

**EXPLORING THE COLLABORATIVE LEARNING OF
SENIOR PHASE MATHEMATICS TEACHERS IN A 1+ 9
MATHEMATICS CLUSTER IN THE MAPHUMULO CIRCUIT**

BY

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for the Degree of Master of Education in Teacher Development Studies**

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DECLARATION

Submitted in partial fulfilment of the requirements for the degree of
Masters in Education, in the Graduate Programme in the College of Humanities,
University of KwaZulu-Natal, Pietermaritzburg, South Africa.

I, Zeblon Sylvester Mbatha, declare that

1. The research reported in this thesis, except where otherwise indicated, is my original research.
2. This thesis has not been submitted for any degree or examination at any other university.
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Name of Supervisor	Date	Signature

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Taking my background into consideration, little did I know that my passion for education was bringing me to a point where a university confers a master's degree on me. Furthermore, I want to thank the Almighty for this achievement for letting me sail through this academic qualification. It is my ardent hope that this achievement is a stepping stone for great things.

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DEDICATION

This study is dedicated to my lovely mother who has been so supportive and motivated me to climb the academic ladder. A further dedication also goes to my three daughters, Thandeka, Thembeke and Siphelele as well as my three sons, Thabani, Njabulo and Mthobisi. I love you all for always surrounding me whenever I need you. May this piece of academic work inspire you in your academic pursuit in the future. Another important dedication goes to my lovely brother and sister, Isaac Mbatha and Sindisiwe Mbatha who sadly joined the company of our ancestors in December 2014 and November 2017 respectively before the completion of this research. I would love to share with you that I am done with my master's degree. However, this did not happen. Your departure, however, strengthened me to complete this piece of academic work with the hope of dedicating it to you also. May your souls rest in peace, brother and sister.

ABSTRACT

Teacher learning and teacher development require that teachers work collaboratively in professional learning communities in order to enhance their classroom practices and expertise. However, different scholars argue whether professional learning communities can attempt to make a difference in an ever-changing school system or whether they hold promise for long term sustainable, system-wide teacher development and learner achievement. The objective of the Professional Learning Communities is to provide a supportive and engaging platform for the continuous learning and development of teachers and schools to enable better learning and achievement by learners.

This study explores how Senior Phase mathematics teachers learn collaboratively in a 1+9 mathematics cluster as a new approach for teacher learning and development in South Africa. The study also aimed to examine to what extent this 1+9 mathematics cluster served as an effective Professional Learning Community.

This study was located within the interpretive paradigm and a qualitative case study design was adopted. Semi-structured interviews and observations were used to generate data. Five participants were interviewed and five cluster meetings were observed. The study was conducted in Ilembe District at Maphumulo Circuit in KwaZulu-Natal.

The findings reveal that the main focus of this cluster is teacher collaboration and learning. A major activity of this cluster was the discussion of effective teaching strategies, content and sharing teaching methods. Teachers also discussed the sharing of teaching resources and ideas. The setting of common assessment tasks and lesson presentations were also activities that teachers engaged in. Different researchers concur on the following attributes of professional learning communities: shared vision, values and goals, collaborative learning, supportive conditions and a collective focus on student learning. The findings of this study show that the above attributes of effective Professional Learning Community were displayed by this 1+9 mathematics cluster.

Based on the above-mentioned findings, it is recommended that teachers build professional learning communities in their schools or with neighbouring schools and that teachers should

use Professional Learning Communities as platforms to discuss challenges related to teaching and learning. A further recommendation is that schools should have a School Development Team (SDT) that will focus on appraising and developing teachers on current teaching approaches.

