematics learning, he wished to introduce a mathematics club at his school that gave him a new identity. He discussed this plan with his colleagues. According to him:

> Most of the teachers, they don’t feel like doing work after school. I am the one who is committed to do that. Some said, no they can’t do that after school (hours), we are here only for school hours. After school they will go home, we have so many things to do at home (Peter Int 1.084).

These utterances indicate the limited communities of practice between Peter and the mathematics department. This also created an identity crisis for him. He wished to establish a mathematics club, but his colleagues (including the principal and the head of the department) rejected this. They did not offer any support due to reasons that were unknown to him. His plan
to involve his colleagues in his teaching activities through a mathematics club thus could not materialise. In his words: *What I prefer is the team teaching. That is very important so that someone can see how the other is teaching mathematics, the approach that he used so that sometimes it will help him or her* (Peter Int 1.105).

His second concern was related to the students whose attitude towards learning mathematics was detrimental. His narrative demonstrated the challenges he faced at his workplace that probably compromised ‘making sense’ of mathematics teaching for him. In future, Peter has to learn to address these challenges so that these become opportunities for him to design his designated identity.

**4.4.2 Lesson 2 (Topic: Graphs)**

*4.4.2.1 Introduction and overview of Peter’s second lesson*

The topic for this lesson in Form D was to plot the graphs and to solve Quadratic Equations using these graphs. Peter assigned the students to work as a group. He moved from group to group, monitored the work, evaluated their performance and then concluded the lesson.

There were only 12 students present on that particular day in Peter’s class. Later, he explained that the students were expelled for non-payment of school fees.

**4.4.2.2 Designing of the lesson**

He started the lesson with an introduction on graphs. The vignette below demonstrates how he introduced the topic:

> *All right, we are going to use graphs to solve quadratic equations ... It is a method of using graphs to solve equations either quadratic or linear equations. All right, now, let us start first with ...* (Peter Ob 2.001).

Peter started the lesson by stating the objective (solving the equations using graphs). When he addressed the students, he included himself as part of the community and frequently used the term, ‘we’, that indicated his inclusiveness in the classroom community. Figure 4.7 represents
the sample that Peter assigned the students to tackle as group work. x represents the domain and y the range of the equation, \( y = 4 - x - x^2 \).

<table>
<thead>
<tr>
<th>x</th>
<th>-4</th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>-0.5</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>-8</td>
<td>a</td>
<td>2</td>
<td>4</td>
<td>4.25</td>
<td>b</td>
<td>2</td>
<td>-2</td>
<td>c</td>
</tr>
</tbody>
</table>

*Figure 4.7: Equation, \( y = 4 - x - x^2 \)

After drawing the table, Peter instructed the students to find the value of a, b and c. Though he asked the students to work in pairs (Peter Ob 2.002), some decided to be in threes. Peter accepted this choice. He continued writing further instructions on the board (*Draw the graph of \( y = 4 - x - x^2 \) for the range of \(-4 \leq x \leq 3\). Take 2cm to represent 1 unit on the x axis and 2 units to represent 2 units on y axis). Then, Peter started moving from group to group, assessing and evaluating their work. He monitored the progress and probed further for clarification. Once they found the correct answers for ‘a, b and c’, he asked them to start drawing the graph. Many students got the answers correct. Peter tried to assist a couple of students. He helped them to calculate the value of ‘c’ when \( x = -3 \), and assessed their understanding on substituting \( x \) to calculate the value of \( y \) (in \( 4 - x - x^2 \)).

Table 4.39a demonstrates a sample that displays subjectifying utterances that are intertwined with mathematizing utterances.

**Table 4.39a: Peter’s explanation** Key: *So the answer is wrong.*

<table>
<thead>
<tr>
<th>Peter’s utterances</th>
<th>Mathematizing actions (with my elaboration)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peter Ob 2.012: Now, (-9), not +9. So the answer is wrong. So let us (see). So first of all you have to be careful about the sign. You have to. This must be in brackets so that you can (see), this negative is still there. So that means 4 plus 3, negative 9.</td>
<td>Student’s answer: ( y = 4 - 3 - 3^2 = 4 + 3 + 9 = 16 (-9, \text{ not } +9) ). This ((-3)^2) must be in brackets so that negative sign outside the bracket remains as it is: (-(-3)^2). That means, ( 4 + 3 - 9 = -2 ). When ( x = -3 ), the correct procedure and the answer is ( 4 - (-3) - (-3)^2 = 4 + 3 - 9 = 7 - 9 = -2 ).</td>
</tr>
</tbody>
</table>
When the students substituted – 3 for x, their final answer was \(4 – 3 – 3^2 = 4 + 3 + 9 = 16\). They considered negative of negative as positive in this example (\(- of -4 = +4\), and \(- of -3^2 = +9\)). Therefore, they wrote \(7 + 9 = 16\). This was the challenge that Peter had to tackle.

### 4.4.2.3 Identifying Peter’s way of addressing challenges

Keeping the mathematical activities aside, I now focus on the subjectifying utterances that reveal Peter’s way of responding to the students’ incorrect answer.

**Table 4.39b: Mathematizing actions in Peter’s classroom practice**

**Key: Be careful about the sign**

<table>
<thead>
<tr>
<th>1st level Subjectification About specific performance</th>
<th>2nd level Subjectification About performance</th>
<th>3rd level Subjectification About the actor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Now, – 9, not + 9. This must be in brackets</td>
<td>So the answer is wrong.</td>
<td>So let us (see).</td>
</tr>
<tr>
<td></td>
<td>So first of all you have to be</td>
<td>You have to.</td>
</tr>
<tr>
<td></td>
<td>careful about the sign.</td>
<td>so that you can (see)</td>
</tr>
<tr>
<td></td>
<td>This negative is still there.</td>
<td>So that means 4 plus 3 negative 9.</td>
</tr>
</tbody>
</table>

These utterances (now, this must be) are categorised under the first level of subjectification. He said, now, – 9, not + 9. He was correcting the error that students made. When he uttered, ‘+ 9’, he meant the value of \((-3^2)\) as + 9., though students wrote ‘– 9’ instead of +9.. That is why he uttered now, – 9, not + 9. His subjectifying utterances in this regard were closely associated with mathematizing action. He then concluded *the answer is wrong*. If the answer was wrong, the next stage was to rectify the error. The utterance that Peter made at that stage (so let us) indicated his way of **encouraging** the students and he meant to say, ‘let us see how to find the correct answer’. He explained what went wrong so that the students would make sense of the correct procedure. He explained the correct procedure and the answer (So that means 4 plus 3 negative 9) rather than giving them the opportunity to learn by themselves.

The next utterances were categorised under the second level of subjectifying and indicated the status of the outcome (so the answer is wrong) because the negative is still there. The most important part is to be careful about the sign. Through these utterances, Peter clarified the errors that were made by the students and rectified them. Consider these utterances: So let us (see), you have to, so that you can (see) and so that means 4 plus 3 negative 9. The utterances like let us demonstrate his supportive nature. The utterances you have to indicate the inevitable step that the
students had to follow to find the answer. Finally, he concluded the answer by uttering *that means 4 plus 3 negative 9* (is – 2). All these subjectifying utterances were mathematizing.

As the lesson progressed Peter encountered some challenges that he needed to address.

**Table 4.39c: Reifying and identifying utterances** Key: *So that means ...*

<table>
<thead>
<tr>
<th>Indirect reification (Forming an opinion about actions of someone or self or something)</th>
<th>Direct reification (describing a person): What does Peter observe about him or about others?</th>
<th>Direct reification Peter’s conclusion in a certain way</th>
</tr>
</thead>
<tbody>
<tr>
<td>So the answer is wrong.</td>
<td>First up all you have to be careful about the sign.</td>
<td>You have to.</td>
</tr>
<tr>
<td></td>
<td>This must be in brackets so that you can (see), this negative is still there.</td>
<td>So that means 4 plus 3 negative 9.</td>
</tr>
</tbody>
</table>

The utterances that were displayed in Table 4.39c did not demonstrate any pattern, but emphasised certain words (*you have to be careful*) that identified the objective (*that means*). He started with the utterance *so the answer is wrong* which demonstrated his conclusion on students’ performance, who were calculating the value of ‘a’ when \( x = -3 \) in the equation \( y = 4 - x - x^2 \). Students were confused when calculating the value of \(- (-3)^2\). They wrote the answer as \(- \text{of } (-3)^2 \text{ as } + 9 \) instead of \(-9\). This made the value of ‘a’ to be entirely different (\(+ 16\)) from the correct answer (\(-2\)). Peter made sense of what went wrong in students’ actions, and that was significant for him as a teacher (*Teacher identity*). He tried to explain what was wrong (Now, \(-9 \text{ not } + 9\)), but failed to trigger students’ reasoning skills in the sense that he could have asked a few questions for them to justify their answer. This action probably hindered students’ mathematics learning even though Peter was keen to correct the error in his ‘own way’.

The next stage was to consider the utterances that were categorised under direct reification that described a person or his actions (*So first up all you have to be careful about the sign*). Peter insisted that the students have to be careful about the sign (negative or positive) possibly because he observed that they usually get confused with the signs as indicated earlier. As a result he emphasised that the numbers \((-3) \text{ must be in brackets so that you can (see), this negative is still there.} \) These utterances endorsed his observation that the students got wrong answers when
brackets were not used while operating with negative signs. That is why he insisted in a concluding tone (you have to) that they use the brackets so that students will not argue about such procedures. Lastly he concluded that means 4 plus 3 negative 9 that elaborated and concluded the answer. In this regard, I observe the following:

1. Peter clarified and elaborated various concerns related to the errors that students made while answering the question y = 4 – x – x².

2. He did not provide any opportunity for them to explain their answers. Instead he concluded that the answer (a = 16) was wrong and he invested part of the lesson in explaining the correct answer.

3. He insisted on correcting their answer rather than instructing them to justify or re-assess the answer.

Peter moved from one group to the other and monitored their work. He assessed their work, gave further instructions and made corrections where necessary. Afterwards, he moved to the next group, who were trying to draw the graph. It was not easy for students to use the scale of 1 to 1 in order to plot the value of y = 4.25 (whereby x = 0.5). Peter therefore instructed take 2 cm to represent 1 unit and 2 cm represents 2 units (Peter Ob 2.014). I present the conversation between Peter and a troubled student from one group in Table 4.40:

Table 4.40a: Mathematics learning is initiated  Key: Student: That means 4.25 is here.

<table>
<thead>
<tr>
<th>Peter’s utterance</th>
<th>Student’s response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peter Ob 2.016. Peter: Hm, yes, what is the problem? (Peter wanted to identify the problem).</td>
<td>Peter Ob 2.017. Student 1: Sir, can you (help) right here, sir, five here sir. 4.2, 4.4, 4.6, 4.8, 5 (Student explained)</td>
</tr>
<tr>
<td>Peter Ob 2.018. Peter: Yes, it is there (He understood their concern).</td>
<td>Peter Ob 2.019. Student 1: 4.0, 4.2. That means 4.25 is here (Student identified 4.25 on the graph).</td>
</tr>
<tr>
<td>Peter Ob 2.020. Peter: Yes (He approved)</td>
<td>Peter Ob 2.021. Student 1: Ok, sir (Student was satisfied, but Peter found that the student had a wrong understanding on the point, 4.25).</td>
</tr>
<tr>
<td>Peter Ob 2.022. Peter: 4.25 is in the middle of (?)</td>
<td>Peter Ob 2.023. Student 1: Here sir, 4.2 and 4.4</td>
</tr>
<tr>
<td>Peter Ob 2.024. Peter: Let me check, this is going to be 4.2 ok?</td>
<td>Peter Ob 2.025. Student 1: Yes</td>
</tr>
<tr>
<td>Peter Ob 2.026. Peter: This is 4 point (Clarifying)</td>
<td>Peter Ob 2.027. Student 1: 4 (Student meant 4.4).</td>
</tr>
</tbody>
</table>
| Peter Ob 2.028. Peter: 4. Means that this is 4.3 | Peter Ob 2.029. Student 1: 4.3, yes (Student
(Considering the points between 4.2 and 4.4. Peter was trying to correct the student because previously student identified 4.3 as 4.25).
understood the error).

Peter Ob 2.032. Peter: 4.25 will be near, somewhere there (showing a point on the graph).

Student1 : Yes sir, (between) 4.3 and …

Peter Ob 2.033.

The challenge for students was to identify and plot the coordinates (0.5, 4.25) on the graph. It was not easy for them to plot \( y = 4.25 \) on the graph. The distance between two nearest lines on the graph was 2mm, and if they chose 1cm = 1 unit, it was not easy to identify the exact value of \( y \). That is why Peter suggested using a larger scale (2cm = 1 unit) that can assist them in identifying the \( y \) coordinates easily (4.2 and 4.3 so that they identify the value 4.25).

The student considered 4.25 to be between 4.2 and 4.4. Even though this is mathematically correct, the midpoint of these two numbers is 4.3. Through deliberate probing and guiding, Peter convinced the student to identify the correct point on the graph. This demonstrated a learner-centred teaching approach because:

- Students uttered words like *that means* as well as responding to Peter’s question.
- They discussed the question and tried to perform the task as instructed by Peter.
- When they were stranded, they approached the teacher (*Sir, can you –help- right here*).
- They decided the rules of the task (taking the scale of 1cm = 1 unit) and plotted the points accordingly.

Peter’s challenge was to maintain this strategy for them to learn by themselves. Students concluded that there is no need to plot the point (0.5, 4.25) accurately. Peter accepted their decision (Peter Ob 2.034: *So you can even round that... 4.25 is rounded to 4.3*). Peter moved to other groups and clarified the same issue that he had observed with this group regarding the rounding off of 4.25 to 4.3.

4.4.2.4 Peter concludes the lesson

The lesson progressed with similar activities. The conversation that took place during the activity indicated that the students actively took part in the classroom learning. The main challenge for students was to calculate the value of ‘\( c \)’ for \( y = 4 - x - x^2 \), when \( x = -3 \) and to plot the point
Many students had difficulty in identifying this point. Peter then had to suggest that they should round off the value of 4.25 to 4.3 in order to plot it easily. In this sense, students followed his suggestion as the final word as no one argued otherwise. The crucial part was that the students engaged in learning by discussing with one another within the group. Whenever Peter asked clarifying questions, students came with the answers (more than yes/no response) that indicated correct answers. The following conversation demonstrated this (Table 4.40b). My focus is on Peter’s responses that are shown in brackets.

**Table 4.40b: Students were engaged in mathematics learning** Key: *look for the middle number*

<table>
<thead>
<tr>
<th>Peter Ob 2.044. Student 3: Sir, you say … to look for the middle number sir (Peter Ob 2.045. Peter: Aha, what do you do?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peter Ob 2.046. Student 3: We add these numbers and multiply by 2, Sir (Peter Ob 2.047. Peter: Multiply?)</td>
</tr>
<tr>
<td>Peter Ob 2.048. Student 3: No, divide by 2 (Peter Ob 2.049. Peter: Divide by 2. Ok, that is what you have to do. You have two 2 -referring to y values- Where is it from?)</td>
</tr>
<tr>
<td>Peter Ob 2.050. Student 3: Here are they, sir (Peter Ob 2.051. Peter: We are talking about the x values).</td>
</tr>
<tr>
<td>Peter Ob 2.052. Student 3: Oh, x values are –1 and 0.</td>
</tr>
</tbody>
</table>

The students captured the concept and managed to plot the graph. The lesson therefore ended as Peter planned. Within this understanding, I explore Peter’s experience in the broader study.

**4.4.2.5 Linking the lesson to the identity**

Active mathematics learning was taking place in this classroom due to the practical structure of the topic. However, it was also observed that the students experienced some challenges while finding the values of y (range). Operating with –x and –x² seemed to be a problem for many students due to the negative sign. They calculated the domains wrongly (using negative numbers) which Peter dutifully addressed. This classroom practice thus became significant with the way he approached the lesson.

On many occasions, students answered Peter’s questions correctly. He neither probed them on their wrong answers nor asked for explanations of their correct answers and simply accepted their answers. Consequently, the meanings that Peter and the students made were not necessarily
the same. When challenged on their wrong answers, the students simply took this as a message and suggested an alternative answer (eg: Peter Ob 2.047. Peter: *Multiply?* Peter Ob 2.048. Student 3: *No, divide by 2*). This indicated that Peter’s guidance was accepted by students according to his expectations. In order to engage in learner-centred activities in the classroom, he needs to ask them to explain their understanding so that he makes sense of students’ understanding of the lesson (*Learning as doing*).

In this part of the analysis, I present an illustration of Peter’s change in approach. I provide his opinion in the following vignette:

> It will benefit the students because the students are able to make their own decisions, what they are doing, they are able to talk among each other, one another and agree with what must be done and what must not be done like that (Peter Int 2.011).

The most important turning point in Peter’s classroom practice was his role as a facilitator (Peter Int 2.015). In future, he would like to arrange the students according to their learning capacity in the sense that the slow learners will be placed with the fast learners so that both members could benefit from each other (Peter Int 2.019). However, he was concerned with the lesser number of students who were present on that day as others were expelled for non-payment of fees. He might need to re-start the lesson to help the absentees (Peter Int 2.025).

When I asked him to reflect on his experience, he said:

> That experience, it was very hectic, but sometimes it was very (useful) to the learners that were there on that day. It was very nice because they were able to explain to others what we were doing there (Peter Int 2.027).

This view reflected his satisfaction towards the approach that benefitted the students (*Meaning – Learning as experience*). In his words: *Ya, it is time wasting, I had to take a long time to (complete the session), it is very time wasting* (Peter Int 2.033). He was under pressure to finish the required syllabus for that academic year, therefore he found this particular learning method as time consuming. On the other hand, he observed that *the students are able to talk amongst one another and then as a teacher I am able to go around the groups, ask them questions and they are able to ask questions freely* (Peter Int 2.037). Why did he choose this particular teaching approach in this class? He answered: *I choose this (method) according to the topic I was doing, ‘the graphs’, so the graphs need that participation, they need involvement of each and every learner so, that is why I choose that approach like that* (Peter Int 2.041).
It was essential for Peter to share his experience with his colleagues at the school (Community - Learning as belonging) so that they could empower one another for effective teaching strategies. He said:

*I will convince them that this method is very important. It is very productive because the students get involved. Somehow (in) learner centred, there is lot of learning taking place than (in) teacher centred. Students are able to participate well* (Peter Int 2.047).

Peter’s change in practice obviously illustrated a change in alignment with respect to the students in the classroom as well as with his colleagues. He was confident to share his teaching experience with other members of the department. This could have a long term impact on his peers, on students and on his career. I asked him about his ‘future plan’ regarding his career. I conclude this story using his own words:

*To improve my career, what I have to do is, after doing this kind of approach in a certain class like I did I have to go to my peers and tell them, how was my class. Then the other thing, which is important, is to invite them in my class to observe what I will be doing in that class so that they can format about this. They can tell the weaknesses of this approach, the strengths and stuff like that so maybe they will give me guidance, I mean how to do it* (Peter Int 2.049).

4.4.3 Lesson 3 (Topic: Circle)

4.4.3.1 Introduction and overview of Peter’s third lesson

The final term of the year is most crucial for teachers whereby they require time to revise important topics, to prepare the students for the final year examination and to finish other topics that were planned earlier. Therefore mathematics teachers rush to complete the syllabus which leads them to choose simple topics with an approach that suits the topic. However, these depend on the time factor, the nature and the relevance of the topic. I asked Peter about the strategies that he had used to choose the topic for this lesson. Peter clarified: *I have to choose very simple topic that can enable us to finish the syllabi in time ... There are some topics. I have to revise so that (and) I have to make sure that I did them* (Peter Int 3.006). The topic that he taught on this day was the Circle. Students had prior knowledge on this topic and it was easy for Peter to start the lesson, and he progressed well. He explored the sub-section Chord and Tangent by asking a few questions that were correctly answered by the students.
In this session, I examine how Peter approached the sub-topic, Chord and Tangent.

4.4.3.2 Designing the lesson

When the lesson started, Peter arranged the students in groups and talked with a smile and a voice that had a high tone. He used his hands extensively to demonstrate certain shapes, when talking about the circle, chords and tangents. He started assessing their prior knowledge by asking a few questions (Peter Ob 3.001: *What are the parts of the circle?*). As the students answered, Peter wrote these (Circumference, diameter, radius, chord, arc, sector etc.) on the board. Listening to them he concluded that the students have the necessary information about the topic.

4.4.3.3 Lesson started with instruction

Once Peter gathered enough data, he decided to distribute a question paper (Appendix 3) that was prepared by him for them to answer. I present the following vignette:

**Table 4.41a: Subjectifying and mathematizing actions in progress**  
Key: *we are running short of time*

Peter Ob 3.015. Peter: … This is just the introduction. This is just a reminder of what you learned (earlier). You may have learned (these) in Form C, right? So, now, I just want to have these question papers here (Distributing the question papers to the students). … You need a pencil and a compass. A book, to draw. **Do it fast**, we are running short of time. Use pencils … number, number one. We have chords, like **we are going to talk** about chords. What are the chords and how do we find the chords (he is specifying the objectives of the activity). **Keep quiet please, you are making noise.**

The vignette demonstrates subjectifying and mathematizing utterances that were intertwined with each other. The activity that Peter designed was revision of selected questions based on the topic, the Circle. Some of his utterances are examined below.
The first three utterances that Peter made had an impact on students’ initial preparation for the lesson. He reminded them what they had learned previously, and assumed that they had the correct prior knowledge and then decided to assign them a task. In order to emphasise this, he used the utterance *just* in three different statements. When he said *this is just the introduction* what he meant was to assess their prior knowledge (specific performance). I therefore categorised these under the first level. Peter needed to elaborate on the performance and then he said *this is just a reminder of what you learned*. The utterances also provided confidence for the students to recall their memory. These two statements talked about the actions, but the next one portrayed what Peter decided (*I just want to have these question papers here*) and the purpose. The statement also demonstrated the steps he had taken in order to assess their knowledge as well as taking them to the next level of the lesson (*We are going to talk about chords*). All these utterances meant to initiate the mathematical learning and complemented mathematizing.

The next utterances that Peter used had a direct and indirect impact on students’ mathematics learning and their behaviour in the class. When they were instructed to form a group, they needed to move from their seats which naturally caused a little excitement. The distribution of the question paper aroused further excitement. Peter, on the other hand, was worried about the lapse of time, therefore he instructed the students to *do it fast*. The purpose was to divert the students from the excitement they had as well as to force them to focus on the task at hand (*we are running short of time*). He then reminded them about the performance that they were about to start (*we have chords*) followed by the utterances *we are going to talk about chords*. The utterances *we are* compared to his previous utterances *I just want to have …* indicated that previously Peter used the singular term (*I*) that had now shifted to the plural (*we*) term. The first utterance indicated his authority and what he had planned. On the other hand, the use of the term ‘*we*’ included him to be part of the mathematical action that they were about to start. Students
understood that Peter is in charge of making decisions and they accepted his authority.

Simultaneously, all members were included in the mathematics learning.

The final stages of the utterances are related to the behaviour of the students. He said *keep quiet please*. The comment indicated students’ specific behaviour (noise making) that he needed to control so that they could move on with the task. He also explained why they should keep quiet (because *you are making noise*).

Once students were settled and started focusing on the activity, Peter moved on from one group to another in order to monitor their progress. He also started distributing the remaining papers. Students were involved in answering the question (construction of the circle). The following utterances (Table 4.41) demonstrated the mathematics action as required by Peter:

**Table 4.42: Mathematizing action** Key: *What is the angle?*

| Peter Ob 3.017: After doing that, sh… (Trying to control the noise makers), after doing that you bisect that triangle, two lines of symmetry, on that page if you do that to show the lines of symmetry. You do that quickly. You draw a line of symmetry there. Draw a line of symmetry that bisects the chord. Draw the line of symmetry. Draw it with, listen, pencil and ruler. Draw it, the lines of symmetry. Let us see if you bisect it with a pencil and ruler. You know the lines of symmetry? |

Peter systematically described the steps that students needed to follow in order to bisect the triangle. They followed the instruction and correctly constructed a circle with an isosceles triangle within the circle as shown below (Figure 4.8):
Based on the diagram, Peter started asking questions and eliciting information about their understanding of the topic. Peter confirmed that they had the necessary prior knowledge of the topic as demonstrated below:

**Table 4.42b: Mathematics learning is active** Key: *What is the angle AMO?*

<table>
<thead>
<tr>
<th>Peter’s questions</th>
<th>Students’ answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peter Ob 3.021. Peter: The angle AMO is 90°, ok? (Confirming)</td>
<td>Peter Ob 3.022. Students: (Chorus) Yes (Students are sure of the answer).</td>
</tr>
<tr>
<td>Peter Ob 3.023. Peter: Ok, what is the angle B (Pause) MO (BMO)? (He asked another question).</td>
<td>Peter Ob 3.024. Students: (in chorus) Ninety degrees (They knew the answer).</td>
</tr>
</tbody>
</table>

The vignette demonstrates Peter’s probing nature that influenced the students who responded accordingly. He repeated the question more than once. Repetition is a strategy that he used for emphasis of certain words guiding the students to respond accordingly. Peter asked some questions that activated students’ ability to link the prior knowledge to the task that was given by him. The following utterances suggested how this approach helped them to learn the characteristics of the circle in connection to the chord.
Table 4.43a: Peter repeated questions Key: What can you say?

<table>
<thead>
<tr>
<th>1st level Subjectification About specific performance</th>
<th>2nd level Subjectification About performance</th>
<th>3rd level Subjectification About the actor</th>
</tr>
</thead>
<tbody>
<tr>
<td>So what can you say about that line, eh, the line O, M (OM)?</td>
<td>The line that you have drawn. The line To the chord (concluding tone). Can you say something there? Can you relate that? What has it to do to the chord, eh, that chord?</td>
<td>What can you say about that line, the line OM? Can you say something there? Can you say something? Yes, what has it to do with chord?</td>
</tr>
<tr>
<td>What can you say about that line, with respect to the what?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can you relate that line, the line of symmetry with the chord?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These utterances demonstrate how Peter tried to elicit the desired answer from the students in order to make sense of a particular concept related to the chord of a circle. These utterances go through various subjectifying levels and explore how these intertwine with mathematizing actions.

Table 4.43b: Mathematics learning in progress Key: Can you say something?

These utterances demonstrate Peter’s deliberate probing and insisting approach in order to elicit some responses from students. He was trying to arouse their imagination so that they could create a meaning from the diagram (e.g., Peter Ob 3.028. Student 7: AM equals BM, and therefore, M bisects. And as I said, the length AM is equal to length BM). He started the question by asking, so what can you say? There was a pause before he completed the sentence as if he was referring to the figure (Figure 4.7) by carefully picking the correct points (O and M). He expected an answer that identified the connection of the line OM to the chord AB. When he repeated the question a second time, he was clear about it and provided extra emphasis on the utterances that line, the line OM. This showed Peter’s effort to show that the line OM had an impact on line AB. He reminded them about the line that you have drawn with a stress on the line.
Peter then repeated the question and said *what can you say about that line, with respect to the what?* He was slowly leading the students to link the chord with the specific line. He elaborated the question in order for the students to have a broader area to suggest the answer (*what can you say about that line, with respect to the what, to the chord*). With this specific question, he was leading the students towards a certain response.

Peter took the students to the next stage by insisting on a response from them. I categorised these utterances in reverse order (Table 4.43b). He said *can you say something there?* Peter had a concluding tone for students to respond accordingly. However, he changed his mind and repeated the question, but omitted the word, *there* and said, *can you say something?* He then elaborated (*Can you relate that line, the line of symmetry with the chord?*) and steered the students towards a desired answer that he required (Designated identity). He insisted on a specific response from the students. Therefore, he repeated the question for the third time; *can you say something?*

Peter was not sure if he had stated the objectives of the question that necessitated the correct response from the students. Therefore, he re-phrased the question for the last time (*Can you relate that? What has it to do to the chord, eh, that chord?*). These utterances qualified to be in the second level of subjectifying. This guided the students to a desired response (Peter Ob 3.028). He finally concluded (*Yes, what has it to do with the chord?*) as if the students would now respond to these views.

These utterances demonstrate a pattern, and made sense of a particular mathematical concept that requires further analysis as shown in Table 4.43c.
Table 4.43c: Reifying and significant utterances  Key: Yes, what has it to do with the chord?

<table>
<thead>
<tr>
<th>Indirect reification (Forming an opinion about actions of someone or self or something)</th>
<th>Direct reification (describing a person): What does Peter observe about him or about others?</th>
<th>Direct reification Peter’s conclusion in a certain way</th>
</tr>
</thead>
<tbody>
<tr>
<td>So what can you say about that line, eh, the line O, M (OM)? What can you say about that line, the line OM? The line that you have drawn, the line.</td>
<td>What can you say about that line, with respect to the what, to the chord? Can you say something? Can you relate that line, the line of symmetry with the chord?</td>
<td>Can you say something there? Can you say something? Can you relate that? What has it to do to the chord, eh, that chord?</td>
</tr>
</tbody>
</table>

These reifying utterances were significant for Peter as his questions were leading students to a desired meaningful response. The utterances that were categorised under indirect reification (so what can you say about …) did not form an opinion about him or anyone else, but guided them (What can you say about that line?). The purpose of this question was to identify the characteristic of a chord in connection with the perpendicular line from the centre to the chord (the line OM). It is of interest to look at the same question that he had to repeat (What can you say about that line?). Possibly, he needed to guide them to attain certain mathematical understanding. Therefore, he had to conclude by re-phrasing the question (can you say something there). He was not sure if he ensured a correct response from the students at this stage even though he received an expected answer from them (Peter Ob 3.028. Student 7: AM equals BM). As a result, he elaborated further with an additional statement (Can you say something? Can you relate that line, the line of symmetry with the chord?) that gave a glimpse of what was going on. Peter perhaps uttered these words due to the following reasons:

- Students probably were hesitant to respond to his questions because they continued exploring various concepts related to the task.
- He had not elaborated the task fully to reach the conclusion.

As a result, he concluded that he should repeat the question (Can you say something? Can you relate that? What has it to do to the chord, eh, that chord?) for students to create meaning from these utterances. This time, the question that Peter asked was directly linked to an appropriate conclusion.

Therefore, these questions (that Peter repeatedly asked) are reifying and significant because these guided the students to reach the correct answer. In a way, these questions identified his
efficiency in leading them to create meaning of the concept. Peter approved the students’ response and said: *As a result, it bisects the chord. The perpendicular line from the centre of the circle to the chord bisects the chord.* The perpendicular line that comes from the centre bisects the chord (Peter Ob 3.030). This was the end product of Peter’s probing approach that he followed in this section. In my view, he successfully achieved the objectives of the lesson.

Peter continued the activities for a while. Once he had established the characteristics of a chord, he introduced the term Tangent. See the following vignette.

Peter Ob 3.042: *Only one, one point. And that point, where the line that you have drawn touches the circle, with that point P, the point P, where it touches in that point ... that touches the circumference. Only one point, only one point* (He is trying to create a meaning for the students to understand the concept of Tangent).

Peter Ob 3.044: *It (Tangent) must touch one point, only one point, one point. So this line is going to pass here as well as there* (The line touched more than two points on the circle and hence this line segment is not considered as tangent). *Do you see?* (Therefore this line is not a tangent).

Peter Ob 3.045: *Ok, now, the line PT, listen here. The line PT is the tangent line. The tangent line, it is tangent to the circle. It is the tangent to the circle. All right?*

Peter Ob 3.047: *Because it touches the circle only on one point, not two points* (the line segment is called a tangent). *Make sure that it touches the circumference on one point. Ok, now* (concluding tone)…

Peter introduced the term Tangent and described its characteristics. There was an inclination towards the descriptive approach and a teacher-centred style that he employed in this section. As they became involved in construction of the tangent line, he moved from one student to the other and assisted them in drawing the tangent and measuring the angle. His utterances also controlled the interaction between himself and the students. However, he changed the strategy after his descriptive utterances. The following utterances demonstrated mathematics learning by the students. The script for this section was designed by Peter in the sense that he asked questions and students answered accordingly. Through probing, he confirmed that the students had learned the concept. I present a sample below to support this view.
Table 4.44: Students make sense of the concept Key: *Are you sure?*

<table>
<thead>
<tr>
<th>Peter’s probing utterances</th>
<th>Students’ response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peter Ob 3.050. Peter: What is the name, what is the angle PTO?</td>
<td>Peter Ob 3.051. Students: (in chorus) Ninety degrees (Students knew that the tangent is perpendicular to the radius of a circle)</td>
</tr>
<tr>
<td>Peter Ob 3.058. Peter: Yes, I am saying the line TO. What is the name of that line, what is that line?</td>
<td>Peter Ob 3.059. Students: Radius</td>
</tr>
<tr>
<td>Peter Ob 3.060. Peter: Radius of the circle, eh? It is the radius of the circle, right? (Are you sure?)</td>
<td>Peter Ob 3.061. Students: Yes.</td>
</tr>
<tr>
<td>Peter Ob 3.068. Peter: What is the relationship there?</td>
<td>Peter Ob 3.073. Student 7: The tangent is perpendicular to the radius.</td>
</tr>
</tbody>
</table>

While engaging with the mathematical concepts related to this section (Tangent), Peter asked questions and students answered correctly. He acknowledged their correct answers only after confirming them by repeating the questions. These utterances clearly demonstrated students’ confidence as well as the meaning they created. Through probing, he created meaning that assisted students to conceptualise the idea of Tangent. He also had the chance to confirm their mathematics learning through their answers.

**4.4.3.4 Conclusion of the lesson**

This section assisted Peter in developing his confidence as a mathematics teacher. He also established the objective of the lesson as shown below:
Table 4.45a: Peter concluded the lesson Key: Therefore, we can say ...

Peter Ob 3.074: Very good. The tangent is perpendicular to the radius. It makes 90 degrees, is perpendicular. The tangent, therefore, we can conclude that the tangent of the circle is perpendicular to the radius at the point of contact

Peter Ob 3.086: Therefore, we can say, tangents from one point to a circle are always equal. The tangents, they are always equal. They have the same length. They are always (equal), tangents from the same point, they are always equal. All right. Ok. All right, now you can conclude that the perpendicular line from the centre of the circle to the chord, they bisect. We have seen that the perpendicular line inside the circle to the chord bisects the chord. To the chord, right? That is the lesson we saw. Another thing is that the tangent to the circle is perpendicular to the radius at any point, at any point of the – circle –

Peter Ob 3.087: And then, again, lastly we saw that, eh, we have discovered that the tangents from a point of the circle are equal.

In order to show what students had learned, I present the work of one student as shown below:

![Diagram of circle and tangent](image)

*Figure 4.9: Work of one student*

Peter asked some questions based on the task and proceeded with the lesson. The vignette below demonstrates how Peter concluded the lesson.

The teaching approach that Peter used for this lesson was different in the sense that he asked many questions that required specific answers rather than the usual response of yes/no. At the
end of the lesson, he concluded and summarised the findings on the Tangent. How did these utterances reify Peter’s activities that endorse students’ mathematics learning? I present these utterances with my comments as shown below:

**Table 4.45b: Properties of the Tangents and the Chords are concluded** Key: *Therefore, we can say ...

<table>
<thead>
<tr>
<th>Subjectifying (In italics) &amp; Mathematizing utterances</th>
<th>My comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peter Ob 3.086: <em>Therefore, we can say</em> tangents from one point to a circle are always equal. The tangents, <em>they are always</em> equal.</td>
<td>The tangents from an external point to a circle are equal in length.</td>
</tr>
<tr>
<td><em>They have</em> the same length. <em>They are always</em> (equal), tangents from the same point, <em>they are always</em> equal.</td>
<td>Repeating and emphasizing the concept.</td>
</tr>
<tr>
<td><em>All right, now you can conclude that</em> the perpendicular line from the centre of the circle to the chord, they bisect.</td>
<td>The perpendicular line from the centre of a circle bisects the chord of that circle.</td>
</tr>
<tr>
<td><em>We have seen that</em> the perpendicular line inside the circle to the chord bisects the chord. To the chord, right?</td>
<td>Is that clear?</td>
</tr>
<tr>
<td><em>That is the lesson we saw.</em></td>
<td>These are the conclusions that we have drawn today.</td>
</tr>
<tr>
<td><em>Another thing is</em> that the tangent to the circle is perpendicular to the radius at any point, at any point of the (circle).</td>
<td>Lastly, a tangent to a circle is perpendicular to the radius at the point of tangency.</td>
</tr>
</tbody>
</table>

Peter ended the lesson by concluding and emphasising the properties of Tangents and Chords. These subjectifying utterances need to be explored further to understand the way he concluded the lesson.
In the concluding section, Peter established the properties of Chords and Tangents that were identified by the students. He confirmed these properties by insisting that they are always equal. He repeated these by emphasising the utterances such as we saw that, we have discovered that, and the students made sense of these utterances. In a way, these endorsed the meaning that he wanted to create. While concluding the lesson, he uttered all right when he tried to obtain a response from the students. They responded to his query (now you can) that he accepted by saying, ok. Meanwhile he had to control the noise that students were making and he said sh… These three utterances portrayed Peter in the following manner:

- He was concerned with the students’ learning capacity and he needed assurance from them (all right)
- He was satisfied with the outcome of the lesson (ok)
- He was concerned with the students’ distracting attitude towards the end of the lesson (sh…).

These utterances are reifying and significant as these identified Peter as a mathematics teacher, who wanted to acknowledge students’ mathematics learning through simple utterances.

Lastly, I consider the following utterances (All right, now you can conclude, we have seen that, and then, again, lastly we saw that, eh, we have discovered that ...) as significant because these utterances concluded the lesson in a particular manner. He uttered the words all right repeatedly and specified now you can conclude. Note that he said, you can conclude, not we. However, he later said we have seen, we saw and we have discovered. There, he included himself as part of the community so that the meaning that they had created was inclusive. Therefore, I consider
these utterances as reifying, endorsable and significant for Peter as he left fully satisfied with the lesson that he ended without any concern.

The concluding session was mostly dominated by Peter’s matter of fact tone that significantly illustrated Peter’s role as a teacher. His story in this chapter undoubtedly demonstrated that he was in charge of the activities, whereby his utterances guided students’ responses. I also observed that the students did not challenge or clarify any mathematical concept. They simply accepted what Peter ‘taught’ them and obediently answered his questions. There were no identity struggles between Peter and his students in the classroom as they accepted the presence of the other. Simultaneously, one might need to look beyond any single event (classroom stories) in order to identify any possible struggle. However, Peter’s role as a mathematics teacher assisted the students in engaging in mathematics learning in a certain way, and therefore his input was meaningful for them.

4.4.3.5 Linking the lesson to the identity

Peter used different approaches for this lesson that included description, probing and clarification (Teacher identity). At least for this classroom practice, he asked questions that required answers and the students answered correctly. However, these were one sided in the sense that the teacher asked and the students answered. Peter was confident that the students learned the concepts and therefore this became a successful experience for him (meaning). He also felt that he had brought changes in their attitude towards mathematics. I present a vignette that assists the readers in understanding how Peter views this classroom practice.

I use different approaches on different topics. Then, after doing that I give a topic test. And I invest on that whether, which topic, they did best ... and I always see that the other one has participated well, so that is how (Peter Int 3.064). I want to start with something that is outside, something that is outside and ... connect it with the classroom situation. And all of the teachers, some of them, they were saying mathematics is difficult. So what I did this year, I was trying to change the attitude of mathematics. And know that mathematics is not only what we do in the classrooms, it is also applied to life situations. So some of them, they have changed that attitude very much. They changed that attitude towards mathematics. And when a student hate, maybe they have that bad attitude. I don’t blame him. I just show him that, it is done in life situation (Peter Int 3.068).
4.5 CHAPTER SUMMARY

It is noted that in the stories (descriptive analysis) of the classroom observations of the participant BTs narrate their particular approaches to classroom practice. The journey that Jack, Jim and Peter took through their classroom practice probably assisted them in realising their meaning from new angles. This is the sense making process that this study considered as shaping their professional identity. Consequently, I need to briefly examine this journey (because a detailed explanation is made in Chapter 5).