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ABBREVIATION AND ACRONYMS

ACE – ADVANCE CERTIFICATE IN EDUCATION

ANA – ANNUAL NATIONAL ASSESSMENT

CAPS – CURRICULUM ASSESSMENT POLICY STATEMENT

CL- COLLABORATIVE LEARNING

DBE – DEPARTMENT OF BASIC EDUCATION

DHET – DEPARTMENT OF HIGHER EDUCATION AND TRAINING

DoE – DEPARTMENT OF EDUCATION

GET – GENERAL EDUCATION AND TRAINING

IDEAS – INNOVATIVE DESIGN FOR ENHANCING ACHIEVEMENT IN SCHOOLS

ISPFTED – INTEGRATED STRATEGIC PLANNING FRAMEWORK FOR TEACHER EDUCATION AND DEVELOPMENT

NPDE – NATIONAL PROFESSIONAL DIPLOMA IN EDUCATION

NSC – NATIONAL SENIOR CERTIFICATE

NSDC – NATIONAL STAFF DEVELOPMENT COUNCIL

PCK – PEDAGOGICAL CONTENT KNOWLEDGE

PD – PROFESSIONAL DEVELOPMENT

PGCE – POST –GRADUATE CERTIFICATE IN EDUCATION

PISA – PROGRAMME FOR INTERNATIONAL STUDENT ASSESSMENT

PLC – PROFESSIONAL LEARNING COMMUNITY

SDT – SCHOOL DEVELOPMENT TEAM

SMT – SCHOOL MANAGEMENT TEAM

TIMMS – THIRD INTERNATIONAL MATHS AND SCIENCE STUDY

UKZN – UNIVERSITY OF KWAZULU- NATAL

UNISA – UNIVERSITY OF SOUTH AFRICA

CHAPTER ONE

ORIENTATION AND BACKGROUND TO THE STUDY

1.1 Introduction

This study focuses on the collaborative learning of Senior Phase mathematics teachers and explores the development of a collaborative learning culture in the 1 + 9 mathematics cluster in the Maphumulo Circuit.

In this chapter, I outline an orientation to the study which encompasses the following aspects: the focus and the purpose of the study, the rationale and background, the critical research questions that underpin the study, a brief literature review and the conceptual framework. The chapter also outlines the methodological approach as well as an overview of the contents of each chapter in this dissertation. The chapter concludes with a brief summary.

Guskey (2010) points out that the collaborative learning of teachers is one of the main aspects of teacher professional development. Guskey (2010) also notes that collaborative learning is characterised by high quality professional development because of its central component for improving teachers' practices in teaching and learning. Furthermore, Guskey (2010) reiterates that professional platforms should be systemic and should bring about change in the classroom practices of teachers. This is in line with Evans (2002), who affirms that teachers should be responsible for their professional development and further contends that teacher professional development occurs when a teacher identifies weaknesses in his or her teaching practices. These assertions resonate with Day and Sachs (2004) who assert that teachers should be involved with these activities if they want to respond to changes in society and also keep up their commitment to enhance quality teaching.

These assertions have led to the formation of clusters where teachers belong to a particular Professional Learning Community (PLC) with the purpose of collaborative learning. The fundamental principle of the PLC is that schools cannot be an academic environment unless teachers are actively involved in learning, thinking, reading and conversing (Brodie & Borko, 2016). Therefore, PLCs seek to improve teachers' competence as professionals for learners' crucial attainment (Stoll et al., 2006). DuFour (2007) argues that schools make use of PLCs

to enhance teacher's capability to change their classroom practices and improve student outcomes. One of the key features that represents a core PLC principle is a culture of collaboration. Teachers who are involved with PLCs are aware that they must work collectively to attain their common purpose of learning for all (DuFour, 2007). This idea corresponds with Borko (2004) who acknowledges the significance of collaborative interaction amongst teachers to encourage teacher learning and development.

Harris (2004) posits that collaborative learning that occurs in clusters enables teachers to address their challenges effectively. This assertion underpins the objective of this study which explores the collaborative learning experiences of senior phase mathematics teachers.

1.2 Focus and purpose of the study

The focus and purpose of this study is to explore the collaborative learning of Senior Phase mathematics teachers in the 1 + 9 mathematics cluster in the Maphumulo Circuit. The study focuses on how teachers learn collaboratively in this cluster and the types of activities that they engage in as a professional learning community. It is hoped that this research study will encourage schools to establish PLCs so that collaborative learning occurs among teachers teaching the same subjects. Furthermore, this research aims to contribute to the current body of knowledge on the collaborative learning and professional development of teachers.

1.3 Rationale

DuFour (2007) contends that schools use professional learning communities to increase the capacity to transform and improve. According to Brodie and Borko (2016), PLCs intend to offer a supportive and engaging atmosphere for the continuing learning and development of teachers and schools to produce better learning and attainment by learners (Stoll et al., 2006). Having taught mathematics for more than fifteen years in the Senior Phase, I have observed that very few mathematics workshops have equipped teachers with the necessary knowledge and skills required to teach mathematics. The views of DuFour (2007) and Stoll et al. (2006) have stimulated my interest to examine how teachers learn collaboratively in a PLC as a cluster of professionals who share common goals and what teaching activities form part of their discussion when they meet as PLCs. Despite several intervention strategies that the Department of Education put in place such as Operation Dudula and Jika Imfundo, it is not evident whether these have been useful. This study should motivate and encourage senior

phase mathematics teachers to belong to and participate in PLCs to enhance their knowledge, skills and classroom practices.

Spaul's (2013) study on teacher professional development indicates that teachers lack the desired knowledge and skills in mathematics. Spaul (2013) also argue that teachers lack pedagogical content knowledge (PCK) in mathematics and these findings resonate with the results obtained by the Trends in Mathematics and Science Study (TIMSS) tests (Howie, 2001; Reddy, 2006) that learners performed very poorly in mathematics in South African schools. This poor performance becomes evident when one scrutinises the Annual National Assessment results particularly in the senior phase (DoE, 2014). Therefore, the rationale for this study is to explore collaborative learning in the 1+ 9 mathematics cluster as a PLC.

Based on the above assertions, Lieberman and Mace (2006) propose the formation of collaborative learning spaces for teachers' professional development. The literature suggests that a community of practice attempts to develop a collaborative work culture for teachers (Thompson, Gregg & Niska, 2004). This study will contribute towards this discourse by providing an insight into the ways in which teachers collaborate and learn within the PLC. This study will further assist the Teacher Professional Development Directorate within the Department of Education to focus on improving and supporting the collaborative culture of learning within PLCs.

1.4 Background

To engage in this study the researcher was motivated by the intervention strategy that the Department of Basic Education implemented. The intervention strategy is called the 1+ 9 mathematics model. This intervention strategy wanted senior phase mathematics teachers to attend cluster meeting once in two weeks. This meant that teachers were going to be teaching for 9 days in two weeks and then attend a mathematics cluster meeting for one day in two weeks. The rationale behind this strategy was that Senior Phase mathematics teachers should belong to a Professional Learning Community to discuss teaching methods, content challenges and share ideas. This is in line with Stoll, Bolam, McMahon, Wallace and Thomas (2011) who assert that the aim of the Professional Learning Communities is to provide supportive and engaging platforms for ongoing learning and development.

This resonates with Brodie (2013) who contends that the effectiveness of such professional Learning Communities is to support teacher collaboration in order to produce shared

understanding, and to focus on curriculum and instruction. Arguing along similar lines are Stoll and Louis (2008) who state that in Professional Learning Communities, teachers should critically interrogate their practice in ongoing, reflective and collaborative ways in order to enhance and promote student learning.

This study explores how senior phase mathematics teachers collaborate and learn within the 1 +9 Mathematics cluster in the Maphumulo Circuit. This study is located in the Ilembe District in the Maphumulo Circuit. The unit of analysis was the five teachers from five different secondary schools who were teaching mathematics in the Senior Phase. The 1+ 9 mathematics programme is an intervention strategy for the National Department of Education that seeks to assist and support Senior Phase mathematics teachers with the necessary knowledge and skills in mathematics. Teachers engage themselves in the discussion of the mathematics concepts and topics through collaborative learning which has some characteristics of a professional learning community. In this cluster, the sharing of knowledge and teaching strategies are the main features.

The concept 'Professional Learning Communities' (PLCs) will be used in this study as a lens to understand how teachers collaborate and learn in clusters. PLCs are thought to be a powerful plan for promoting the professional development of teachers (Stoll et al., 2006) and for improving teaching (Harris, 2011). One of the essential features of professional learning communities is to actively engage teachers in their own learning and development to increase their professional knowledge and enhance student learning (Harris, 2011). One of the elements of PLCs is collective learning which involves sharing information, looking for recent knowledge and skills and working together collaboratively (Hord, 2008). For this reason, this study aims to explore how Senior Phase mathematics teachers collaborate within the 1+ 9 mathematics cluster as a PLC.

Education reform and the implementation of the new curriculum expect teachers to re-professionalise themselves. It also requires teachers to re- skill themselves in their areas of practice. Darling-Hammond (2009) corroborates that teachers need knowledge about learning and teaching. This paradigm shift requires teachers to engage themselves in continuing professional development activities such as workshops in order to teach effectively in the classroom.