In general, the approaches that they employed in the classrooms sometimes ended satisfactorily according to them, and they also acknowledged that the classroom practice was a sense making experience. However, their failure (if students could not grasp the mathematical ideas) also took them one step forward, in that they could have approached the lesson differently (e.g., Jim Ob 1). If they claim that they have achieved their goal of ‘becoming’ experienced teachers, this may be an over-ambitious and ‘unreal’ dream, but each classroom ‘experience’ taught them a new lesson from which they created meaning from these experiences that they own.

In terms of shaping identity, these BTs also faced some identity crises. Jack and Peter had met with challenges within the school community. They overcame these challenges by exploring other communities of practice or by taking the initiative to create some activities. As a result, they were recognised as a certain kind of a teacher (e.g., Peter was known as the founder and the patron of a mathematics club in his school). On the other hand, Jim met various challenges within the classrooms, and therefore, he overcame these by changing his classroom practice. This probably helped him to be recognised as a facilitator in mathematics classrooms.

Jack had a dream to become a lecturer one day which showed his designated identity. He was a teacher who communicated with members from LSMTA in order to plan his lessons (Jack Int 2.034). This showed his community of practice identity. I conclude his story by quoting his utterances: If you want to teach pupil a certain thing ... you have to come to their level ... [but] it becomes a problem for a teacher to come to the level of the students (Jack Int 2.020). This story is an example of his learning as experience as he created meaning from this experience. In my view, these are the benchmarks for Jack’s shaping of his professional identity.
Jim experienced challenges in his classroom. These were the learning experiences for him to change his approach. He reflected: I should have started with the simpler one. Actually, it was a bit difficult. I think the problem came too early (Jim Int 1.092). The meaning that he created helped him to change his practice (Learning as doing).

Peter observed that the students had a negative attitude towards mathematics. In his words:

I was trying to change the attitude of mathematics ... They changed that attitude towards mathematics. And when a student hate, may be they have that bad attitude. I don’t blame him. I just show him that, it is done in life situation (Peter Int 3.068).

Peter’s story illustrated how he negotiated new meanings that changed students’ approach in mathematics. He achieved this by establishing a mathematics club at his school and in this way, he found a new identity for himself.

With this understanding, the next chapter discusses the meanings that shape professional identity of the BTs in this study through a horizontal analysis of the data.
CHAPTER 5

HORIZONTAL ANALYSIS AND DISCUSSION

5.2 INTRODUCTION

The aim of this chapter is to examine the narratives of Jack, Jim and Peter that I described in chapter 4 in order to obtain possible answers to the research question: How do BTs shape their professional identity in their first three years of teaching?

In the previous chapter, I narrated the classroom stories of these three BTs which revealed the approaches that they have executed in their classroom teaching. The way they made sense of their stories illustrated how they shifted from peripheral participation to central participation. The common themes that emerged from their narratives are analysed horizontally in this chapter (Kelchtermans, 1993). The horizontal analysis concludes with how BTs shape their identities.

5.1.1 Introduction to analysis

Stories are collected, quoted and analysed according to the prime theme, i.e. shaping a professional identity. Felix (2014) suggests that narrative analysis focuses on the dynamic nature of the interpretive process and how this process changes over time. In the light of new experiences, BTs (in this study) form new meanings that shape their identities.

The interpretations that are presented in this chapter are multi-layered intertwined stories and histories of BTs’ teaching. The advantage of such a multi-layered interpretation is that these provide various dimensions to the real story (Cohen et al., 2000) from BTs and meaning is created by them. This is the learning process for them that may change their practice and thus shapes their professional identity.

Sfard (1998) suggests that learning is a process of becoming a member of a certain community. Smith (2004) concludes that “learning in teacher education is evidenced when there is increased participation in: mutual and meaningful activities; negotiating and making meaning; and developing a sense of becoming and belonging within multiple communities of practice” (p. 1).
The purpose of this section is thus to examine how BTs learned to become mathematics teachers. Through their stories, the learning process shapes their identity. In order to extract evidence, I linked at least one single conversation from the stories in Chapter 4 to the identity discourses in order to provide an overall picture of their stories. The crucial part is then to extract the features of the stories that made sense to the BTs.

Narrating BTs’ stories as the first person’s narrative (Emerson et al., 1995) helped me to consider these events through their eyes, allowing the readers to see an insider’s view. The meanings they formed are then linked to the identities (Personal identity, Teacher identity, Mathematics identity and Community of Practice identity) that are intertwined to become the professional identity. I start this analysis with Jack.

5.2 JACK’S STORY

5.2.1 Unfolding Jack’s professional identity

When exploring Jack’s classroom practice, I asked: what was typical of Jack’s classroom teaching that was different from others”? The most striking feature of his classroom experience was his meaningful reflection on those teaching moments that I had observed. He was concerned with students’ attitude towards mathematics learning (Jack Int 5.010: *These kids are lazy*) and their yes/no responses to most of his questions. He also stated that his philosophy in teaching was shaped by what he experienced in life (Jack Int 4.021: *It seems I suffered a lot. So, I don’t want my students to be part of that suffering*). This inspired him to adopt particular approaches as a teacher towards his students (Jack Int 5.075: *If somebody failed, then let me be responsible*). In my view, this philosophy made his classroom practice different from the other BTs and shaped his identity accordingly. Jack built his career through such perspectives to improve his teaching skills. In these moments of negotiating meanings, Wenger (1998) observes that participation intertwines reification over time but these do not fuse. He also suggests that the world and the experience interact. Wenger (1998) further suggests that through practice, participation and reification are interconnected. Thus we are connected to our histories. Jack expressed his thoughts by saying that the pain that he experienced in the past should not be repeated (*I don’t
want ...). He was therefore determined to take responsibility for his actions. Jack will be thus recognised in this manner. I quote Wenger (1998):

*In the process of sustaining a practice, we become invested in what we do as well as in each other and our shared history. Our identities (my emphasis in bold) become anchored in each other and what we do together. As a result, it is not easy to become a radically new person in the same community of practice. Conversely, it is not easy to transform oneself without the support of a community* (p. 89).

When exploring Jack’s professional identity, Wenger’s view guided me to conclude Jack’s way of making sense. For Wenger (1998) learning is inevitable. Therefore, ‘not learning in a particular moment or situation’ can also guide a person to learn something, if not at that moment then later (Ref: Figure 2.4). One of Jack’s challenges was to link his classroom practice to students’ engaging with mathematical concepts. On various occasions, he assumed (like Jim) that the students have the basic knowledge so that they are able to learn mathematical concepts easily. In many occasions, such assumptions proved to be wrong. In my view, this is a serious concern because identity is conceptualised in terms of the ways teachers practice and participate in particular types of activities (e.g. classroom practice) that are shaped by their norms, values and practices (Cobb, Gresalfi, & Hodge, 2009). Jack had many questions; *what we should realise is that the child is on something and your work is to unfold what nature has given, then the big question is, how do we do that? How do we deal with that? You see?* (FG Int 1.187). There was a crisis in his budding teacher identity. He observed these students as lazy, who came to school to eat fat cakes as they failed to respond to certain tasks that he assigned to them. The challenge for him was to transform their attitude (actual identity) of being ignorant to become responsible mathematics students (designated identity).

Against this backdrop, I narrate Jack’s story that suggests how he shaped his professional identity.

### 5.2.2 Jack’s postscript

One of my questions to Jack was to comment on the impact of my presence on him and his students while observing his classroom teachings. On many occasions, he introduced me to the class, explaining my reason for being there. Students seemed to accept my presence in their classroom. According to Jack my presence inspired him to be focused (FG Int 2. 322, 4: Study ... has channeled me. It has channeled me to do my things in a focused manner). However, his
two year journey to become a mathematics teacher was not an easy one as he observed. This means:

- Jack triggered the learning activities, but students’ responses were minimal (indication of students’ failure to understand the concept or Jack’s inadequate teaching method);
- Students had insufficient learning equipment for constructing some mathematical figures (probably because the students’ caretakers failed to accommodate their study needs). This compromised Jack becoming a mathematics teacher as well as students learning mathematics in an effective manner.

Jack also encountered challenges in choosing an appropriate teaching approach for the topics that he had schemed earlier. I provide a vignette (Table 5.1) that narrates how Jack identified strategies to teach particular topics.

**Table 5.1: Learning from experience**

<table>
<thead>
<tr>
<th>Key: Topic is the one that determines the teaching strategy</th>
</tr>
</thead>
</table>

I wanted them to involve in quality teaching, quality learning. So what I have learned is that every topic has its nature and the nature of the topic is the one that determines the teaching strategy to be implemented. When you are planning, look at the nature of the topic. Then you look at the teaching strategy that goes with that topic, then after you have taught that topic, you discover that, no, the teacher’s strategy was **not appropriate**, but afterwards you don’t have a way of going back and then trying to implement another one (alternative method to teach). Because, may be the next topic, it is a topic of a different nature from the previous one. So it was a matter of time versus quality then, I think, I have learned different topics and I have seen its nature. How should we treat them, how do we cope with them (FG Int 1.055)?

These utterances illustrated Jack’s way of reflecting and identifying the strategies for effective teaching and learning of mathematics (*I think, I have learned *…). The utterances also showed what he had learned (learning as experience) and helped him to “negotiate new meanings” in the mathematics classrooms (Wenger, 1998).

**5.2.3 Essence of Jack’s experience**

Table 5.2a demonstrates how certain selected utterances from Jack’s stories are linked to various identities that shape his professional identity. The first column indicates the identities under which these utterances are placed. The 3rd column indicates which approach Jack followed. This approach carried certain meanings for him and his students. The justifications illustrate the purpose of the utterances.
Note: Examples for mathematics identity are not shown because it was assumed that the mathematizing utterances in the classrooms have demonstrated this. However, I used some of the utterances in Table 5.2b to show a link to mathematics identity. I also described Jack’s mathematics identity in Sections 5.2.5. A similar procedure was followed for Jim (Table 5.3b, Section 5.3.3 & 5.3.4) and for Peter (Table 5.4b, Section 5.4.5).

Table 5.2a: Identifying Jack’s classroom approaches

Key: Ja - Jack, S - Student/s, R - Researcher (Model: A B - A addressing B about an action/task)

<table>
<thead>
<tr>
<th>Identity A B</th>
<th>Reifying utterances (My emphasis in bold)</th>
<th>My interpretations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal Identity (Ja S)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jack Ob 1.011: I said <strong>we should</strong> speak aloud</td>
<td>Jack instructs the class</td>
</tr>
<tr>
<td></td>
<td>Jack Ob 1.026: And look at <strong>how smart</strong> he is…</td>
<td>He appreciates the student</td>
</tr>
<tr>
<td></td>
<td>Jack Ob 1.011: And <strong>we know</strong> that …</td>
<td>He is judgmental</td>
</tr>
<tr>
<td></td>
<td>Jack Ob 1.028: These <strong>bo Me’</strong> (ladies in Sesotho) are <strong>very silly</strong></td>
<td>Jack expresses his anger on students’ non-participation</td>
</tr>
<tr>
<td></td>
<td>Jack Ob 2.005: So I promise you that <strong>today we are going</strong> to learn</td>
<td>He is enthusiastic</td>
</tr>
<tr>
<td><strong>Teacher Identity (Ja S)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jack Ob 3.005: <strong>Remember</strong>, what I said about data. I told you</td>
<td>He reminds the students</td>
</tr>
<tr>
<td></td>
<td>Jack Ob 4.087: <strong>I think</strong> this is clear</td>
<td>He makes an assumption</td>
</tr>
<tr>
<td></td>
<td>Jack Ob 4.168: <strong>Don’t worry</strong> …</td>
<td>He assures the students that everything is ok.</td>
</tr>
<tr>
<td></td>
<td>Jack Ob 4.027: <strong>Are you aware of</strong> that?</td>
<td>He questions the students on their understanding of the concept</td>
</tr>
<tr>
<td></td>
<td>Jack Ob 1.024: Now <strong>let us give</strong> him a chance</td>
<td>He is accommodative</td>
</tr>
<tr>
<td></td>
<td>Jack Ob 3.090: Ok, time up. It is time up. <strong>So tomorrow we shall continue</strong></td>
<td>He concludes the lesson</td>
</tr>
<tr>
<td><strong>Communities of practice in classrooms (Ja S)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jack Ob 1.026: <strong>let us talk about it</strong> …</td>
<td>He demonstrates the togetherness</td>
</tr>
<tr>
<td></td>
<td>Jack Ob 4.091: <strong>Do you have</strong> any question? (Students say, no sir)</td>
<td>He probes in a certain way</td>
</tr>
<tr>
<td></td>
<td>Jack Ob 1.005. Jack: <strong>What type of an angle is this one</strong>, yes? (Jack Ob 1.006. Student 3: An obtuse angle) – wrong answer</td>
<td>He probes on prior knowledge</td>
</tr>
<tr>
<td></td>
<td>Jack Ob 1.020: <strong>we are</strong> saying …</td>
<td>He begins the lesson in a certain way</td>
</tr>
<tr>
<td></td>
<td>Jack Ob 4.089: <strong>Is it clear</strong> to everybody? (Students say, yes sir)</td>
<td>He concludes the lesson in a certain way</td>
</tr>
</tbody>
</table>
Table 5.2a&b demonstrates a model that assisted me in portraying Jack’s identities. Using Table 5.2a as the indicator, I cross checked Jack’s classroom practice and the meanings that he negotiated through his stories. The special characteristics (key words describing Jack’s certain approach) that were illustrated in the 3rd column in Table 5.2 are the kind of approaches Jack followed. These approaches are my subjective interpretations. Similar other approaches are also explored in Table 5.2b. These key words show the meanings that were formed by Jack and his students. These are then linked to the strands of identities in this study.

Table 5.2b: Findings from Jack’s classroom practice

<table>
<thead>
<tr>
<th>Jack’s classroom practice &amp; the outcome</th>
<th>Identifying features of Jack’s approach</th>
<th>Examples</th>
<th>Meaning that Jack formed</th>
<th>Associating meaning to the identity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack accommodates students’ needs of learning. He encourages them to participate. He acknowledges their contributions</td>
<td>Encouraging</td>
<td>Jack Ob 1.024: Now let us give him a chance</td>
<td>He is a caring teacher. Students acknowledge his support</td>
<td>Teacher Identity and Community of practice Identity: Jack is a person who provides opportunities for students to explore activities</td>
</tr>
<tr>
<td>He initiates discussion. He is also part of the community</td>
<td>Ownership</td>
<td>Jack Ob 1.026: let us talk about it</td>
<td>Students consider being close to him</td>
<td>Personal Identity: He is part of the community</td>
</tr>
<tr>
<td>He links previous activities to the present lesson</td>
<td>Facilitating Enthusiasm</td>
<td>Jack Ob 2.003: Do you still remember that?</td>
<td>Students need to remember what has happened. He prepares the ground for learning/teaching</td>
<td>Mathematics Identity: He creates a learning atmosphere</td>
</tr>
<tr>
<td>He interprets the task that is performed by students</td>
<td>Facilitating and interpreting students’ mathematizing actions</td>
<td>Jack Ob 1.026: let us talk about it … what did he do?</td>
<td>Students remember the topic Rotation. Jack then continues the lesson by interpreting student’s presentation</td>
<td>Students’ Mathematics identity is interpreted by Jack</td>
</tr>
<tr>
<td>Introducing the plan for the day</td>
<td>Supportive</td>
<td>Jack Ob 2.005: So I promise you that today we are going to learn …</td>
<td>Students appreciate by uttering ‘yes sir’.</td>
<td>Community of practice identity: Learning is a continuous process</td>
</tr>
</tbody>
</table>
| His interpretation of student’s action makes sense of the students’ | Interpretation | Jack Ob 1.026: He measured the angles in degrees because he knows that angles | The lesson progresses similarly | Mathematics Identity: Jack tries to interpret what student has learned so far and how
<table>
<thead>
<tr>
<th>actions</th>
<th>are measured in degrees</th>
<th>he acted accordingly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students agreed to what Jack had said</td>
<td>Clarification</td>
<td>Jack Ob 2.003: Do you still remember that?</td>
</tr>
<tr>
<td>Jack interprets that the students have prior knowledge</td>
<td>Reminder</td>
<td>Jack Ob 2.005: We have agreed up on this.</td>
</tr>
<tr>
<td>His probing helps him to make sense of student’s mathematizing</td>
<td>Assessing</td>
<td>Jack Int 1.002: Prior knowledge vary</td>
</tr>
<tr>
<td>He realises that his instruction on measuring reflex angle is incomplete (learning as experience)</td>
<td>Assumption</td>
<td>Jack Int 1.006: I see the instruction was incomplete</td>
</tr>
</tbody>
</table>

With reference to the Table 5.2 (a&b) I examine how Jack understood and shaped his professional identity. Through this narrative, I link the situated meanings that he created to his various identities. These are intertwined to become his professional identity.

### 5.2.4 Jack’s Teacher Identity

How did Jack become a mathematics teacher? How did his becoming a mathematics teacher change his classroom practice? Even though it was not possible to find answers to these questions from a limited number of classroom observations, ethnographers can trace some benchmarks of one’s identity. Therefore, I present Jack’s teacher identity in this way: He wishes to become a facilitator (FG Int 1. 172). His dream is to assist a student to transform himself to become a person, who is able to think critically and straight forward (FG Int 1.181). His identification with mathematics and teaching mathematics does not initiate from students’ utterances. In many occasions, his questions (Jack Ob 1.020: Do you think; Jack Ob 2.004: Do you still remember that; Jack Ob 3.068: Isn’t it, Jack Ob 4.027: Are you aware of etc.) required
limited responses from students. Accordingly, they responded yes/no to these questions. This observation indicates that he was inclined to an approach that neither accommodated probing nor generated curiosity among the students in this case. As a result, his students imitated the mathematics models that he demonstrated.

Simultaneously, Jack unfolded mathematical concepts with some examples on the chalkboard and then a few assignments for them to perform independently (Jack Ob 1.020: *We are saying that acute angles are being measured* …). He appreciated the good work of the students, extended assistance and monitored their work (Jack Ob 1.026: *And look at how smart he is*) and probed their prior knowledge. He frequently uttered words like *us, we* and *our*, compared to the word, ‘I’. He was a person who moved around to monitor students’ works and guided them in their learning activities. Jack identified and fitted into a role of *being a good teacher* within this traditional framework. These certain kinds of approaches shaped his **Teacher Identity** (learning as experience).

There were also moments of crisis for Jack. Students’ utterances indicated how they understood the mathematical concepts that Jack explained. On many occasions, he initiated and controlled the interactions and accepted their yes/no response and continued teaching. It was unusual for them to seek clarification in the classrooms. When Jack reflected on his classroom practice, he revealed his **worries, uncertainty and confusion** as a beginner teacher (*I thought I was not going to make it* – Ref: Jack Int 4.150). These utterances actually showed evidence of his growing recognition as a professional teacher (Gee, 2000). Building an identity is about negotiating meanings of our experience of membership in social communities (Wenger, 1998). Within this context, Jack’s utterance *I thought I was not going to make it* indicated the whole meaning of his concerns and pride of being a teacher. This also showed how his identity shaped with hope is changing his practices (learning as change in practice).

The way Jack engaged in teaching perhaps demonstrated a teacher-centred approach. He needs to work on such perspectives in order to initiate effective teaching/learning. Simultaneously, he encountered challenges in the localised curriculum because he was not given the opportunity to learn about it. However, he identifies the change in curriculum as an opportunity towards positioning himself peripherally. In his words;
You may hope for the best, but expecting the worst. I am saying this because if you look at localizing the curriculum. So I am afraid that if this is (implemented), it is going to bring tension. And if it happens that we don’t understand this, we have the tension. I am afraid, we might be schooling again, while we should be teaching (FG Int 2.346. Jack).

These utterances indicated his **willingness to learn** further so that he improves his skills. In this way he might shape a new professional identity.