Despite numerous workshops that the Department of Education has offered for the teachers, mathematics teachers in particular still lack the necessary knowledge and skills to teach

mathematics. Recent studies such as the TIMMS study and ANA reports reveal that there was no positive impact on learner performance in mathematics, particularly in the Senior Phase. The deteriorating performance in mathematics in the Further Education and Training (FET) phase caused the Department of Education to introduce Annual National Assessment in the Foundation, Intermediate and Senior Phases as it was believed that very little attention was given to these phases. Darling-Hammond (1995, p. 1) asserts that “the vision of practice that underlies the nation’s improvement agenda requires most teachers to rethink their own practice, to construct new classroom roles and expectations about student outcomes, and to teach in ways they have never taught before”. Collaborative learning of teachers in clusters has been adopted as one of the intervention strategies to support teacher professional development (DoE, 2015). For this reason, this study examines the collaborative learning activities and discussion of teaching strategies in the PLC.

However, there are similar studies that have been conducted in the field of professional learning communities. For an example, Vescio, Ross and Adams (2007) conducted a review of research on the impact of professional learning communities on teaching practice and student learning. They found that well-developed PLCs have positive impact on both teaching and student achievement. Similarly, the research conducted by DuFour (2003) prompted many educators to explore the effectiveness of professional learning communities as a strategy to enhance student learning and achievement.

1.5 Research Questions

This study will address the following research questions:

1. How do Senior Phase mathematics teachers collaborate and learn in the 1 + 9 mathematics cluster?
2. To what extent is this 1 + 9 mathematics cluster an effective Professional Learning Community?

1.6 Brief review of related literature and conceptual framework

In chapter two, I present in detail the international and local literature related to the focus of this study. The literature review will deliberate on aspects of teacher professional development (Baunet & Kunter, 2006) and teacher learning (Kelly, 2006) and examine the

collaborative learning of teachers in Professional Learning Communities (Louis, 2002, Lassonde & Israel, 2010, Jansen, Cumnock & Conner, 2010 & Sackney, 2000). Furthermore, this literature review also deliberates on collaborative professional learning (Meirink; Verloop & Meijer, 2007 & Borko, 2000), features of effective PLCs (DuFour & Eaker, 2008) and professional learning communities and teaching practice (Vescio, Ross & Adams, 2008 & Buysse, Sparkman & Wesley, 2003).

The conceptual framework in this study draws on the concept of collaborative learning from Brodie's framework of collaborative learning (2013) and also the features of effective PLCs (Vescio et al. 2008). This conceptual framework will provide an insight about the social nature of collaborative learning and assist to analyse how teachers collaborate and learn in PLCs as well as characteristics of effective PLCs. I adopted this framework as a lens to understand teacher collaborative learning in the 1 + 9 mathematics cluster and the extent to which this cluster was an effective PLC.

1.7 Methodological approach

My study is located within the interpretive paradigm since I sought to explore the collaborative learning of mathematics teachers in the cluster within the Professional Learning Community (PLC). Burton, Brndrett and Jones (2008) describe the interpretive paradigm as involving insight, the deeper knowledge and understanding of human behaviour and relationship. To support this, Agger (2006, p. 30) concurs that "interpretive researchers seek to know the social action on the level of the meaning that people connect to it". Arguing along similar lines, Cohen, Manion and Morrison (2011) corroborate that the interpretive paradigm allows for the interpretation of the world from the participant's perspective. According to Creswell (2013) a qualitative approach is one in which the inquirer often makes knowledge claims based predominantly on constructivist perceptions, that is, the multiple meanings of individual experiences, meaning, socially and historically constructed. Maree (2011) concurs that qualitative researchers seek to understand the phenomenon through the meaning people give to them.

Having adopted the interpretive stance in this study, I have used the case study as a research design that illuminated the way in which my study was conducted. This is in line with Baxter and Jack (2008) who claim that rigorous case studies afford researchers opportunities to

explore or describe a phenomenon in context using a variety of data sources and justifies why I have used a case study in this research. In addition, Yin (2003), cited in Maree (2007, p. 5) defines a case study as “an empirical enquiry that investigates a contemporary phenomenon with a real life context”. Furthermore, Kothari (1990, p. 141) contends that “a case study deepens our perceptions and gives us a clear insight into life”. For the purpose of my study, the use of case study provides me with the chance to go deeper into the question of how Senior Phase mathematics teachers learn collaboratively in clusters and assists me to understand the behaviour and conduct of these teachers in PLCs. Yin (2003) maintains that the case study provides a holistic understanding of the phenomenon.