If identities play a critical role in determining whether the process of learning ends with success or with what was regarded as failure (Graven, 2003) then Jack’s narratives illustrated that he had identified himself as a mathematics teacher. He had a dream to improve the students’ future through their learning mathematics (Jack Int 2.001: I have to improve –learning- it somehow ... making sure that all of them –perform better). Negotiating new meanings for students is a way of becoming a mathematics teacher for Jack. These are the learning experiences for him in the course of **doing the job** (Wenger, 1998; Lasky, 2005). While exercising the ‘job’, he expected his students to learn through the examples that he displayed and demonstrated in the classroom. When students followed these examples, Jack identified himself as a mathematics teacher which was the recognition he expected (Gee, 2001).

### 5.2.5 Jack’s Mathematics Identity

When Jack identified himself as a mathematics teacher, he saw the power of mathematics and mathematics teaching as **bringing change** in the lives of students (it seems I suffered a lot. So, I don’t want my students to be part of that suffering). I present the following vignette that narrates his philosophy as a mathematics teacher:

\[
I \text{ want to have a positive feeling towards each and every mathematics topic ... I want to create that sense ... So I want (the students) to have a positive feeling towards each and every mathematics topic} \quad \text{(FG Int 1.004).}
\]

\[
I \text{ managed to do all the topics} \quad \text{(despite of being a beginner teacher - my emphasis and interpretation). I managed to do them with quality} \quad \text{(FG Int 1.060).}
\]

Jack’s classroom practice included demonstration of a few models and their imitation of these examples as assigned by him. Students’ achievements were thus linked to his mathematics and teacher identity (Grootenboer & Zevenbergen, 2008). He considered mathematics as a tool to be successful in life. In his own words;
It is [a] tool ... because we are living in the world of interaction, world of technology, world of science. If we don’t learn mathematics, or if we haven’t learned mathematics, such things bec

ome like off your sights (Mathematics is an eye opener). You see? So you will be part of the changing world. And ... you should have mathematical skills that are going to help us with life (FG Int 1.248).

These utterances identified his views about learning mathematics. The way he emphasised you should have mathematical skills that are going to help us with life showed how he valued mathematics. Sharing such views with students activated their mathematics learning. These presumptions shaped his mathematics identity with meanings. If mathematical identity is about having mathematical knowledge and skills, creating a positive attitude towards the subject, and making a sense of joy and satisfaction in undertaking mathematical practice, Jack’s narratives demonstrated his mathematics identity that also instilled students’ mathematics identity.

5.2.6 Jack’s Communities of Practice Identity (Learning as belonging)

Exploring Jack’s community of practice identity was interesting in the sense that he had a close affiliation with the teaching community through other agents like LSMTA, where he meets, shares and learns from them (Jack Re 1). He frequently visited his former peers from LCE and attended a few workshops from which he benefitted. He was willing to learn from others and was eager to learn more about mathematical contents. This gave him a new identity, whereby he was known as a mathematics teacher who learned from members and other agents. He felt a sense of joy in these activities that clearly sent a positive message to many within the school. These activities cohered with what Wenger (2002) considered as communities of practices, whereby a group of people who share a concern or a passion for teaching learn how to do it better as they interact regularly. According to this view, Jack’s interactions with other agents in education benefitted his teaching approach.

Jack’s certain way of communicating in the classrooms demonstrated the kind of a person he is in relation to the students. In my view, these shaped his communities of practice. For instance, he asked questions that students answered promptly. He probed their prior knowledge before starting lessons, but their responses at times discouraged him. He categorically asked the students if they understood him, and they dutifully answered ‘yes’. In such situations, he used the terms, we, us and our that indicated that they were ‘learning’ together (learning as doing). This approach created a relaxed atmosphere in the classroom. They accepted the way he
communicated to them, and enjoyed his lessons. Together they shaped their communities of practice identity and enjoyed their experience together. I link his approach to Wenger’s (1998) arguments on identity: We define who we are by the ways we experience ourselves through participation as well as by the ways we and others reify ourselves (p. 149).

5.2.7 Jack’s Personal Identity
In identity discourse, the frequently asked questions such as who am I, where do I come from and where am I going etc. are the indicators of one’s personal identity (Wenger, 1998). In identity discourse, such questions are not directly answered. Through one’s attitudes and approaches answers can be interpreted. On many occasions, I considered Jack to be emotional in the classrooms. For instance, on one occasion, he uttered: (Jack Ob 5.143) Are you mad or something? Do you come to school to eat fat-cake? He said this in an angry tone when he found students were not actively involved in the activities. He did not want the students to be lazy or ignorant and expected them to be actively involved in learning. This should be read with what he said at another occasion: I suffered a lot, I don’t want my students to be part of that suffering (Jack Int 4.021). This clearly indicated where Jack came from and where he is going. This also specifically illustrated his actual identity and the designated identity.

Jack wanted his students to recognise him as being friendly to them. He said: I would like them to see me, as a friend, a friend with a passion about the way they learn, and then how do they acquire knowledge, and how do they perform. That is how I see (and) how I want them to see me (FG Int 1.298). These words portrayed a colourful designated personal identity for him. In association with his views, I quote Wenger (1998): The experience of identity in practice is a way of being in the world ... We often think about our identities as self-images because we talk about ourselves and each other – and even think about ourselves and each other – in words (p. 151).
5.2.8 Jack’s Professional Identity

The professional identity of a person is socially negotiated and personally shaped as this study proposes. What does this mean to Jack? Acquiring teaching skills were crucial for him. In this vignette Jack shared his dream to become a mathematics teacher:

As a mathematics teacher ... I need to create a way of perfecting students’ way of learning, you see? Because there are two types of learning involved. You learn or acquire skills with listening. Sometimes you just acquire skills, you see, so I need to have a way of getting ... the acquired skills and then after acquiring skills, they should have reasoned, because I think a student (should) have listening skills. That is when they can tackle the problems easily. You see? That is one of the things that I wanted to perfect in my teaching (FG Int 1.177).

Jack’s philosophy of being a teacher was based on the thought that he needed to create a way of perfecting students’ way of learning. In this manner, students’ learning is the central focus of his learning to become a teacher (Wenger, 1998). Through these utterances (FG Int 1.177), Jack was critically looking into his classroom experience (making sense) and exploring options to improve his teaching skills. This aligns with the argument that by recognising and portraying his own reality, Jack would be gaining confidence to become a mathematics teacher through a similar learning experience (Gee, 2001; Wenger, 1998).

Jack negotiated meaning for himself and for students in classrooms by changing their attitude towards mathematics. The meanings that Jack extracted earlier assisted him to understand his professional identity. In conclusion, I quote these utterances that are useful for understanding his views on teaching and learning mathematics:

If the classroom is lively and very active and they (teachers) have good relationships with the students, then that attitude towards you also changes (influences) the attitude towards the subject (FG Int 1.209). There is something that I have noticed that is common with kids. You teach them something today, you know what they do? They do some small exercise, they close the book, and they will have the mathematics book the next lesson tomorrow again. They are more dependent on teacher. And that is still a challenge for me. You have to build confidence (and) you have to give them the directions (FG Int 1.243). They grow up following certain ideas (FG Int 1.266). I believe in work with interaction (Jack Int 3.044).

In my view, Jack found the teaching profession as a means of building a person that helps this person to develop the community through his actions. He would practice professional interaction so that, at least he brings changes within himself. In his words, he is dreaming of being a perfect teacher (Jack Int 3.063) which will be his Professional Identity as he desired.
5.2.9 Concluding Jack’s story

I conclude Jack’s story by suggesting that he is a teacher who enjoyed teaching and plans to further his studies. The teaching approaches that he had followed in these observed activities are inclined to be teacher-centred, but he is working on these concerns. He is also trying to shift his position from being teacher-centred to a facilitator who activates learner-centred learning. This vision identified Jack as a teacher who is dedicated to his profession.

Wenger (1998) observes that “building an identity consists of negotiating meanings of our experience of membership in social communities” (p. 145). This view fitted with Jack’s classroom approaches as well as his practices in the communities. I find his practices outside the classrooms (e.g., attending meetings and workshops) assisted him to shift his position from the periphery to the centre. He found his teacher identity in such communities of practices. In my view, Jack saw his professional identity as closely associated to the activities that happened outside the classrooms from which he learned. His active participation in these events helped him to be recognised as a mathematics teacher, as he expected to become one day.

5.3 JIM’s STORY

5.3.1 Unfolding Jim’s professional identity

Jim is a person who demonstrated confidence in his classroom practice. He talks with a low pitch, selects words with care and avoids playing around with words. He usually looks around when talking, as if picking the appropriate words from his surroundings. In the classroom, he is firm, friendly and a good listener. He is a confident mathematics teacher (and a mathematician - FG Int 1.428) who understands the dynamics and diversity of the classroom communities that made him choose suitable teaching styles (Ref. Appendix 1). He viewed himself as a person who knew ‘everything’ that students wanted to know about mathematics (content). He also observed that he was cooperative in his team and delivered his services according to their expectations.
5.3.2 Jim’s post script story

In Jim’s view, being a participant in this study helped him to understand what kind of a teacher he is (Jim Int 5.088). In his voice:

*When somebody ... is observing, you will have to pinch yourself (and) somehow try to get things correct (Jim Int 5.090). However at the beginning, I was scared because you know somebody is coming to observe, especially for the first time with the digital cam (FG 2.337) that changed the dynamics of the class. The students do not act naturally. Even you as a teacher, you are trying to collect yourself (FG 2.339). Basically I am a mathematician, but I wasn’t trained as a teacher. So things like teaching methodologies, learning styles, ethics, things like that, learning them when you are meeting like this from you guys ... those are helping us to grow through, in our teaching career as a teacher because these things, no one is experiencing them at classroom level. We are not taught about those. It is very helpful ... and I do appreciate it (FG Int 1.428).*

It appeared as if Jim learned to observe *what was going on in the classroom with him as well as with students*. This helped him to understand how he should assess the situation in order to respond to the students accordingly. Evidence gathered also indicated Jim’s way of negotiating meanings from such situations that shaped his professional identity (Identity is a negotiated experience: Wenger, 1998).

Within the context of identity discourse, Jim’s stories helped me to portray how he shaped his professional identity. His classroom approaches had certain meanings for him and his students. In Table 5.3a, I present the indicators of how Jim addressed the students in the classrooms. I also used the students’ utterances that may have influenced his classroom practice. These utterances narrated his story and illustrated how he approached teaching. The format is the same as drawn in Table 5.2a.
Table 5.3a: Identifying Jim’s classroom approaches

Key: J - Jim, S - Student/s, R - Researcher (Model: A B - A addressing B about an action/task)

<table>
<thead>
<tr>
<th>Identity A B</th>
<th>Reifying utterances (My emphasis in bold)</th>
<th>My interpretations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal Identity (J S) (Personal knowledge)</td>
<td>Jim Ob 1.115: … Because they are not equal</td>
<td>Jim makes assumptions</td>
</tr>
<tr>
<td></td>
<td>Jim Ob 1.067: But you moved your hand.</td>
<td>He tries to discipline in a certain way</td>
</tr>
<tr>
<td></td>
<td>Jim Ob 1.067: I thought you wanted to say something</td>
<td>He concludes an issue</td>
</tr>
<tr>
<td></td>
<td>Jim Ob 4.009: I know that in primary schools, you were taught that this is impossible.</td>
<td>He has an attitude towards the way mathematics is taught in primary schools</td>
</tr>
<tr>
<td></td>
<td>Jim Ob 4.053: I like that one. Do you see?</td>
<td>He shares his appreciations</td>
</tr>
<tr>
<td></td>
<td>Jim Ob 3.001: Ok?</td>
<td>Do you understand?</td>
</tr>
<tr>
<td></td>
<td>Jim Ob 4.053: (laughs) I like that one …</td>
<td>He has a pleasant nature</td>
</tr>
<tr>
<td></td>
<td>Jim Ob 2.029: Now let us talk about this (part of the community). You know that it is 1g.</td>
<td>He makes an assumption</td>
</tr>
<tr>
<td>Teacher Identity (J S) (Classroom Practice)</td>
<td>Jim Ob 1.045: We need to compare numerators</td>
<td>He is guiding/elaborating</td>
</tr>
<tr>
<td></td>
<td>Jim Ob 4.009: I know that in primary schools …</td>
<td>He assumes what happens</td>
</tr>
<tr>
<td></td>
<td>Jim Ob 1.045: do it your way …</td>
<td>He provides the freedom of choice</td>
</tr>
<tr>
<td></td>
<td>Jim Ob 3.004: What I am saying is …</td>
<td>He clarifies</td>
</tr>
<tr>
<td></td>
<td>Jim Ob 2.089: You know you can.</td>
<td>He assures</td>
</tr>
<tr>
<td></td>
<td>Jim Ob 3.012: So make sure that your compass is not dancing</td>
<td>For Jim, language is a resource</td>
</tr>
<tr>
<td></td>
<td>Jim Ob 3.004: What do I mean?</td>
<td>He interprets</td>
</tr>
<tr>
<td></td>
<td>Jim Ob 3.004: What was happening?</td>
<td>He elaborates</td>
</tr>
<tr>
<td>Communities of practice in classrooms (J S) Jim acts in a certain way</td>
<td>Jim Ob 2.089: Thank you very much</td>
<td>He appreciates in a certain way</td>
</tr>
<tr>
<td></td>
<td>Jim Ob 2.052: But what did you think?</td>
<td>He probes in a certain way</td>
</tr>
<tr>
<td></td>
<td>Jim Ob 2.040: What happened here? How did you subtract?</td>
<td>He follows a learner-centred approach</td>
</tr>
<tr>
<td></td>
<td>Jim Ob 2.050: I wanted you to do it yourself</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jim Ob 2.040: Yes, let us talk about it …</td>
<td>He shows togetherness</td>
</tr>
<tr>
<td></td>
<td>Jim Ob 3.015: I need your attention please…</td>
<td>Starting in a certain way</td>
</tr>
<tr>
<td></td>
<td>Jim Ob 2.003: Ok, you are going to help each other …</td>
<td>Instruction in a certain way</td>
</tr>
</tbody>
</table>
Table 5.3a illustrates the approach Jim had taken in the classrooms. The key words in this table indicated the kind of approach that Jim followed in the classrooms. These are my subjective interpretations. Table 5.3b is an elaborated version of Table 5.3a. The model is similar to Table 5.2b that assisted me to portray Jim’s identities.

**Table 5.3b: Findings from Jim’s classroom practice**

<table>
<thead>
<tr>
<th>Jim’s classroom practice &amp; the outcome</th>
<th>Identifying features of Jim’s approach</th>
<th>Examples</th>
<th>Meaning that Jim formed</th>
<th>Associating meaning to the identity</th>
</tr>
</thead>
<tbody>
<tr>
<td>The task was to compare ¾ m and ( \frac{6}{8} ) km. Students argued that these two are equal (Ref: Jim’s story: Chapter 1)</td>
<td>Assumption</td>
<td>Jim Ob 1.115: <em>Because they are not equal</em></td>
<td>When Jim asks how these two are equal, students answers: <em>we normally know that ¾ m is 750 meters</em> (Jim Ob 1.111). It is then students’ turn for clarification</td>
<td>Personal identity: Jim makes assumptions that required clarification from students</td>
</tr>
<tr>
<td>The assignment was to simplify ( 2x+3x+4y = 5x+4y ) (by Jim)</td>
<td>Assurance, guidance (by Jim)</td>
<td>Jim Ob 2.089: <em>You know, you can ...</em></td>
<td>Students know that the unlike terms cannot be brought together</td>
<td>Teacher Identity: Jim approaches the topic by reminding what students know</td>
</tr>
<tr>
<td><strong>Construction of line bisector.</strong></td>
<td>Language is a resource. Instruction in a humorous manner</td>
<td>Jim Ob 3.012: <em>So make sure that your compass is not dancing</em></td>
<td>Jim tries to make sense of the procedure (precautions). Jim describes the procedure of constructing the bisector.</td>
<td>Teacher Identity: He talks to students in a certain manner. Community of Practice identity: We learn certain ways of engaging in action (Wenger, 1998).</td>
</tr>
<tr>
<td>Jim Observes that the students knew how to compare the fractions. He also assumes that they would be able to compare the fractions with units.</td>
<td>Students know that ¾ is equivalent to ( \frac{6}{8} ) (750).</td>
<td>Jim Ob 1.115: <em>Because they are not equal</em></td>
<td>Students’ knowledge and Jim’s knowledge do not match. Jim Ob 1.116: <em>They are not equal, how sir?</em></td>
<td>Mathematics Identity for students and for Jim are not the same</td>
</tr>
<tr>
<td>Jim and the students reach the same desired goal through Jim’s guiding them to the correct direction.</td>
<td>Guiding</td>
<td>Jim Ob 2.091: <em>So that means how much?</em></td>
<td>Students’ meaning and Jim’s meaning are the same. Jim Ob 2.093: <em>because it has the same letter.</em></td>
<td>Mathematics identity &amp; Teacher identity: Negotiation of meaning (Wenger, 1998)</td>
</tr>
<tr>
<td>Jim Int 1.077: <em>I should have started with the simpler one</em></td>
<td>Instruction</td>
<td>Jim Ob 1.117: <em>You convert this ...</em></td>
<td>Jim introduces the idea of whole number in order to consider ¾ m is less than one meter</td>
<td>Teacher identity &amp; Mathematics identity: Jim negotiates</td>
</tr>
</tbody>
</table>
Jim learns from experience. Meaning is formed. The lesson worked well because he interacted with groups rather than the whole class. He tries to convince students that their understanding on comparing distance is wrong. 

### Planning

<table>
<thead>
<tr>
<th>Jim Ob 3.012: because it is going to get it wrong …</th>
<th>Assumption</th>
<th>Jim Int 3.002: I used chalk and talk style to demonstrate the model because this is a new concept</th>
<th>Jim Int 3.006: I gave them the activity to do individually and, I have to go around … and they are their right track</th>
<th>Community of Practice identity: He is a person who is eager to share his experience with peers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Int 4.152: I can deliver actually (Confidence)</td>
<td>Belief</td>
<td>Jim Ob 4.009: I know that in primary schools, you were taught that this is impossible</td>
<td>Students accept that there are numbers with negative sign, and less than zero</td>
<td>Personal identity: He makes assumptions.</td>
</tr>
</tbody>
</table>

### Instruction

<table>
<thead>
<tr>
<th>Students learn by listening (Jim Int 3.035)</th>
<th></th>
<th>Jim Int 3.012: So make sure that your compass is not dancing</th>
<th>Jim Int 3.083: I encourage them to work together</th>
<th>Teacher identity: Appropriate instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The findings shown in Table 5.3b are used as the starting point to understand how Jim shapes his professional identity. The table demonstrated Jim’s classroom approaches. For instance, he gives assurance to the students (that means, how much …?, you know you can …). He makes assumptions and can be judgmental at times (I know in primary school …). He instructs them in a humorous manner (make sure that your compass is not dancing). These examples perhaps show how he approaches the mathematics classrooms. I examine more examples from his utterances that create meanings for him and link these to his professional identity.
5.3.3 Jim’s mathematics identity and teacher identity are intertwined

Jim’s lessons were different from the other lessons that I observed during this study in that his students were willing to share their mathematics knowledge with him. In this exercise, they also challenged certain mathematical knowledge that he passed on to them. (Jim Ob 1.116: *They are not equal, how sir!?*). His role is then to engage them meaningfully so that these meanings are the same for him as well as for his students. There was an identity crisis for Jim in this case, as his mathematics identity and students’ mathematics identity mismatched.

Students were willing to share their understanding with Jim in a way that demonstrated disagreement with what he had explained (*they are not equal*). He knew the correct answer to the task that he had assigned to the students, but he failed to negotiate that answer with them. However, there was an active negotiation between Jim and his students in order to make sense of the activity that Jim had introduced to them (comparing the fractions). Wenger (1998) views this as mutuality of engagement. Jim realised that *it was bit difficult* (Jack Int 1.041). This was a learning experience for him that made him change the teaching strategies in other lessons (Learning as change in doing).