Semi-structured interviews and observations were used to collect data in this study. I used the semi-structured interviews since they would allow me to sit one-on-one with senior phase mathematics teachers and pose questions about their collaborative learning in the cluster. Semi-structured interviews allowed participants to tell their stories about their experiences and perceptions of collaborative learning within the Professional Learning Community (De Vos, Strydom, Fouche & Delport, 2005). I also used observations to generate data in this study. In support of this method Robson (2000) claims that during observations the researcher does not enquire about participant’s judgements, their feelings, or stance, they observe what they do and listen to what they say.

I purposively selected five senior phase mathematics teachers whom I believed had the relevant knowledge and experience to help to answer my research questions. These teachers are the holders of the data that is required for my study.

All semi-structured interviews were voice recorded and later transcribed, word for word. The transcripts were analysed using thematic analysis. According to Bogdan and Biklen (2005) qualitative data analysis means working with the data, organising them, breaking them into manageable units, coding them, synthesise them and looking for patterns. This process assisted me to determine what is significant and what is to be understood.

1.8 Overview of the Dissertation

This dissertation is comprised of five chapters. The section below gives an outline of each chapter.

Chapter One commences with the introduction, followed by a discussion of the focus and purpose of the study. Subsequent to this the rationale and the significance of this study are explained. This is followed by an outline of the background information and the critical questions that this study seeks to address as well as a brief outline of the literature review, conceptual framework and methodological approach of the study. The chapter concludes with an outline of the five chapters in this dissertation.

Chapter Two presents a comprehensive literature review on collaborative learning of teachers in Professional Learning Communities, professional teacher development and teacher learning. This chapter also provides a detailed account of the conceptual framework drawing on the concept of collaborative learning from Brodie's framework of collaborative learning as well as characteristics of the effective PLCs by DuFour (2007) and Hord (2004) that directed the analysis of data.

Chapter Three outlines a detailed description of the research design and methodology that was employed in this study. The data generation methods, namely, semi-structured interviews and observations, purposive sampling technique and issues of trustworthiness and ethics are discussed. Furthermore, this chapter explains how the data analysis was done.

Chapter Four presents the discussion of data that was collected. The data is presented using themes that came to light from the process of data analysis.

Chapter Five discusses the findings, conclusions and recommendations for further research based on the findings.

1.9 Summary

In this chapter, I commenced with an introduction of the study and also highlighted the focus and purpose of this study. I also outlined the significance and rationale for this study as well as briefly discussed the conceptual framework and methodological approach. To conclude, I presented an overview of the chapters in this dissertation. The following chapter presents a detailed account of the literature review and the conceptual framework of the study.

CHAPTER TWO

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1 Introduction

In chapter one I outlined the background, the rationale, the purpose and the key research questions that drive this study. This study aims to explore the collaborative learning of senior phase mathematics teachers in Professional Learning Communities. This chapter presents relevant national and international literature on collaborative learning of teachers in the Professional Learning Communities and explores the significance of teacher learning and professional development through collaborative professional learning,

This chapter commences with the explanation of the key concepts such as: teacher professional development, teacher learning, collaborative learning and, professional learning communities. Next, the features of effective professional learning communities are outlined. The chapter concludes with a description of Brodie's notion of professional learning communities and professional development which will be used as the conceptual framework in this study.

2.2 Outline of key concepts

This section outlines the key concepts of teacher professional development, teacher learning, collaborative learning and professional learning communities which are relevant to this study.

2.2.1 Teacher professional development

Different scholars define teacher professional development in different ways. O'Neill (1994, p. 285) conceptualises it as "an ongoing programme which focuses on a wide range of knowledge, skills and attitudes required to educate learners more effectively". This description resonates with Baumert and Kunter (2006) who describe teacher professional development as getting on board with formal and informal learning opportunities that strengthen and expand teachers' professional competence, including, knowledge, commitment and expertise. In the same vein, Bolam (2005) reveals that professional

development (PD) is an ongoing process of education, training, learning, skills development, obtaining of new knowledge and support activities. Similarly, Kennedy (2016) contends that teacher professional development programmes raise a lot of related questions about the kind of PD activities that lead to teacher learning and about the effectiveness of learning in the context, such as workshops.

A significant part in every contemporary proposal for school education is the high quality development of teachers. Policy-developers and implementers acknowledge that schools cannot be better than the teachers and managers who function within them (Guskey, 2002). Despite the differences in content and arrangement that exist in professional development programmes, many of them share the same rationale: to transform the professional practices, beliefs and understanding of school people towards a communicative end. Kennedy (2016) broadly acknowledges the assumption that professional development (PD) can cultivate improvements in teaching. She emphasises that PD is mandatory by almost every teaching contract in the country and teachers' participation is essential in every year. Given the South African performance in mathematics in particular, PD for teachers is envisaged to be the significant element of policies in order to raise the quality of teaching and learning in schools. As a result, there is increased concern in research that highlights characteristics of efficient professional learning (Ingvarson, Meiers & Beavis, 2005). Guskey (2010) asserts that professional development programmes should be systematic so that they bring about changes in the classroom practices. Guskey (2010) further posits that professional programmes should lead to a change of attitudes and beliefs and should have a positive influence on learner achievements. The assumption is that professional development leads to teacher change, particularly in subject content knowledge (Guskey, 2010). However, teachers should make every effort to develop their own practice from knowledge that they have attained (Evans, 2002). This requires the full participation of each teacher who is self-motivated and enthused to be developed. According to Evans (2002), teacher development happens when teachers are able to identify their deficit in their classroom practice.

Knight (2002) contends that professional development programmes are essential because institutions of higher learning could not offer all of the propositional knowledge that is necessary. In order to be up to date with the ever- changing curriculum, it is of paramount importance that teachers engage themselves in ongoing professional development especially in mathematics that has been identified as one of the subjects that pose a challenge to most of the learners and teachers. Stuart, Akyeampong and Croft (2009) argue that quality teaching

and learning demands that mathematics teachers have both procedural and propositional knowledge.

Desimone (2009) accentuates that professional development is the most critical strategy to bring about change in teaching and learning and leads to improved learner performance. Hawley and Valli (1999), Kennedy (1998) and Wilson and Berne's (1999) contend that professional development is crucial to enhance teachers knowledge and skills, improve teachers' practice and to lead to learner attainment. It should have the following characteristics: focus on content, active learning, coherence, time and collective effort. Guskey (2010) also identifies the above features as significant components of effective professional development.

On the other hand Knight (2002) advises those responsible for professional development to make the learning message known and create space for learning activities. He further adds that the heads of department should take a leading role, evaluate learning and make it clear what subject teaching is for. Garet, Porter, Andrew and Desimone (2001) stress that teachers require time to develop, take up, discuss, and practice new skills. They argue that short and random activities do not support teacher professional development.

Darling – Hammond and Richardson (2009) argue that the focus of professional development can distinguish between increasing and improving teachers' competence and providing opportunities for teachers to talk. Darling-Hammond and McLaughlin (2009) contend that the most valuable professional development puts emphasis on active learning, evaluation, examination and reflection rather than theoretical discussion.

Professional development that pays attention to student learning and supports teachers to acquire and develop their pedagogical skills to teach particular types of content professional development is crucial to enhance teachers' knowledge and skills, to improve teachers' practice and to lead to learner attainment. It should have the following characteristics: focus on content, active learning, coherence, time and collective efforts. Guskey (2010) also identified the above features as significant components of effective professional development. has a vigorous outcome on practice (Blank, de las Alas & Smith, 2007; Wenglinsky, 2000). Guskey and Yoon (2009) reiterate that effective professional development demands adequate time, which must be well planned and purposefully focused on content or methodology. Shulman (2004) indicates that professional development should

seek to improve and enhance teachers' content knowledge and pedagogical content knowledge.

This corresponds with Darling-Hammond (2009) who adds that professional development becomes successful when the approach of the schools is not separated, as in the traditional one-short course, but should be a consistent programme of a school improvement plan. Studies conducted on successful professional development also highlighted that a collective and collegial learning context assists to create communities of practice that can promote school transformation and improve individual classroom practices. In my view there is still a challenge in professional development of teachers in South Africa. This is evident when analysing the performance of South African learners in Mathematics in the Trends in International Mathematics and Sciences Study (TIMSS) that shows a decline in learner attainment. In the same vein, Ono and Ferreira (2010) argue that inadequate teacher professional development in South Africa impacts adversely on teaching and learning particularly in mathematics and sciences. These scholars argue that professional development should not be offered through once-off workshops, seminars or courses since these activities have been condemned as being scrappy, short and inconsistent.