When Jim insisted that he is *able to deliver*, he was demonstrating his confidence as a teacher, but (students disagreed) which demonstrates a contradiction. Jim’s utterances (interviews) later on actually showed evidence of his growing recognition as a mathematics teacher (Gee, 2000). This experience might have taught him that there is a right time to introduce certain mathematical concepts in the classrooms (Jim Int 1.077: *I should have started with the simpler one*). I find this an example that demonstrated different mathematics identities for Jim and his students.

Students identify Jim as an **approachable** person (*Sir, why do we put that x*). Students recognised that he motivated them to learn from each other. According to him;

*Students can learn something by themselves because as a teacher, you facilitate and I have exploited peer learning, then I have seen that it helps some of the students* (FG Int 2.339).

Jim made sense of such observations. He negotiated his **teacher identity** in connection to such approaches in classrooms. In this context, Wenger (1998) confers that:
We experience and manifest ourselves by what we recognise and what we don’t, what we grasp immediately and what we can’t interpret ... what we can negotiate and what we remains out of reach. In practice, we know who we are by what is familiar, understandable, usable (and) negotiable” (p. 153).

5.3.4 Jim’s Mathematics Identity

Jim identified himself as a mathematics teacher, who saw the power of mathematics and mathematics teaching as bringing change in the lives of students. For instance, he said;

- Ok, you are going to help each other (Jim Ob 2.003).
- I can be able to develop young minds to appreciate mathematics and pass mathematics (Jim Int 4.138).
- I always tell my students that I should see what you are doing (Jim Int 4.098).

I asked Jim what kind of mathematics teacher he would like to be (Appendix 1). According to him, he is not somebody who takes a piece of chalk and gives it to a student (FG Int 1.147). He would like to be more of a facilitator in the coming years. He finds mathematics as a means to achieve success (FG Int 1.148). He said:

I do allow them to have that discussion in class, so that we can learn together. With students, you always have to be patient. The way the students are learning, you are (also) learning yourself how to teach (FG Int 2.044).

These utterances indicated how Jim engaged in learning. He created a meaning from the way they grasped the concepts (There are those who are fast learners, average ones, slow learners). He experienced challenges to bring them to learn the same thing at the same time, but he took this as his learning. The situated meaning that he created had led him to shape the designated mathematics identity for him as well as for his students. The way he addressed their learning difficulties indicated his changing attitude (you always have to be patient). This change can be meaningful if his approach in the classroom also changes.

5.3.5 Jim’s Community of Practice Identity (Learning as belonging)

Utterances like: but what did you think, what happened here, Yes, let us talk about it (Table 5.3a) had influenced students’ mathematics learning in Jim’s classrooms. He wanted to know what they have learned so far. These are the indications of the way he communicated to them to make sense of mathematical activities that he introduced. The utterances let us talk about it indicated that he was part of the community. Jim said this with confidence that encouraged the students to
share their understanding with him (Jim Ob 1.116: They are not equal, how sir?). The particular utterances demonstrated togetherness that shaped his **communities of practice identity**.

Utterances such as *do it your way, you know* etc. are instructional that insured that students performed the task in a certain way. These indicated Jim’s supportive nature that encouraged the students to participate in mathematics learning in their own way. In this regard, Cobb (2011) points out that teachers have to reorganise their current instructional practices in ways that support students’ engagement with central mathematical ideas. Jim is concerned with the examples that he used once as a student. These are the same samples that he had to use from the prescribed text books in the classrooms (FG Int 2.283). It implied that the resources were limited and not revisited by the educational agents for a longer period. Another major concern for Jim is that the assignments displayed in the textbook are not ‘learner-centred’. Somehow this also compromised his teaching. In this regard, he said;

*Our students depend entirely on teachers, or the way we have been brought up, even ourselves depending on our teachers, so we treat our students saying that they should depend on us. So they tend not to look at any other resource. I don’t think we are encouraging them enough to look at something else, which is useful for them rather than ourselves, because we tend to descend the information like that* (FG Int 2.283).

One way to address such concerns is to work as a team and hold the regular meetings where we make sure that we are teaching the same thing so that we have the common goals (FG Int 2.044). He further commented that;

*You know, sometimes as a person, you have a way, you believe you can do things yourself, but when we sit together as a team, you communicate about certain common problems you have in class and then you discuss them, you will get some of the best methods that you can use or that you can try in class from your peers. So, if there is somebody new who is coming in the department, I will be trusted to guide that person and give the visions of the department to that person* (FG Int 2.121).

These views demonstrated confidence. These also disseminated his views on guiding newcomers as they would expect. His confidence was linked to the experience that he had gained from the classroom practice (*you communicate about certain common problems you have in class and then you discuss them*). Furthermore, it indicated his changing identity as he viewed himself being a successful mathematics teacher. This aligns with Wenger’s (1998) view that newcomers can engage with their own practice and provide new models for different ways of participation.
5.3.6 Jim’s Personal Identity

While Jim considered himself as a confident and successful mathematics teacher, which changes did that ‘feeling’ bring into his personal identity? Utterances such as *I know that in primary schools, you were taught that this is impossible* etc. are linked to Jim’s understanding of what students learned at primary school. It also demonstrated his attitude about their mathematical background. In my view, his personal identity was shaped from these attitudes and beliefs that contributed to his image of teaching and teacher identity. It also implied that he would not invest in students’ prior knowledge. Does he consider this identity as the reality, even after realising that students’ actual mathematical identity is different from his assumed identity? This was a challenge for him.

Jim’s frequent use of certain utterances like *what do I mean, thank you very much, what I am saying* etc. carried the same message from the beginning of this study. Occasionally, his personal emotions would dominate the teaching approaches. For instance, when Jim said, *I need your attention please*... there was a touch of politeness that he passed on to the students. That was Jim in his normal way of communicating; soft, polite and pleasant. This personal way of talking to students prepared the ground for them to be obliged, respectful and attentive. His personal identity is built within that perspective of being an approachable person to others. What is more important for Jim in his career was to help students to perform better in mathematics (FG Int 1.413) which was the philosophy that helped him to shape his personal identity.

5.3.7 Jim’s Professional Identity

The nature of Jim’s experience encouraged him to approach teaching differently (Jim Int 1.077: *I should have started with the simpler one*). The observations that I made in Jim’s classroom practice carried different dimensions of his shaping professional identity. On various occasions, Jim faced identity crisis, when students experienced difficulty in understanding certain mathematics concepts (Jim story 1). I quote his words: *I thought they should be able to do a simple comparison because they couldn’t just compare them as they are* (Jim Int 1.086). These utterances indicated his miscalculation of the students’ grasping capacity. He also expected them, for instance, to understand meaningful comparison of the units of measurement that was readily available in the textbook. This experience helped him to adopt a different approach in the next
lessons (Jim Int 4.098: *you don’t have to tell me, I have to see*). These are the stages of learning processes that negotiated meanings for him because the crises converted into opportunities that shaped his new **professional identity**.

Re-visiting the electronically recorded lessons helped Jim to understand how his classroom practices met with challenges that jeopardised students’ mathematics learning. At a later stage, he confessed that there was a judgmental error which occurred at times when he was introducing a new concept (Ref: Jim Ob 1.061; *Now let us jump to ‘c’*). That is why he said *I should have started with the simpler one* (Jim Int 1.077). These utterances demonstrated how he learned from the experience. As a result, he developed new strategies in order to develop students’ mathematics learning. In this way, **learning as change in practice shaped his professional identity**.

In conclusion, I quote Wenger (1998): *if learning in practice is negotiating an identity, and if that identity incorporates the past and the future, then it is in each other that old-timers and newcomers find their experience of history* (p. 157). In this case, Jim would become a mathematics teacher through similar learning situations.

**5.3.9 Concluding Jim’s story**

I conclude the analysis of Jim’s classroom practice and his stories by suggesting that during his ‘apprenticeship’, he learned to become a mathematics teacher through active participation and practice. Learning as social participation (Wenger, 1998) refers not only to the events of engagement in certain activities with certain people, but also to social communities and constructing identities in relation to these communities. In the context of my study, the certain activities are the way BTs engaged in mathematics teaching. The certain people are the students in the classrooms. The practices and the participation shape what we do, what we are at present, and how we interpret what we do (Wenger, 1998).

It is difficult to understand the complex relationship between personal identity and professional identity in the identity formation process. Furthermore, it is the interplay between mathematizing and subjectifying that illustrates and demonstrates these identities (Jim Ob 3.012: *Make sure that*
your compass is not dancing). As Wenger (1998) indicates, learning becomes the vehicle for the evolution of practices and for growing professional identities. Practicing and participating in mathematics classrooms thus shape and re-shape Jim in becoming a successful mathematics teacher one day, as he dreams to be. Through these shaping and re-shaping processes, one day Jim may renegotiate his professional identity.

5.4 PETER’s STORY

5.4.1 Unfolding Peter’s professional identity

In this section, I unfold Peter’s journey of becoming a mathematics teacher. Through his narratives, I portray his particular approaches in classrooms, and the meaning that he created through such practices within the classroom settings.

Peter is confident and comfortable in classrooms. He skillfully engaged in teaching and facilitates students’ needs in classrooms. He ensures that they understood the mathematical concept that he taught, and like Jim, he talks softly. Like Jack, he repeats the utterances until students respond. Unlike Jim and Jack, he taught comparatively smaller number of students.

5.4.2 Peter’s postscript story

Peter’s story unfolded his enthusiasm of becoming a mathematics teacher. In his voice:

*I just want to sit back and observe how things are done. Ya ... (when) I arrived there, things were a bit difficult. There were lots of problems in that school, especially in this department. I’m hoping that there will be some more changes in that school after the new HOD was chosen (FG Int 2.113).*

The school environment was not conducive for him to become an effective teacher. He experienced an identity crisis at his workplace (*We have more than two staff rooms, and as mathematics teachers, we are not in the same staff room, so we are not able to communicate – Peter Ob 1.119, 121*) yet he succeeded in becoming a mathematics teacher. The newcomers and the old-timers at this school seem to have a gap (identity gap) in their working relationship that limited their interactions within the department. Wenger (1998) in this context observes that different generations bring different perspectives to their encounter, because their identities are invested in different moments of that history. Peter’s experience was similar as he had limited
opportunities to learn from his peers or from experienced teachers. In my view, he must find a place in the past, as Wenger argues, so that he can be progressive as well as accommodative. Did this jeopardise his community of practice identity? Being a newcomer, Peter needed his space in the community.

Peter was eager in time to establish his identity at this school which indeed created tension for him as a beginner. Simultaneously, he identified tension as an opportunity *to work in as a team, to help each other and just help to make the results to be as good as possible. That is our main goal there* (FG Int 2.115). Thus, he considered himself as a motivator and facilitator to the students as well as to the members of the department. With this understanding, I present a selected number of utterances (Table 5.4a) from various chapters of Peter’s story to understand how he identifies himself as a teacher.

### 5.4.3 Essence of Peter’s experience

Table 5.4a demonstrates how certain selected utterances from Peter’s stories are linked to various identities that shape his professional identity. The model is the same as shown in Table 5.2a. The first column indicates the identities under which these utterances are placed. The 3rd column indicates which approach Peter followed. This approach carried certain meanings for him and his students. The justifications illustrate the purpose of the utterances as showed in the Table 5.4b.
Table 5.4a: Identifying Peter’s classroom approaches

Key: P - Peter, S - Student/s, R - Researcher (Model: A B - A addressing B about an action/task)

<table>
<thead>
<tr>
<th>Identity</th>
<th>Reifying utterances (My emphasis in bold)</th>
<th>My interpretations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal</td>
<td>Peter Ob 3.015: Keep quiet please, you are making noise</td>
<td>Peter <strong>cautions</strong> the students</td>
</tr>
<tr>
<td></td>
<td>Peter Ob 1.007: Right, that is true</td>
<td>He <strong>acknowledges</strong> students’ understanding</td>
</tr>
<tr>
<td></td>
<td>Peter Ob 1.007: Very good girl, Liau, can you try it?</td>
<td>He <strong>appreciates</strong> a student</td>
</tr>
<tr>
<td></td>
<td>Peter Ob 4.053: You are saying it is units? Aha …</td>
<td>He uses an <strong>accepting tone</strong></td>
</tr>
<tr>
<td></td>
<td>Peter Ob 3.017: After doing that, <strong>sh</strong>…</td>
<td>He is trying to <strong>control</strong> the noise</td>
</tr>
<tr>
<td>Teacher</td>
<td>Peter Ob 2.045: Aha, what do you do?</td>
<td>He is <strong>probing</strong></td>
</tr>
<tr>
<td></td>
<td>Peter Ob 4.253: Is it correct? Is it correct? Ok. This is correct, this is correct</td>
<td>He <strong>confirms</strong> the answer</td>
</tr>
<tr>
<td></td>
<td>Peter Ob 2.012: So let us (see). So first up all you have to be careful about the sign. You have to …</td>
<td>He is <strong>assuring and then guiding</strong></td>
</tr>
<tr>
<td></td>
<td>Peter Ob 3.015: We are going to talk about chords …</td>
<td>He <strong>introduces</strong> the lesson and <strong>prepare</strong> the students</td>
</tr>
<tr>
<td></td>
<td>Peter Ob 3.027: So what can you say about that line, eh, the line?</td>
<td>He is trying to make a <strong>meaning</strong></td>
</tr>
<tr>
<td>Communities of practice in classrooms</td>
<td>Peter Ob 1.039: <strong>Let us</strong> go to ‘b’ …</td>
<td>He shows <strong>togetherness</strong></td>
</tr>
<tr>
<td></td>
<td>Peter Ob 4.262: So, you can explain what is going on</td>
<td>He seeks <strong>clarification</strong></td>
</tr>
<tr>
<td></td>
<td>Peter Ob 5.086: <strong>All right. Sh</strong>…</td>
<td>He is trying to <strong>manage</strong> the students in a certain way</td>
</tr>
<tr>
<td></td>
<td>Peter Ob 1.086: <strong>now we can conclude and make a summary</strong> …</td>
<td>He <strong>concludes</strong> in a certain way</td>
</tr>
<tr>
<td></td>
<td>Peter Ob 3.044: Do you see?</td>
<td>He <strong>leads</strong> in a certain way</td>
</tr>
</tbody>
</table>

These utterances narrate Peter’s particular approaches in my opinion. I will not elaborate these in detail, as I have already illustrated these in chapter 4. However, I use some of these utterances to cross-check the meanings that he created. This exercise is critical to establish the identities that he shaped in connection to his professional identity. In this regard, the nature of his classroom practice is the starting point to understand this. I use the same model as in Table 5.2b.
Table 5.4b: Findings from Peter’s classroom practice

<table>
<thead>
<tr>
<th>Peter’s classroom practice &amp; the outcome</th>
<th>Identifying features of Peter’s approach</th>
<th>Examples</th>
<th>Meaning that Peter forms</th>
<th>Associating meaning to the identity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peter starts the lesson by reminding what is done previously. He asks a question and expects an answer</td>
<td>Probing</td>
<td>Peter Ob 1.007: How do you know the slope is negative?</td>
<td>He needs to assess students’ prior knowledge. It also helps students to recall certain necessary knowledge on the topic</td>
<td>Teacher identity: Understanding gives meaning to their engagements in practice (Wenger, 1998)</td>
</tr>
<tr>
<td>He tries to guide the students towards a desired direction</td>
<td>Assessing (students’ understanding)</td>
<td>Peter Ob 3.027: So what can you say about that line, eh, the line?</td>
<td>As the students understand one of the characteristics of chord (perpendicular line from centre bisects chord), he proceeds with the lesson</td>
<td>Community of practice identity: What we grasp immediately is a component of community of practice (Wenger, 1998)</td>
</tr>
<tr>
<td>Peter describes the nature of slope of a line</td>
<td>Probing and recalling prior knowledge</td>
<td>Peter Ob 1.007: How do you tell when the slope is negative or positive?</td>
<td>One student demonstrates the correct answer by drawing a line indicating positive gradient</td>
<td>Mathematics identity: Mathematizing and mathematics learning are taking place</td>
</tr>
<tr>
<td>When (x = -3, x^2 = (-3)^2 = 9) ((+9) = 9), but students wrote (+9)</td>
<td>Meaning is created differently by Peter and his students</td>
<td>Peter Ob 2.012: This (+9) must be in bracket</td>
<td>Peter instructs them to work it out again</td>
<td>Teacher identity: Learning as experience</td>
</tr>
<tr>
<td>The perpendicular line from the centre of a circle to the chord bisects the chord.</td>
<td>Meanings created by Peter and his students are the same.</td>
<td>Peter Ob 3.027: Can you relate that (line OM to the chord)?</td>
<td>One student identifies that the line bisects the chord.</td>
<td>Mathematics identity: Peter’s utterances made sense to him and his students</td>
</tr>
<tr>
<td>Peter rephrases and repeats the question many times.</td>
<td>Probing</td>
<td>Peter Ob 3.027: What has it to do with chord?</td>
<td>Peter continued probing towards a desired direction and concluded that it (OM) bisects the chord.</td>
<td>Teacher identity: He repeats by rephrasing the utterances (reification)</td>
</tr>
<tr>
<td>Peter identifies students’ challenges in calculating the slope of a line from a given equation of a line.</td>
<td>Peter taught this topic in the previous year. Prior knowledge.</td>
<td>Peter Ob 1.007: What about negative?</td>
<td>He is planning to use models for demonstration (Peter Int 1.056).</td>
<td>Continuity is necessary. Our identity incorporates past and future (Wenger, 1998)</td>
</tr>
<tr>
<td>Peter assumes that the students know how to operate with negative numbers. Learning as experience.</td>
<td>Learning</td>
<td>Peter Ob 2.013: This one is correct</td>
<td>Peter Int 2.011: Students are able to make their own decisions</td>
<td>Personal identity: Different generations bring different perspectives</td>
</tr>
</tbody>
</table>
Peter asks many questions that activates students’ learning  He is concerned about the students’ attitude towards learning mathematics (Peter Int 3.068)  Peter Ob 3.027: Can you relate that (line OM to the chord)?  Peter Int 3.042: We have to discuss together (on) how to improve  (Wenger, 1998).

Community of practice identity: Partnership in practice  Teacher identity

Peter keeps on probing and that helps students to respond accordingly  Reflection  Peter Re 4. Peter: The participation was very good  Peter needs to work on their weakness (on expanded notation)  Growing confidence is necessary for students as well as for Peter

With reference to Table 5.4 (a&b), I examine Peter’s way of creating meanings from his classroom practice and approaches. The nature of Peter’s classroom approaches are described with indications of what changes are brought by him. Such changes help the readers to recognise him as certain kind of mathematics teacher. Learning as change shapes his professional identity. I explore the various identities that surface from this narrative. These are intertwined to become his professional identity.

5.4.3 Essence of what Peter had learned.

When Peter started working at this school, he was excited to build his career with a dream of being a ‘good’ mathematics teacher. His vision was to develop his students to be responsible citizens. However, what he experienced was unexpected. I present a vignette as evidence:

Alright, ah, when you arrive in a new place, first of all you need to learn how people are working there. You don’t have just to come up with some new ideas when you arrived that place. The principal, so to speak anyway, he always says the mathematics department is a corrupt one. (FG Int 2.094). It was very hard for me to cope in that situation. But I had to learn something there. (FG Int 2.098).

The essence of this story is this: It was very hard for me to cope in that situation. But I had to learn something there. This is an excellent moment of converting crisis into opportunity as identity as a way of talking about how learning changes who we are and creates our histories (Wenger, 1998). In this sense, Peter made his history and in that process he learned to change, and thus he shaped his professional identity. I will justify this.

Even though Peter hoped to bring changes in the livee of students and in the culture of the school, it was not easy for him to achieve this goal due to the challenges that he encountered at the school. The principal identified the Mathematics and Science department as a corrupt one.
That was the (actual) **identity** that the principal gave to the department. Peter struggled to find a new meaning and identity for himself as well as for his department (*It was very hard for me to cope in that situation*). He continued working at this school with a hope that ‘things’ will change as they will be choosing a new HoD for this department. The actual identity (that the department is extremely ineffective) needed to be revisited in order to revise the strategies and to inspire the teachers with a newly designated identity for the department. It was not an easy task for him. He needed to understand his identity through a negotiated experience with his peers, old-timers and the students. This way, he may be able to define who he is by the way he experiences himself through participation (Wenger, 1998).