In South Africa, professional development has been delivered through cascade training. Ono and Ferreira (2010, p.61) describe cascade training as "training-the-trainer". They contend that crucial information may be interpreted wrongly if transmitted through cascade training. They further argue that this type of professional development (PD) saves funds because trainers subsequently train others. Borko (2004) recommends that professional development designers work together with researchers in drawing up the programmes for teacher development. Haqq (1995) highlights a set of features for PD to be successful and effective: PD should be continuous, training should form part of PD, practice and feedback is essential, PD should be located in schools and focus on teachers' daily practice, offer teachers opportunities to work together and share ideas, provide enough time and reflection. PD organisers should take note of the words of Marike and De Witt (2007) who quote the thoughtful words of Confucius who asserts that "*I hear I forget, I see I remember, I do and I understand*". Besides paying attention to these features, professional development activities should also take into consideration other factors.

According to O' Brian (2004) professional development programmes should consider aspects such as the phase each teacher is in in their teaching career, the qualification of the teacher,

and the current knowledge and skills of each teacher, which may influence professional development programmes. Similarly, Henze, van Driel and Verloop (2009) argue that teachers acquire knowledge in a variety of ways; hence PD organisers should take this into account and avoid using one model of professional development of teachers. Teacher development becomes productive and yields positive results when teachers participate in the programme and decide on what to learn and the kind of the learning activities provided. In the context of the educational arena, it is argued that teachers should decide on the form and course of their own development.

2.2.2 Teacher learning

Kelly (2006) describes teacher learning as the process whereby teachers move towards the know-how. This description is in line with Evans (2002) who describes teacher learning as the kind of learning which changes the individual's knowledge and skills. In the same vein, Fraser, Kennedy, Reid and McKinney (2007) assert that teacher learning represents the practice that, whether intuitive or intentional, individual or social, leads to particular changes in teachers' professional knowledge, skills, way of thinking, beliefs or actions.

Scholars highlight that teachers learn in many diverse ways. The opportunities that teachers learn from may be separated as either formal or non-formal and prepared or unprepared. Kelly (2006, p. 514) describes teacher learning as "the process by which novice teachers move towards expertise, and a distinction is made between teacher knowing and teachers' identity." Kelly (2006) views teacher knowing as the knowledge in practice which means the knowledge obtained from teaching experiences and knowledge of practice which encompasses the knowledge of pedagogical methods, that is, how to teach a particular concept. On the other hand, he stresses that teacher identity refers to the character of teachers and emphasises that a teacher's 'individuality always changes.

There are two key theories to teacher learning: the cognitive approach and the socio-cultural approach (Kelly, 2006). The cognitive approach outlines that knowledge and skills can be obtained in one context and then applied in another context. This approach highlights many once-off professional activities. Conversely, a socio-cultural approach contends that teacher learning is collaborative and discursive and should be situated in the working environment. However, Erant (2007) argues that these two approaches balance each other. Similarly, situative theorists believe that learning occurs in an array of

different contexts since learning includes a process of individual construction and a process of learning which takes place during social practices (Borko, 2004).

Schoenfeld (2006, p. 6) maintains that “one has learned when one has developed new understanding of capacity” Therefore, personal and professional change are the most significant features of teacher learning. Kwakman (2003) asserts that learning is required for teachers to develop professionally.

A literature study conducted by scholars on teachers’ beliefs about mathematics in the field of learners learning, classroom teaching, and the nature of mathematics, highlight that there are three common belief structures about the nature of mathematics, namely, problem solving, Platonist and instrumentalist. Brady (2011); Sherman (1995); Swam (2006); Turner, Warzon and Christensen (2011); and Wilkins (2008) contend that these multiple beliefs structures, combined with other factors, dictate how teachers choose to cascade mathematics instruction in their classroom. Similarly, Gabriele and Joram (2007); Prawal and Jennings (1997); and Stipek, Givvin, Salmon and MacGyvers (2011) concur that teachers’ beliefs have a strong influence on teachers taking up new instructional practices and the depth of their enactment. In addition, Staub and Stern (2002) suggest that the influence of teachers’ beliefs on teaching practice also affects student learning and achievement outcome.