The biggest challenge for him was also to **eradicate** students’ fear of mathematics and thus help them to change their attitude towards learning mathematics. For Peter, this means **changing** his classroom approaches so that the students are inspired to learn mathematics with passion. I narrate Peter’s experience to show how he learned to change his practice and made a feeling of belonging to the community. In his voice:

> I realise that before this (extra) study (that he introduced for his students), we were thinking that mathematics is very difficult. Then, ah, I just made them to know that mathematics can be very exciting ... I treated them (Mathematics) as a game. I will make an example of the rotation. We made a circle like that and there were twelve (students) then I was the one in the Centre. They were making a circle... (FG Int 2.012).

Peter was trying to explain how he incorporated some games that linked mathematical concepts (circles and angles) using such games. This was helpful to achieve the objectives of the lessons that he planned in order to have a desired outcome. He continued:

> I was using the spin bottle. So that was very exciting because they understand that the bottle rotates to twelve people, to twelve students, it makes 360. I was making something like that. A very exciting game for them. I was using that to show them that mathematics sometimes is very exciting (FG Int 2.014).

Through this narrative, Peter tried to portray the meaning that he formed through such activities which helped him to inspire the students’ learning skills that also shaped his **professional identity**.
5.4.4 Peter’s Teacher identity (Learning as experience)

What does it mean for Peter to be a mathematics teacher? Peter said;

They (students) were used to this method of lecturing. They are just expecting something from the teacher. So I tried my best to show them that they are my students and they are not empty vessels. They can do something. I even told them that I am not just a teacher I am also a learner. I made that to be clear to them that I can get something from them (FG Int 1.085).

Peter recognised himself as a teacher who learns from his students. He understands the commitment that he had undertaken by being a mathematics teacher. He believed in students’ ability to do something with his assistance. This indicated his mathematics teaching career was not by chance but by choice. His understanding of being a teacher and the meaning that he created as a teacher are the learning experiences for him. To support this argument, I provide the following vignette:

It is very important (learning). I am just there for them just to facilitate, just for (guiding) the right way. They have to know that I am a teacher! I am learning. I am learning too. Don’t expect me to give everything to them, so I tried all my best to make them used to that (style whereby they also explore and actively participate in learning). Teacher is not giving out information. When switched to the next topic, I always tell them to go and read, after reading them, when I start these topics, it will be a revision for them (FG Int 1. 086).

These utterances suggest Peter’s teacher identity taking a specific shape as he wished. He knew that a teacher is not always giving out information. Students have to go and read. His role is to be a facilitator in the classroom. However, he is not the sole provider of the knowledge. When he uttered, don’t expect me to give everything to them, he did not mean to be irresponsible, but allowed the students to explore the opportunity to learn by themselves. He wished them to make sense of the mathematical concepts heuristically, as he did when he was a student when he continued learning. His attitude and approaches in learning mathematics also had some shortcomings, as he reflected: It looks like my students were lacking prior knowledge. Like, they didn’t study mathematics at all. They even don’t know how to add the fractions (Peter demonstrated his frustration through facial expression). So it was very challenging for them to achieve that but I have tried my level best to do that (FG Int 1.087). These utterances indicated his effort to assist the students. Peter realised that he is not only a teacher but also a learner which suggests that he is a teacher who is willing to change his practice as he learns.
Peter’s teacher identity is shaped around the philosophy that no man is an island (FG Int 1.195). In his words:

As a mathematics teacher, I want to have a cooperative team with my colleagues (where) I am teaching, you know? It won’t be possible, not that it is very easy, if I can’t just do things alone without (any assistance from others) I have to work together. Oneness is very important. It is needed to change the attitude of all students in that school, because, I am teaching only one class (FG Int 1.197).

He experienced non-alignment (Wenger, 1998) within the mathematics department at this school, whereby the administrators identified this department as a corrupt one. The only way to eradicate this stigma, according to Peter, was to work as a team to change the attitude of all students (and that of other members in the school community). This is how he would like to perform his responsibilities in future and attain a new designated identity for his department that also shapes his teacher identity.

5.4.5 Peter’s Mathematics Identity

Peter identifies himself as a mathematics teacher, who experienced the power of mathematics and mathematics teaching for bringing change in the lives of students. In support, I present Peter’s utterances indicating his strong identification with mathematics and his attitude towards mathematics. In this regard, his biggest challenge comes from students and their learning approach. In his view:

The students that I am teaching, maybe, they were used to be spoon feeding. Spoon fed to be specific because they don’t want to participate on their own. So they hate this thing of learner centred approach. So they hate it very much because maybe they understand that the teacher is the resource. But this is not supposed to happen. The teacher is just like Ntate (Respectful word in Sesotho – Father) Jack has said, he can just pass it. He can just facilitate (FG Int 2.250).

Peter was referring to what Jack had mentioned in the interview (when things have been done in a passive manner, it is going to mess up, FG Int 2.246, Jack). Engaging with significant mathematical knowledge was not easy for Peter which compromised his mathematics identity. Jack shared the same opinion.

It is also important for Peter to be recognised as a certain kind of mathematics teacher which is demonstrated in his philosophy: In order for you to live in a house, you have to clean first. You cannot live in the house, in a messy house, in a dirty house. You have to clean the house (FG Int 1.199). His mathematics identity was fine-tuned around this philosophy. He knew that the joy
of learning mathematics came with a positive attitude towards the subject. In order to create that attitude, you have to clean first. He talks in parables and meant to bring change in the attitude of the students towards mathematics and mathematics learning. He speaks of change in practice that he was planning to implement in classrooms. In order to bring changes in attitudes and approaches in mathematics learning, he knew that he had to eradicate all misconceptions that students have towards mathematics. It is also interesting to note that Peter considered the classroom as a house where students are the inhabitants, unlike Jack who considered students’ mind as clay that can be shaped as he dreams and designs.

For Peter, students are the members of a family, living, caring and sharing together. As a result, they grow together and learn from each other. In both views, the desired outcomes can be different and so the mathematical identity for these students. Their philosophy in teaching has different dynamics and projections. When, Jack determines the outcome of the learning he thus guides the students accordingly, Peter includes them in his dreams. His practice involves students’ participation so that the ownership is claimed and meaning is created together. This implied that his membership in this community of practice translates into an identity for him (Wenger, 1998). In this regard, Peter needs to familiarise himself with the way this community responds to his needs as a mathematics teacher and as a beginner.

5.4.6 Peter’s Community of Practice Identity
Peter’s alignment with the students at school is an exciting experience for him. He established a tradition for his students that bring them closer to him with an intention to share ideas. This linked to his communities of practice identity. He said: I think they shared (their concerns with me). They told me the problems they had, how I treated them and the stuff like that. So they were (very happy - FG Int 1.092). These utterances demonstrated how his students shared their ‘feelings’. They identify him as a teacher and as a friend who listens to them. They talked about their dreams and about the reality of life showing they trust him which creates a new bond between them. They together identify one anothers’ role within this community that builds confidence and new identity for all of them. Peter thus establishes his teacher identity through this practice.
5.4.7 Peter’s Personal Identity

When a BT is involved in various learning activities, his personal perspectives perhaps changes. He comes with hope and expectations that he may change the lives of young minds. In this exercise, a BT is also expected to change his attitude and approaches that possibly make him a different person. In his words:

I developed some strategies, new strategies (on) how to teach them (and) how to make them enjoy mathematics and I am able to do that nowadays because I am able to think before (teaching). Sometimes, I go to class before my time because I enjoy teaching and developing those, you know concepts and making them to love mathematics because I realise that mathematics sometimes very, very exciting (FG Int 2.027).

These utterances reveal Peter’s passion, commitment and dedication as a person who believes in what he is doing. He finds meaning in being a teacher that inspires him to be a model for others. He observes that he has to change strategies in order to capture students’ trust as a teacher therefore, it is essential to change his approach in his classroom practice. The core of his reflective thoughts demonstrated his personal identity. This also intertwined with his mathematics identity. I summarise this below:

a. Peter enjoys teaching mathematics;
   b. He loves to change the attitude of students towards mathematics and tries to convert their ‘fear’ to ‘passion’;
   c. Mathematics is an exciting experience for him and his students;
   d. He is committed to being a mathematics teacher with whom students enjoy learning mathematics.

5.4.8 Peter’s Professional Identity

Peter is recognised by his students as a mathematics teacher who listens to their concerns and worries. He eradicated their fear and then created love for mathematics by engaging in some mathematical games that aroused their creativity. Peter listened to their ‘stories’. He started a mathematics club for them. He gained their confidence by recognising their reality (Grootenboer & Zevenbergen, 2008; Graven, 2003; Gee, 2001).

I conclude his professional identity as intertwined strands of other identities. Peter considers himself as a facilitator: The seed that grows there is knowledge. The other thing that is important is that if you are a farmer, you cannot make that plants grow (naturally). What you have to do is just give them water. Facilitate them, (and) make them grow. They need to care just like that and
support (FG Int 1. 227). He frequently expresses his views through parables. Previously he talked about cleaning the house. Now he symbolises his role as a farmer who prepared the ground for growing seeds. Similarly, his role as a teacher is to prepare the ground for learning so that the students grow and become whole human beings. These are his personal stories and histories that shaped his professional identity.

5.4.9 Concluding Peter’s story

In conclusion, Peter’s story suggests that the prime purpose of being a teacher for him is to build students’ good citizenship for the common good of the community. He gives a different meaning to his teaching career by considering himself as a farmer or a cleaner. In this manner, he sends the message: *I am here for you to show you that mathematics is very (easy), you can do it. It is not that difficult at all* (FG Int 2.157). His approach was convincing and inspiring that aligns his professional identity with community membership (*I am here for you*) and as relation with the members (*you can do it because I am here for you*). This is what Wenger (1998) considers as identity in practice.

The following section examines the findings from the analysis that will be used for a general discussion on professional identity in conjunction with the literature.
5.5 FINDINGS FROM THE ANALYSIS

Based on this discussion and the stories that are narrated, I tabulate the main findings.

Table 5.5: BTs’ identities

<table>
<thead>
<tr>
<th>Identity</th>
<th>Jack</th>
<th>Jim</th>
<th>Peter</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal Identity</strong></td>
<td>Uncertain. He thought he will not make it. Dreaming to be a perfect teacher. As time moves on, he will make it. He frequently includes himself in the community (use of words we, us, our etc.).</td>
<td>He came with a dream of becoming a successful mathematics teacher. He tries to attain it. He identifies himself as a mathematician.</td>
<td>He was enthusiastic when employed, but disappointed due to the attitude of his peers. He is trying to involve them in his activities. Comes with a hope of changing students’ attitudes in mathematics.</td>
</tr>
<tr>
<td>Teacher Identity (Teaching mathematics)</td>
<td>Facilitator. He wants to create a positive attitude among students to learn mathematics better. He encourages students. Provides opportunities for them to explore learning.</td>
<td>Facilitator. He assigns group work. In classrooms he guides, probes, clarifies, interprets. He appreciates the students when they complete a task successfully.</td>
<td>Innovative, improvising, participating, facilitator, motivator. Willing to work as a team.</td>
</tr>
<tr>
<td>Teacher Identity (Learning mathematics - Philosophy)</td>
<td>Students are empty vessels His responsibility is to fill the vessels with knowledge</td>
<td>Students come with little prior knowledge, but enthusiastic. Peer learning is effective. Students can learn something by themselves.</td>
<td>Does not believe in spoon feeding. New brooms sweep clean. Students are not empty vessels</td>
</tr>
<tr>
<td>Mathematics Identity</td>
<td>A tool to improve life, students should have mathematical skills.</td>
<td>Mathematics is the future. He believes that the students come with their knowledge about mathematics. <em>I can be able to develop young minds to appreciate mathematics</em></td>
<td>Exciting but difficult. Mathematics can be very exciting.</td>
</tr>
<tr>
<td>BTs’ Approach</td>
<td>Instructional, descriptive, willing to learn from peers</td>
<td>Chalk and talk style, demonstrator</td>
<td>Team work, established a mathematics club to activate mathematics learning.</td>
</tr>
<tr>
<td>(BTs’ views on)</td>
<td>Accommodative, supportive</td>
<td>Supportive.</td>
<td>Messy, dirty house that requires cleaning. No support from administration.</td>
</tr>
<tr>
<td>1. School</td>
<td>Work by interaction</td>
<td>Team work. Planning &amp; scheming together</td>
<td>Limited interactions. Corrupt department according to the administrator’s view. He wants to eradicate his stigma.</td>
</tr>
<tr>
<td>2. Department</td>
<td>Must be lively and active for learning</td>
<td>Share and care (team spirit)</td>
<td>Good participation</td>
</tr>
<tr>
<td>3. Classroom</td>
<td>He found the students to be less engaged in learning (<em>These kids</em></td>
<td>They come with indigenous</td>
<td>Like seeds that need watering.</td>
</tr>
<tr>
<td>4. Students</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Through this study, I tried to bring the experiences of these three BTs and their narratives closer to the readers who may observe how they shaped their professional identity. The common characteristics of Jack, Jim and Peter suggest that they all behave in a similar manner, but their learning experience and the way they make meaning out of these experiences make them unique.

Based on these findings, I discuss the general issues related to BTs’ professional identity.

### 5.6 DISCUSSION OF THE ANALYSIS

#### 5.6.1 BTs’ IDENTITY DURING THEIR CAREER DEVELOPMENT

I start this section with a brief account of identity discourse. There is enough evidence in the literature to acknowledge the need for identity talk in teacher education and teacher training programmes (Grootenboer & Zevenbergen, 2008; Anderson, 2007; Beijaard et al., 2004; Boaler, 2002; Gee, 2001; Adler, 2000; Beijaard et al., 2000). The identity talk in the teaching profession involves exploring teachers’ participation in practices (Graven, 2003; Wenger, 1998). Their active participation may shape their perceptions on professional identity (Beijaard et al., 2000). BTs’ perception on their professional identity, according to Beijaard et al. (2000), is the “changes in identity and relevant experiences throughout their careers. These insights are not only useful for understanding their self-image and helping them to reflect on themselves as teachers, they are also useful for student teachers as part of their orientation on becoming teachers” (p. 762).

The emphasis on becoming an experienced teacher and becoming a part of the educational community, according to Boaler (2011), demythologises the special status in mathematics.
Belonging to multiple communities of practice is equally important for teachers to shape their professional identity. Jack benefitted from such communities of practice identity. Some of these multiple communities in Lesotho are teachers’ associations and educational organizations (e.g., LSMTA). The growing interest on identity and studying how teachers are recognised as a certain kind of mathematics teacher can also be activated by interaction between members of the neighbouring school communities. Peter mentioned such opportunities that he opted for (FG Int 1). Through networking for instance; community of practice in the contemporary period is a more practical way of interaction.

Samuel and Stephen (2000) point out the need for documenting the stories of teachers. In their words: “researchers and policy makers should adopt a methodology which unashamedly puts the experience and voice of teachers, whether at the start of her profession or after many years of teaching, at the forefront of the inquiry” (p. 490). As I narrated the stories of BTs in this study, these stories could be the bench mark for those who are potential teachers.

With this understanding, I present the significant findings of the study with an emphasis on the need for introducing identity discourse in teacher training programmes.

5.6.2 Exploring the significant findings on identity discourse
The responses from participant BTs and the deductions from their classroom practice in this study are categorised under personal identity, teacher identity, mathematics identity and community of practice identity.

Personal Identity:
I find BTs’ personal understanding of being mathematics teachers contributed to a pattern that they followed (Jack Ob 2.005: Today we are going to learn …, Jack Ob 4.087: I think this is clear …). This approach is linked to a socio-cultural perspective that focuses on the interactions between the individual, culture and society (Grootenboer et al., 2006). This also implied that the BTs’ teacher identity is shaped within the same framework.
In my view, the lessons (that I observed) though dominated by a personally oriented approach, showed a trend to move away from this by the end of the study. For instance, BTs were aware of their beliefs regarding the inadequate pre-requisite knowledge of students that needed to be rectified for the benefit of progressive learning (Beijaard et al., 2000). Personal identity is therefore formed in relationships with others, extending their past to the future through active participation (Anderson, 2007; Wenger, 1998).

**Teacher Identity:** On many occasions, the BTs continued teaching without assessing and exploring students’ understanding of the mathematical concepts. Their approach had mainly whirled around as teacher oriented learning that was teacher dominated. Flores and Day (2005) in their study discuss similar findings:

*The process of learning from the first teaching experiences impacted upon new teachers’ understanding of teaching and of their identities as teachers and the way in which they behaved professionally. Overall, they reported that their interaction with the students in the classroom produced a more defensive and custodial attitude for their teaching, both in their pedagogical strategies and at the personal level. These resulted in an increasing self-confidence and a more positive evaluation of their performance. It seemed that they were beginning to make sense of themselves in terms of their ability to exercise control (p. 8).*

In this study, exercising control was not an issue in the sense that students on many occasions accepted the teacher as the authority in the classroom (students frequently uttered, *yes sir*). The anticipated threat, in my view, was the BTs’ traditional approach of teaching that was driven by similar patterns. Therefore, their teacher identity is also shaped towards that direction that is dominated by *chalk and talk*. Even though this pattern varies slightly from one BT to another, the outcomes in all classroom activities were predictable with similarities (Jim Ob 1.185: *Ok, now, let me give you some work to do*). Wenger (1998) is also concerned with the traditional classroom format because it is disconnected from the world and is uniform to support meaningful forms of identification. This may imply that identity and learning though linked are limited within the classroom setting, whereby all students learn the same thing simultaneously with a teacher teaching (Wenger, 1998).

This suggests that BTs’ personal identity and teacher identity are linked to the way they teach mathematics. With this understanding, I examine their mathematics identity.
**Mathematics Identity:** Grootenboer and Ballantyne (2010) associate mathematics teachers’ identities to their mathematical sense of self and their professional sense of self that is foundational to their teaching practice. The findings from their study showed that the (experienced) teachers’ teaching approaches vary from strict, highly structured classes to quiet informal and open lessons. In this study, the participants are the beginners. Their teaching approaches were similar and teacher oriented. BTs’ professional identity thus revolved around similar practices and approaches.

In my opinion, there is something unique about the participant BTs’ shaping their professional identity. When they experienced certain challenges in the classrooms (like Jim) as well as from the school community (like Peter), they turned these challenges into opportunities and changed their approaches accordingly, hence shaped their identities too.

These are the significant general observation that I have drawn from this study. A detailed discussion follows:

**Community of practice identity:**

I could not identify any utterance that is linked to community of practice identity.

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**5.6.3 Influence of identity narratives and BTs’ voice in professional development**

Felix (2014) in his study concludes that narrative methodology provides teachers with an opportunity to tell their own series of practice. Such ‘telling stories’ open various opportunities for reflection and learning. Learning thus occurs by finding answers to questions such as who am I, and what do I want to become; that are frequently asked by them. Samuel and Stephen (2000) allude that these questions lie at the heart of the fundamental relationship between the individual sense of self and the development of a professional identity in a rapidly changing educational environment. As they elaborate, the two key relationships are those of self with identity, and cultural context with professional environment. They state that “(w)hat constitutes a professional identity and a role is thus a percolated understanding and acceptance of a series of competing and sometimes contradictory values, behaviors, and attitudes, all of which are grounded in the life experiences of the self in information” (p. 476). Based on the learning experiences and the answers they formed, BTs shaped their new identity. For instance, Jack looked outside the school
community and learned from it. Peter on the other hand struggled within the school community and established a club to inspire students learning mathematics. Jim had to explore various teaching approaches for effective mathematics learning. Thus, they all found new meanings of **being a mathematics teacher** in their own way.

Within the context of this study, the participant BTs’ narratives and classroom approaches did indicate that contradictory attitudes and values are reflected and assessed by them in the light of their classroom teaching (FG Int 1.055: *What I have learned is that every topic has its nature and the nature of the topic is the one that determines the teaching strategy to be implemented*). Sfard and Prusak (2005b, p. 29) argue that the present narrative approach considers stories as windows to another entity that stays unchanged when “the stories themselves” evolve by accepting what they appear to be and by taking their words seriously. This gives an impression that they are being recognised in a certain way, therefore their confidence grew. Thus, BTs’ stories narrate their particular way of teaching mathematics and them being recognised as mathematics teachers.

As BTs grow in confidence and are recognised as a certain kind of mathematics teacher, they will be aware of various identities that they shape (Teacher identity, Mathematics identity, Community of Practice identity and Personal identity). They shaped their identities through the opportunities they had in various occasions, and that changed their classroom practices. This awareness will help them understand how their students and other members within the community see them as mathematics teachers (Anderson, 2007). This becomes the most significant outcome of this study that requires further elaboration within the framework of Wenger’s theory of learning.

### 5.6.4 Summary remarks on identity

Theory of learning (Wenger, 1998) is elaborately used in this study to understand how BTs shape their professional identity. In order to conclude the identity discourse, I used Wenger’s perspectives on identity that he associated with education. According to him, education concerns the opening of identities:

> Education thus becomes a mutual developmental process between communities and individuals, one that goes beyond mere socialization. It is an investment of a community in its own future, not
as a reproduction of the past through cultural transmission, but as the formation of new identities that can take its history of learning forward (p. 264).

The emerging professional identity is thus shaped through educational engagement, educational imagination, educational alignment as well as educational resources as Wenger (1998) suggests. I now link these views to this study as shown below:

**Educational engagement:** Wenger (1998) suggests that a learner (BTs in this study) must be able to invest himself in **communities of practice** in the process of his teaching approaches and subject matters. Participants in a community of practice contribute in a variety of interdependent ways that become material for building an identity. A beginner should take the initiative to participate in any formal or informal community of practice so that they are known as a particular kind of mathematics teacher within that community. As the participants mentioned in this study, they rarely get the opportunity to attend workshops, but Jack was an active participant in some activities which helped him to be familiar with the other members of the community. This also helped him to follow certain teaching activities and approaches (for instance, setting the question papers with teachers from other schools). Jack’s communities of practice thus assisted him to shape his community of practice identity.

In terms of professional identity, BTs’ participation in certain communities of practices (like attending workshops) becomes meaningful for them. Clarke and Hollingsworth (2002) agree that the professional growth “takes teacher change to be a learning process and suggests the possible mechanisms by which this learning might occur” (p. 965). Teacher growth thus opens new opportunity for BTs to learn in the fashion that they find most useful (Clarke & Hollingsworth, 2002). This is a way forward for BTs to become mathematics teachers.

**Educational imagination:** Wenger (1998) suggests that if the purpose of education is to prepare students for specific capability, then education must involve imagination in a central way. In my view, teachers should guide the students to explore who they are, who they are not and who they could be. In this sense, the study revealed that the BTs had specific dreams about their role as mathematics teachers, like Jim who wishes *to help students to perform better in mathematics*
(FG Int 1.413) and explored various teaching approaches in order to engage the students in learning mathematics. His teacher identity was thus shaped to a desired direction as he expected. In a broader sense, BTs should be given opportunities to explore how identities shape through their lived experiences and continue being shaped in mathematics classrooms (Marsh, 2002). This may provide an insight for teacher trainers for preparing the BTs to become future mathematics teachers.

**Educational alignment:** The participant BTs hoped to play key roles for the success of their students, who should contribute meaningfully to a broader enterprise. In their view, education is the key to success. I noticed that the students were not taken out of the classroom community for exposure to other parts of the community, at least not during the duration of this study. In this manner, students were not given the opportunity to be exposed to multi-membership. Wenger (1998) notes that a learning community must “articulate participation inside with participation outside” (p. 274). Even though BTs allowed students to learn from their peers within the classroom community, they might have overlooked this factor and compromised students becoming members of a broader horizon (non-alignment). However, Peter attempted to form a mathematics club in order to empower students’ mathematics learning. As a result, he was recognised as the founder of this club at his workplace.

**Educational resources:** Wenger (1998) warns the readers that there are reasons to shelter newcomers from the intensity of actual practice, from the power struggles of full participation, and possibly from the abuses of established members. Peter (fully) and Jack (partially) had similar challenges from their respective communities. I consider these as BTs’ moments of identity crisis. Jack emerged from such a crisis by learning through his communities of practice such as LSMTA activities, whereby he invited his peers to join him. On the other hand, Peter failed to incorporate his colleagues in his activities. Jim claimed to have had no opportunity at all to involve others in any similar activities. These BTs, in my view, need to overcome any threat that may occur from the power struggle within their communities using their own professional strategies. In turn, this may help them to be recognised as mathematics teachers reaching out to the school community as well as sharing their dreams with others.
I conclude this section by quoting Wenger (1998) that if “learning is a matter of identity, then identity is itself an educational resource” (p. 277). If one needs an identity of participation in order to learn then, “invite others into our own identities of participation” (p. 277) so that learning becomes dynamic.

5.6.5 Conclusion on identity discourse

The change in BTs’ identity can be social and personal (Grootenboer et al., 2006). What changes occurred with the participant BTs in this study? I would say that, through their stories, they became the biographers who narrated their previous school experience (of being a student). They even narrated their personal background (Appendix 1; Sections 4.2.0, 4.3.0 and 4.4.0). Through this study, they demonstrated where they come from and what values they uphold. They also demonstrated their attitudes towards the teaching career and teaching mathematics. For instance, initially Jack was uncertain of his choice of being a mathematics teacher, but eventually he learned to become a teacher. Jim came with a dream of becoming a mathematics teacher, and Peter was enthusiastic about being a mathematics teacher. They all tried to facilitate learning in the classrooms (Table 5.6). By the end of the study, they showed change in their understanding of the teaching approach; Jack became confident, Jim found himself as a teacher who is able to deliver and Peter recognised himself as a teacher who is there for the students (Table 5.6).

These are the benchmarks for BTs in the process of becoming mathematics teachers because “learning and a sense of identity are inseparable; they are aspects of the same phenomenon” (Lave & Wenger, 1991, p. 115).
5.7 SIGNIFICANCE OF BTs’ PROFESSIONAL IDENTITY

Most of the studies on BTs show the sudden and dramatic experience of the transition from student to teacher and from beginner to old-timer (Flores & Day, 2005). With this understanding, I present the significance of BTs’ professional identity in this study.

✓ BTs being the beginners in the teaching field come with the hope of becoming a successful mathematics teacher. Therefore what is meant to be a teacher is critical for them to shape their professional identity.

✓ Identity is an ongoing and evolving process that involves interpretation and re-interpretation of experiences. Therefore, continuous and consistent practice and participation is the key to BTs’ learning to become a mathematics teacher. BTs’ identity is continually formed and informed through these interpretations.

✓ When a mathematics teacher has a well-developed mathematics identity, his students also develop their mathematics identities. This is useful for effective mathematics learning.

In particular, this is what emerged from the stories of Jack, Jim and Peter in this study. Becoming a mathematics teacher is a transforming process. Flores and Day (2005) suggest that making sense and reinterpretation of one’s own experience shapes identity. In this sense Jack, Jim and Peter are expected to continue becoming mathematics teachers. There is enough evidence indicating this process from their classroom practice. For instance, Jim once mentioned that he jumped into one assignment without considering the complexity of the concepts involved in that task (Jim Ob 1). This resulted in the task becoming a ‘problem’ for students that were not easily solved by Jim and his students. However, his crisis opened a new opportunity for him to explore other teaching approaches, which were effective in the classroom.

When BTs experienced challenges in the classrooms (learning difficulties), they linked these to students’ inadequate prior knowledge or laziness to learn new concepts. For Jack, this created an identity crisis. Peter had a different kind of crisis that was caused by the old-timers of his school community. However, he took this as a challenge and tried to eradicate this ‘stigma’ of corruption. Whereas Jack reached out to seek assistance, Peter internalised the crisis and created new opportunities in the school. Their identity thus took new shapes. Changing the classroom
practice by Jim, establishing a mathematics club by Peter, and learning from other educational communities by Jack helped them to grow their confidence as mathematics teachers. These initiatives shaped their designated professional identity as they desired.

In a broader context, teacher identity suggests what teachers think and do, with a sense of who they are in classrooms as well as in other communities (Grootenboer & Ballantyne, 2010). BTs’ actions, practice and decisions may have significant consequences in classrooms as well as in shaping their identities. Grootenboer and Ballantyne (2010) argue that, “if this is the case, then teacher development will be about developing the all-round person who teaches mathematics (p. 231). Being an all-round person thus becomes BTs’ identity as a mathematics teacher.

5.8 CHAPTER SUMMARY
The detailed analysis of the classroom experiences of Jack, Jim and Peter ends here. I examined some of their utterances in light of their professional identity. The approaches and attitude they demonstrated through the utterances were linked to the broader study (Tables 5.2, 5.3 & 5.4). I also cross checked these to verify the meaning they formed. Furthermore, I brought the findings together in Table 5.6 to view their identities through a single lens. This perhaps helped me to see the meaning that they created from their teaching experiences. These meanings are closely linked to their identities. On their journey to become mathematics teachers, they may continue learning because learning is first and foremost the ability to negotiate new meanings: it involves our whole person in a dynamic interplay of participation and reification that transforms one’s identity (Wenger, 1998). In my view, this study is a beginning for negotiating new meanings of their experience that continue shaping their professional identity.
CHAPTER 6
FINDINGS, RECOMMENDATIONS AND CONCLUSIONS

6.1 INTRODUCTION
The aim of this chapter is to summarise the findings of this study and suggest recommendations that are relevant to future similar studies. The main research question was: how do beginner mathematics teachers shape their professional identity? Based on the answers gathered from the study and from a careful review of the available literature, the study revealed three emerging areas. These are:

- **Learning** by participation and by practice empowers BTs’ capacity to make sense of their classroom approaches. Learning thus shapes their professional identity.
- **Developing and shaping** strong professional identities for BTs in the classrooms and outside the classrooms are equally important. Therefore, BTs should learn to convert crises and challenges into sense making processes. Lastly;
- **BTs’ Listening** to their own voices about their identities may help them to understand the students’ mathematics identity in the classrooms as well as teacher identity of the colleagues outside the classrooms because these identities are linked to each other.

These areas are used as a framework to make recommendations and suggestions for future research. A brief summary of findings are presented with issues gleaned from the discussion in Chapter 5. **Limitations** of this study based on the current research perspectives are also presented with an emphasis on implications for future research opportunities. Finally, I conclude the chapter with the remarks on the personal significance of this study.

6.2 FINDINGS IN TERMS OF IDENTITY
The main findings that emerged from this study are briefly illustrated in this section (Ref: Table 5.5).

1. BTs came with a dream of being part of a teaching community and they participated in various activities. This helped them to form meanings for their actions that shaped their
identity. For instance, Peter was known as the founder of the mathematics club at his school that inspired students to be active in his mathematics classrooms. Consequently this helped Peter to become a mathematics teacher as he wished.

2. At a later stage of the study, BTs recognised themselves as a certain kind of a mathematics teacher which became their identity. Their general routine and monotonous teaching approaches met with some challenges. When they realised that these approaches were inadequate, they were willing to adopt other methods. They continued learning various approaches to classroom teaching. The learning as change in practice thus shaped their identity.

3. They shaped their professional identity through a learning and sense making process. I elaborate these points further.

6.2.1 Responding to the research question

While searching for answers to the research questions (How BTs shape their professional identity), the following observations were made.

There is evidence to indicate how BTs make sense of their classroom activities. The meanings that they formed from their classroom practice helped them to shape their professional identity. However, these were not without any identity crises. In my opinion, these identity crises became opportunities for creating new identities. Thus their voices were heard by others (students, peers or administration) who recognised them as a ‘certain kind of a mathematics teacher’. I elaborate this further within the framework of the research question of how they shaped their identities.

a. Personal identity

Jack had a personal identity crisis in the beginning of his teaching career. He thought; I was not going to make it, but at the end of the day, I end up having C’s and B’s (Jack Int 4.418). He then decided; I am trying to make sure that I am not going to experience the same problem (Jack Int 4.170). Peter had similar experiences and he felt very good when learners were able to tackle a task by themselves (Peter Int 1.099). He also aimed to produce ‘very good results’ in mathematics (Peter Int 1.088).
In general, like other teachers, the BTs believed that learning mathematics is the key for success in life. Jim was keen on becoming a successful mathematics teacher. Jack was confident that he will become a mathematics teacher. Peter was engaged in various activities in order to encourage the students to become successful in life by learning mathematics.

b. Teacher identity

As a teacher, Jack knew that; no topic is better than the other one (Jack Int 4.418). He chose the teaching strategy depending on the type of the topic (Jack Int 3.008). He engaged the students in various learning activities by giving them opportunities to demonstrate (Jack Ob 1.024) and was happy to observe the improvements in their performance ((Jack Int 3.073).

On many occasions, Jim experienced identity crises that necessitated him exploring different teaching approaches in the classroom. He also observed that his students learned freely (Jim Int 2.010). He said: I used the chalk style or call it demonstration method ... because I knew that it was a new concept all together (Jim Int 3.002).

These BTs identified themselves as facilitators. They participated in classroom activities and encouraged students to be active participants. The interesting feature was that they had their own philosophy on how teaching should be. In my view, their teacher identity evolved around these philosophies (e.g., Peter Int 1.105: What I prefer is the team teaching).

c. Mathematics identity

For these BTs, mathematics is a strong tool to change the life of students. Jack, when met with some challenges in the classroom, reflected; I could have given a chance for the student to explore the angle on the board (Jack Int 1.008). Jim met with a similar crisis (Jim Story 1) and he then changed his teaching approach in the next lesson (Jim story 2). On the other hand, Peter took a courageous measure of forming a mathematics club for his students. The point that I make from these observations is that these BTs, when faced with crises in mathematics teaching, explored other options that shaped their new identity.
d. Community of practice identity
Communities of practice for these BTs were limited to a few activities conducted by external agencies. Jack experienced difficulties to scheme the lesson plans within the department that challenged his teacher identity. He then found new opportunities with other teachers through other organisations. In his view: *At times conflicts resulted in confusion on setting the question papers* (Jack Int 2.044). He resolved these conflicts in a dignified manner by creating new opportunities which shaped his new identity. He was thus known by his colleagues as a teacher who learned from others. On a similar occasion, Peter decided to form a mathematics club for his students and he invited his colleagues to join him. In my view, Peter looked ‘within the school’ while Jack explored ‘outside the school’ to shape his identity.

6.3 IMPLICATIONS FOR PRACTICE

The shaping of identity is an on-going process. Therefore, career development programmes and continuous learning is necessary for shaping professional identity for a beginner. In this regard, appropriate measures should be taken by the stake-holders to listen to the ‘voice’ of these BTs. Borko (2011) suggests a curriculum-based professional development programme with support materials for facilitators. In addition, she also suggests a model of teacher teaching teachers. This is peer learning in my view that may contribute in shaping BTs’ professional identity through communities of practice. Learning for BTs thus aligns with their dreams to become mathematics teachers. When actively participating in the community, they will be identified as a certain kind of a mathematics teacher within that community which becomes their identity. In connection to this study, the most important turning point for participant BTs was their wish to overcome the identity crises by creating opportunities that shaped their identity. In teacher training programmes, their experiences and stories can be narrated so that future mathematics teachers gain an insight to such situations.

On educational resources, Wenger (1998) also brings another concern. According to Wenger: “If education is understood as fulfilling a different function than preparing for engagement in specific practices, then it may be useful to have specific settings dedicated to it” (p. 275). In order to engage the newcomers within the community, they need to be sheltered from the
intensity of actual practices, from the power struggles of full participation and possibly from the
abuse of established members. Peter had a similar experience (as narrated in this study) that
inhibited his full participation in the school activities. Peter then established a Mathematics club
for his students with a hope to change the attitude of students as well as the teachers in that
community. He hardly secured any shelter from the community, but he survived through his own
change in approach. In a way, this is an eye opener for Lesotho teacher trainers in order to
prepare the future teachers from such threats.

Within the Lesotho context, there is a need for periodic academic empowerment for BTs in order
to avoid fatigue in professionalism among them. Teachers in general and BTs specifically should
have a forum to share their worries and anxieties that arise from the challenges in teaching so
that they learn from each other in a free environment that is conducive to their well-being.
Within this community of practice, they listen to each other and find their identity through their
stories, hence shape their professional identity.
This view is supported by Borko (2004):

Research on teacher learning communities typically explores features of professional
development programs such as the establishment and maintenance of communication
norms and trust, as well as the collaborative interactions that occur when groups of
teachers work together to examine and improve their practice (p. 6).

6.3.1 Communities of practice shape BTs’ identities
The study suggests that teachers will have to undergo continuous training under supervision as
their profession requires development. There is a need for active induction programmes to
support them during their ‘apprenticeship’. Such actions may assist them to fine-tune their
teaching skills. In my opinion, their participation with such communities will make sense for
them as they negotiate new meanings of what they attained from these communities to what they
have learned from their own classroom practice. Thus they shape their professional identity.
Within the context of this study, Jack, Jim and Peter were not fully exposed to such
opportunities. However, Jack took the initiative to communicate with LSMTA which benefitted
him shaping his community of practice identity.
BTs are able to shape their professional identity when they participate in career development programmes. This enables them to engage in communities of practice beyond the classroom and school community. Flores and Day (2005) suggest that “the relatively weak influence of pre-service programs might be strengthened by a stronger focus upon opportunities to experience and reflect upon personal biography and the cultural contexts of schools in order that the tensions between them might be better understood” (p. 14). These authors recommend induction programmes for teachers to focus upon their career development and construction of identity through exploring possible links between personal beliefs with BTs’ classroom practice and peer support in order to bring about change.

For change to be substantial and sustainable beyond a professional development programme, teachers need to both adopt and adapt new knowledge into their own conceptual framework about teaching and learning through communication and participation (Hunter, 2010). Communities of practice and active participation are the key to shape the professional identity of BTs as the literature suggested (Wenger, 1998; Lave & Wenger, 1991). This encourages the required opportunities for them to go through continuous career development by participating in induction programmes and career development programmes. Borko (2011) recommends curriculum-based professional development programmes for BTs. Such programmes according to this author help “teachers deepen their understanding of mathematics content, students’ mathematical thinking, and instructional strategies; and develop norms and practices for learning about teaching” (p. 10). Within the Lesotho context, inadequate in-service course and insufficient teacher development programmes compromise the BTs’ professional development (Section 1.3 & 2.2). This may have an adverse impact on BTs’ professional identity.

An enrichment programme is therefore obligatory for any school that intends to employ a BT because the first year of teaching is the most challenging period for him. This is possibly due to some mathematics teachers who have robust mathematical identities and are perceived as being less committed to their pedagogical relationships with students (Grootenboer & Zevenberger, 2008). In order to guide these teachers, MoET (2011b) appeals to schools’ management to plan for improvement in their varying stages of performance ensuring that teaching/learning is given maximum attention at all times. A BT who is single-handedly addressing the learners in
classrooms equipped only with training and qualification can therefore gain confidence through such affirmative actions and substantiate his decisions in the ever-changing circumstances (Hewson, 1996). The empowerment actions thus enable BTs to make sense of their activities. As a result, they may belong to a community and shape their communities of practice identity accordingly (Wenger, 1998).

6.3.2 BTs shape students’ mathematics identity
From the early stages of their career, there is a need for BTs to understand how students see themselves as mathematics learners in relation to their experiences in mathematics classrooms. From the beginning of this study, I have identified the participants’ commitment towards mathematics. They enjoyed being mathematics teachers and believed that mathematics is a tool towards a good life. Consequently, their mathematics identity was specifically shaped in a desired direction.

Equally important is the way their experiences and practices fit into their broader life experience (Anderson, 2007). This study suggests that BTs address these issues as they follow teacher-oriented or learner-centred learning. Within the context of this study, Jim frequently tried to negotiate a meaning in mathematics learning in the classroom with the students. Peter had challenges in this regard, as there was a ‘fear’ factor that had a negative impact on students’ mathematics learning. In order to stimulate students’ mathematics identities; “teachers should consider mathematical tasks and classroom structures where students are actively involved in the creation of mathematics” (Lampert, 2001, as cited in Anderson, 2007, p. 12).

6.3.3 BT’s personal identity influences his teacher identity
It is possible that a BT comes with a revolutionary mind to activate students’ enthusiasm for learning mathematics. Stoll (1996) raises a concern that a BT is likely to shy away from using innovative ideas in mathematics classrooms due to the confusion caused by various challenges. On the other hand, when a BT takes bold actions that jeopardises the norms of the school, this adds to their existing conflict (Beijaard et al., 2000). In this regard, the personal beliefs and attitudes that BTs bring, and the manner in which the old-timers practice their classroom
activities, may carry different meanings. As a result, a BT may develop tension that may have an adverse impact on his personal identity.

Peter had a similar experience when he initiated a mathematics club at his school. Therefore, BTs will be skeptical in using any imaginary stories to make classrooms lively. As some of the participants pointed out, they do create a lively atmosphere in the classrooms by bringing real-life situations in mathematics classrooms. This is an appropriate approach for the effectiveness of the mathematics lessons that may help BTs to build a positive attitude towards mathematics for students. In that way, BTs’ personal identity may cohere with that of students.

This indicated that each BT had their own views about how children learn mathematics. According to such views, BTs may develop their classroom practices that possibly shape their teacher identity (Grootenboer & Ballantyne, 2010). It is then appropriate for BTs to have a common forum to share their stories with others.

6.3.4 Common forum to listen to BTs’ stories
A revisiting programme is necessary to understand how BTs are coping with their professional career. It is also necessary to know how they plan to further their career. Such programmes should be structured, monitored and implemented by MoET in liaison with NUL, LCE or other stake holders in education. In this regard, I suggest a forum for BTs to share their stories so that these stories (and their biographies) are appreciated by all. By sharing their stories, they create meanings of their practices. This is their learning process that shapes their professional identity. Bringing them together under one umbrella encourages them to use someone’s classroom practice in their classrooms. If peer learning is an effective mechanism for students in the classroom (e.g. Jim’s story) then it can also be effective for BTs. Thus they learn from each other. All such activities open opportunities for them to enhance their professional identity.
6.4 LIMITATIONS

There is no single research method that is without flaw and even with intensive planning research does not unfold without limitations. This study is no exception. Hunter (2007) argues that the small number of sample teachers and generalising the findings from such samples in the context of different classroom settings limit the validity of the findings. In my study, I started with 6 participant BTs in the first year. In the second year, one teacher had to withdraw his participation. However, in the analysis, I considered only three classroom observations from three participant BTs due to the vast quantity of data that was gathered from the 28 classroom observations, 28 interviews and 2 focus group interviews in order to reduce the analytical load. Hunter (2007) in this regard observes that: “Because of the complex nature of the schools and classroom practice, interpretation of the results … can only provide an emerging understanding of the pedagogical practices teachers use to enact the communication and participation patterns of inquiry communities” (p. 223). This may lead to a superficial analysis.

The validity of analysis was also perhaps compromised due to the time factor and the length of transcribed data. Eisenhart (1988) suggests that the meanings encoded in the language of mathematics (subjectifying utterances as this study described), in the way they are presented, understood and used by students, have not been fully investigated in mathematics education. The numerous data collected from the field with a small number of classroom observations limited and compromised the quality of data collection. This may have an impact on the findings. Such limitations can be remedied by engaging in further research on identity discourses that opens opportunities for the research world to investigate the use of language as a semiotic tool in mathematics education (Heyd-Metzuyanim & Sfard, 2011; Gee, 2001). In this study, I explored subjectifying utterances in various ways that suggested many meanings to the similar utterances in different situations (eg. Use of the utterance, ok). In a way, such interpretations open more possibilities in the research world for investigating language as a semiotic tool in mathematics classrooms.
6.5 SUGGESTIONS & RECOMMENDATIONS

In my view, this study benefits the Lesotho teachers because listening to stories can help one to relate such stories with own experience. In light of the discussions (Chapter 5), I present a way forward that may help researchers to learn more about how BTs shape their professional identity in an expected manner in order to become mathematics teachers.

6.5.1 A way forward for research

On the basis of discussions and findings from this study, a number of questions arise that indicate the need for further research. Even though the biographic details of BTs were not the focus in this study, their life stories could have enhanced the study in order to understand why they practice certain lessons in a certain manner. Lasky (2005) found that teachers’ personal and cultural background have an impact on their career selection and further career development. In her words, teachers carry a dual responsibility:

One aspect was to teach the curriculum and academic skills. The other was to teach the whole child, to be an integral part of their safety net of support. Their feelings of job satisfaction came largely from their interactions with students and the feeling that they had some kind of positive influence on students’ academic, social, and emotional development (p. 906).

Graven (2003) in her study indicated that the key challenges in applying Wenger’s four components of learning as a frame for analysing teachers’ learning process (in shaping their identity) deals with communities of practice and traditional teaching. According to Graven (2003), Wenger undermines the values of teaching, and therefore she asks, what does it mean for a person to be a teacher? I find Wenger’s view mainly focused on learning, and therefore learning to become a teacher can thus create a strong sense of mathematics identity too for BTs.

One of the findings of this study was that BTs have a dream of being part of the teaching community. In order to become a mathematics teacher within this community, they engage in various activities that make sense as a learning process for them. Without disregarding teaching (classroom practice) a BT should be able to learn about the effectiveness of teaching. In this manner, Wenger’s concern on minimising teaching and maximising learning needs to be negotiated. From this study, I agree with Graven (2003) who suggested that “classroom practice, access to knowledge resources, access to community resources, confidence of others in teachers,
increased participation, effective factors and understanding one’s own limitation will build confidence and thus a teacher will become an experienced mathematics teacher” (p. 32). Within the Lesotho context, this suggests the need for frequent re-visiting of the skills BTs attain for classroom practices through in-service courses for them. Active participation in such activities can increase their alignment and engagement with other teaching communities. BTs’ confidence can thus grow. Further research can put more light on this matter as a way forward to this study.

Sfard and Prusak (2005) equate identity-building with storytelling. Consequently, BTs’ classroom practice and the interviews are the stories that they tell about themselves or about their students to the researcher (Ref: Chapter 5). In listening to the stories of Jack, Jim and Peter, probably the most prominent and critical element of their stories suggested that they have chosen this career not by chance but by choice. For instance, Jack in an interview confessed that he thought he was not going to make it (Ref: Jack Int 4.150). In his words; It seems I suffered a lot, so I don’t want my students to be part of that suffering (Jack Int 4.021). These utterances infer that he had chosen a career to change the young generation’s attitude and approach in life. He therefore found teaching as a calling. In order to achieve the objectives of classroom teaching Jim used to encourage his students to work together (Jim Int 3.083) because he believed in interaction (Jim Int 3.063). These are the various approaches that they followed which, in turn, also shaped their teacher identity. In this regard, my suggestion is to listen to BTs’ personal background to understand where they come from so that we also understand where they are going. Their personal history can thus resonate with the stories of other members that shape a new personal identity for them. Marsh (2002) agrees to this observation by suggesting that opportunities should be provided for BTs to examine their own personal biographies to scrutinize how they shape their “lived experience” (p. 346).

The challenges and concerns that Peter encountered in teaching were the negative attitude of students towards mathematics learning (Peter Int 1.088). He realised that he is not just a teacher but also a learner that gave insight into his philosophy as a mathematics teacher (Ref: FG Int 1.085). When these stories unfold, “the adherent of the narrative perspective is interested in the stories as such, accepting them for what they appear to be: words that are taken seriously and that shapes one’s actions” (Wenger, 1998, p. 21). Their stories therefore carry different levels of
learning that indicate a possible negotiation on minimising teaching for maximising learning (Wenger, 1998). This negotiation, in my view, empowered their identity (Learning as change). Clarke & Hollingsworth (2002) argue that this kind of investment in teacher preparation is teacher change. In their words; “Change as personal development – teachers seek to change in an attempt to improve their performance or develop additional skills or strategies” (p. 948). The attitudes of students and teachers towards learning and teaching mathematics in Lesotho require further research that may assist BTs to shape their teaching skills accordingly.

6.6 FUTURE RESEARCH OPPORTUNITIES
Professional identity discourse in Lesotho has great potential for research that presents a new world for researchers. There are many questions that deserve answers in the Lesotho context such as:

a. Due to the nature of narratives, teacher identity is ever evolving. Therefore detailed study is required to understand why teachers behave differently in the same situation (Sfard & Prusak, 2005b). This may assist them to change the perception of identity within the frame of professional identity. In the Lesotho context this could be relevant due to the peculiar topographical position of Lesotho that creates a different teaching and learning atmosphere in many schools (MoET, 2005). In my view, such limitations hinder BTs’ classroom practices.

b. Another concern that surfaced from this study was about the students’ approach towards learning mathematics that perhaps compromises their mathematics identity. This is due to inflexible learning according to Boaler (1998). An elaborated study could provide an insight into such issues. In this regard, Anderson (2007) observes: “Engaging in a particular mathematics learning environment aids students in their development of an identity as capable mathematics learners” (p. 8). As a result, these students not only learn mathematics concept and skills, but also discover something about themselves as learners (Anderson, 2007).
6.7 CHAPTER CONCLUSION

The intention of this study was to examine how BTs shape their professional identity during the first three years of their teaching. The focus of the study was their classroom practices. They have learned that the kinds of approaches that they adopted in classrooms will have an impact on students’ mathematics learning.

This study revealed the possible association of BTs’ active participation and practices in mathematics classrooms that changed their understanding of being a teacher (Teacher Identity). This was their learning experience that created new meanings for them which helped them in shaping their various identities that intertwined to become a single strand of professional identity. Within the classroom settings, BTs’ professional identity is thus understood as a process of learning and meaning formation. These are the two mutual activities that shape identity within the frame of individual and social settings. In this way, BTs’ ability to grow professionally is related to their professional identity.

Within the context of this study, by answering the research questions, the participants probably found the answers to the questions; ‘who they are’ through their classroom practices (identity as negotiated experience, as community membership and as learning trajectory – Section 2.4.1).

In this study, the narrative notion of identity assisted me to gain insight into the way BTs approached teaching mathematics. Consequently, I also observe that I contributed to add more depth to the wider literature on BTs professional identity. It also helped me to understand how they tried to develop substantial teaching approaches and practices. Their certain way of classroom practice thus could shape their professional identity. Subsequently, the ethnographic study and narrative approach assisted me ‘to tell their stories’ as they illustrated. By taking a close look at these narratives, other beginners, experienced teachers or readers may benefit from the way these BTs made sense of their classroom activities during their apprenticeship.
6.7.1 Specific contributions of this study

✓ This study was conducted in the Lesotho context, which was a different setting from the literature that was reviewed.

✓ The study provided specific insights into ways selected BTs in the Lesotho context shape their professional identity. In this regard, the study suggested that the shaping of a professional identity is a learning process that is manifested through teaching and participating in a school community.

✓ This study thus contributed towards understanding what it means to becoming a mathematics teacher.

6.7.2 Final remarks

I remind readers that in ethnographic study and narrative inquiry, conclusion is not necessarily made on the interpretations. Felix (2014) in this context observes that the fluid nature of the teacher’s professional identity is continuously shaped by their narratives. They change their practice accordingly. Analogous to the participants’ stories and narratives, I also feel that I have changed. The 5 year long journey gave me a new identity as a teacher and as a researcher. I am thus recognised as a teacher and a lifetime learner by my family, friends and colleagues. I realise that this is my new identity. In this manner, I realise that Jack, Jim and Peter also recognised their own identity through their experience in classrooms as mathematics teachers.

…………………………

We are shaped by our thoughts; we become what we think

(Buddha)
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## Appendices

### Appendix 1: Questionnaire distributed in 2011 during the pilot study

1. What kind of a person you are?
2. What kind of a mathematics teacher are you?
3. What kind of a mathematics teacher would you like to be?

### Appendix 2: Questionnaire distributed in 2012 at the beginning of the field work

1. What challenges and concerns did you encounter at your workplace as a **beginner mathematics teacher**, regarding:
   a. Your school community (management, administration and department).
   b. Your mathematics classroom.
   c. Curriculum offered at your school.

### Appendix 3: Questionnaire distributed in 2013 at the end of the field work

1. Who are you, who do you think you are?
2. Who are you, who do you want to be?
3. Who were you, before you started participating in this study?
4. Who are you, as seen by your students?
5. Who are you, the way you are seen by your peers in the mathematics department?

(Adopted from Brown & McNamara, 2011).

### Appendix 4: One to One interview questions after viewing the observed classroom teaching

1. How do you assess your teaching approach in mathematics classrooms?
2. What changes have you brought into the students’ approach towards mathematics learning through your classroom practices?
3. What changes have you brought to yourself through your teaching experience?
4. How did this study bring changes in your career?
5. What have you learned about yourself as a mathematics teacher from this study?
6. What have you learned about your professional practices and communities of practices? After watching these video recording of the classroom teaching, how do you reflect on your
7. a. How did the present mathematics classroom practice differ from the previous one?

   b. What difference will you bring to this approach if you have to repeat the activity for the same class?

8. According to you, what are the strengths and limitations of the approach you followed in the teaching/learning of mathematics?

9. How would you advocate for this approach among your peers in the mathematics department?

10. How do you interact with the members of the mathematics department at your workplace in order to tune your ability to engage in classroom practice?

11. Can you think of a mathematics lesson that you enjoyed or disliked, and elaborate on what made you feel that way?

12. What have you learned about you being a mathematics teacher during this one year period of teaching experience?

13. How would you critically reflect on your mathematics teaching experience for this year?

14. What changes have you brought in your beliefs and attitudes (as a beginner mathematics teacher) that might have an impact in your mathematics classroom practices?

(Adopted from Clarke & Hollingsworth, 2002)

**Appendix 5: Focus Group Interview (2012)**

1. As a mathematics teacher, what did you achieve in 2012? What were your shortcomings? How will you overcome these in 2013?

2. How do you **visualize** yourself as a mathematics teacher in coming years?
3. What changes would you like to bring in the life of your mathematics students?

4. a. What is your attitude and approach towards teaching mathematics?
   
   b. According to you, what values should teaching and learning of mathematics hold in schools?

5. How would you like your students to recognise (identify) you in your mathematics classroom?

6. What do you like to achieve (your vision and values) in your mathematics classroom?

7. Building an identity consists of negotiating the meanings of our experience. In this regard;
   
   a. What challenges have you experienced in the mathematics classrooms?
   
   b. What meaning have you negotiated from these (mathematics classroom) experiences?
   
   c. How do you build on the meanings (that you have negotiated) from such experiences?

8. With reference to the new policy of ‘localizing the curriculum’;
   
   a. What changes are you expecting in your career as a mathematics teacher in 2013?
   
   b. What changes are you anticipating in the mathematics classroom in 2013?

9. What is more important for you in your career?

10. What is your vision as a teacher?

**Appendix 6: Focus Group Interview (2013)**

1. Your teaching experience for the past two years:
   
   a. What changes have you brought to your school?
   
   b. What changes have you brought to mathematics department?
   
   c. What changes have you brought to your students?
   
   d. What changes have you brought to yourself through your own classroom practices?

2. Your role as a mathematics teacher:
   
   a. How do you interact with your peers in mathematics department at your school?
b. How does it help you to improve your teaching?

c. How do you see yourself in this department?

3. Reflecting on your experience:
   a. What have you learned from your teaching experience?
   b. How did it change your attitude and beliefs towards mathematics teaching?
   c. What are your memorable moments of being a beginner mathematics teacher?

4. What is your view on using prescribed text books as a resource in Mathematics classrooms?

5. What are your concerns on students’ learning approaches in classrooms?

6. Listening to your voice in relation to this study:
   a. How did the study benefit you?
   b. What have you learned about yourself as a mathematics teacher?
   c. What have you learned about your professional practices?
   d. What have you learned from being part of this study?
Appendix 7: Ethical consent from the Principal

18 February 2012

Mr. Ajayagosh Narayan
PO Box 434, Maseru 100, Lesotho.
Tel: (H) 266 22320138, Tel (W) 266 22331029 Cell: 63156513
Email: agnarayan@gmail.com

To
The Principal

Dear Sir/Madam

Re: PERMISSION TO OBSERVE A MATHEMATICS TEACHER IN CLASSROOM.

Hello, my name is Ajayagosh Narayanan. I am doing a research that needs observing a teacher from this school once or twice per term in a mathematics classroom. This research is for a PhD in Education at Rhodes University, Grahamstown.

This research investigates how beginner mathematics teachers in Lesotho shape their professional identity. I have identified this school as the participating school to do the research. The research includes observing a teacher while engaged in teaching mathematics. I will also be interviewing the teacher. Photos will also be taken during this session.

The responses from the teacher will be treated confidentially. Once the data collected has been used and presented in the research, the original transcripts in electronic form will be kept safely under my custody for a period of 5 years for any further reference if needed.

I also offer you the opportunity to read through the research once it has been completed. You are free to refuse to participate in this research. You may also withdraw from participation at any time. The teacher will also be free to refuse to participate in the research or to withdraw at any stage.

Yours faithfully
Ajayagosh Narayanan

PARTICIPANT RESPONSE:

I ............................................................................................................................have read the above form, understand its contents, and I consent this school to participate in the above research. I understand that participation is voluntary and that I may withdraw at any stage.

Signature of Principal.................................................................

Date .................................................................
Appendix 8: Ethical consent from the participant teacher

18 February 2012

Mr. Ajayagosh Narayanan
PO Box 434, Maseru 100, Lesotho.
Tel: (H) 266 22320138, Tel (W) 266 22331029 Cell: 63156513
E Mail: agnarayanan@gmail.com

To

The Mathematics Teacher

..............................................................

Dear Sir/Madam

Re: Request to participate in a research project by being observed by the researcher while teaching mathematics.

Hello, my name is Ajayagosh Narayanan. I am doing a research that needs observing a teacher from this school once or twice in a mathematics classroom. This research is for a PhD in Education at Rhodes University, Grahamstown.

This research investigates how beginner mathematics teachers in Lesotho shape their professional identity. I have identified this school as the participating school and you as a mathematics teacher to participate in this research. My comments will be recorded using a general format and will be presented to you for approval. The teaching activity will be photographed for future reference. I will also be interviewing you afterwards to find your ‘story’ as a teacher.

Your responses will be treated confidentially. Once the data collected has been used and presented in the research, the original transcripts in electronic form will be kept safely with me for a period of 5 years on a CD Rom.

I also offer you the opportunity to read through the research once it has been completed. You are free to refuse to participate in this research. You may also withdraw from participation at any time.

Yours faithfully

Ajayagosh Narayanan

PARTICIPANT RESPONSE:

I .............................................................. have read the above form, understand its contents, and I consent to participate in the above research. I understand that participation is voluntary and that I may withdraw at any stage.

Signature of Participant .................................... Date.............................................
Appendix 9: Ethical consent from the Ministry of Education and Training

THE KINGDOM OF LESOTHO
MINISTRY OF EDUCATION AND TRAINING

24th February 2012

Mr Ajayagosh Narayanan

Dear Sir

RE: PERMISSION TO CARRY OUT RESEARCH IN POST - PRIMARY SCHOOLS

The caption bears reference.

On behalf of the Chief Education Officer – Secondary, I am pleased to inform you that you have been granted permission to carry out your research in the indicated schools. The Ministry of Education and Training hopes that your interaction with these teachers will assist them to improve teaching and learning of Mathematics in secondary schools.

Wishing you the best in your endeavors.

Best Regards

Mpho Sekhosana-Nyenye
Inspector Science

MINISTRY OF EDUCATION
CENTRAL INSPECTORATE
2012 -02- 2 4
TEL: 22322816/22313628
P.O. BOX 47, MASERU 100

P.O. BOX 47 MASERU 100 LESOTHO TEL.: 0 (266) 22 312228 FAX 0266 22 312206