Gordon and Wells (2000) add that learning is the change which continually takes place in the character of an individual and his or her involvement in collective activities with others. Fraser et al. (2007, p. 157) suggest that “teacher professional learning can be viewed as the practice that leads to precise changes in the professional knowledge, skills, attitudes, beliefs or action of teachers”. The formal platforms where teachers may learn are those that are clearly constituted by an agent other than the teacher. Informal opportunities are established through networking. Fraser et al. (2007, p. 161) contend that “Teacher learning could also be planned or incidental or unpredictable”.

Knight (2002) asserts that it is crucial to promote informal communications, companionship and non-formal learning opportunities where unexpected, unintentional and valuable leaning can occur. In Becher’s (1999) viewpoint, some professional non-formal learning is much more significant than formal learning. Similarly, Kelly (2006) suggests that teachers should take part in the process of teaching experiences so that they contribute fully in their day-to -day classroom practices and improve ways in which they

convey knowledge to the learners. He further argues that this process encompasses the development of situated teacher identities which translate to teachers' personality and disposition. Fraser (2007) and Evans (2002) maintain that teacher learning brings about change in teachers.

Correspondingly Wilson and Demetriou (2007) corroborate that both formal and informal learning is essential and plays a vital role in teachers' professional growth and development. Illeris (2009) posits that learning involves two processes, namely, external interaction process and an internal psychological process of explanation and achievement. He emphasises that for learning to take place, the two processes must work collaboratively.

Borko (2004) contends that the concept of teacher learning can only be understood by looking at it in various contexts and by taking into cognisance the type of professional learning that teachers undertake as learners themselves and as part of a social system such as a learning community. In the same vein, Lieberman (1996) argues that continuing professional development (CPD) can be located in three contexts: direct learning workshops, in-service learning such as mentoring and learning out of school for example, and networking. Day and Sachs (2004) add that teachers should be involved with all of these activities if they want to respond to changes in society and also maintain their commitment to enhance quality teaching and learning.

Darling-Hammond (2009) conducted a study on what teachers are required to know to teach all students according to the acceptable standards. She reveals that teachers need a deep and a flexible subject matter, in order to help students create helpful cognitive maps, connect ideas to one another and attend to misunderstanding. Darling-Hammond (2009) further suggests that teachers should know how to connect ideas across the subject areas and to everyday life. Shulman (2004) contends that this kind of understanding offers a foundation of pedagogical content knowledge, which assists teachers to convey views to others. Darling-Hammond (2009) emphasises that teachers require several kinds of learning: learning to select which kinds of learning are most suitable in different contexts, and apply different techniques to achieve various objectives and a range of ways to assess students' knowledge and approaches to learning. Finally, teachers are required to analyze and reflect on their practice (Darling- Hammond, 2009). These findings seem to suggest

that teachers should be life-long learners and be self-motivated to learn new teaching strategies.

A qualitative study conducted by Prammoney (2011) focuses on the ways teachers learn informally, and stresses the importance of the informal learning practices of teachers. The main findings of the study is the application of Reid's quadrants of teacher learning theory and it provides the foundation for understanding the informal learning practices that teachers are involved in. Furthermore, Meirink, Meijer and Verloop (2007) assert that learning is enhancing when it takes place through collaborative learning. These scholars were examining the learning activities that teachers engage in, in a collaborative context and how these learning opportunities influence teachers' beliefs and behaviour.

According to Illeris (2009), the core principle of learning should involve three dimensions. Firstly, the content dimension which is about what is learned. Illeris (2009) describes this dimension as knowledge and skills, which also include opinions, meaning, attitudes, values behaviour, methods and techniques. According to Illeris (2009) all these aspects are involved as learning content and add to developing the understanding and the capability of the learner. The second sphere is the incentive dimension which gives and directs the mental energy that is critical for the learning process to occur. This dimension encompasses elements as feelings, emotions, motivation and will. The main function of this dimension is to provide security to the continuous mental balance of the learner and the also develops a personal compassion. The third sphere is the interaction dimension which gives the desire that instigates the learning process. According to Illeris (2009) this may include the perception, experience, imitation, activity and participation. This dimension provides the personal relations in communities and society and also develops the sociality of the learner.

Beckett and Hager (2002) concur with Illeris (2002) that learning is primarily situated within the individual but that the individual and his or her learning are inherently determined by the situation in which they work and learn intentionally and unintentionally. Drawing from Illeris (2009) structure of learning theory, all learning requires the combination of two distinct processes, namely an external interaction process between the learner and his or her socio-cultural environment, and an internal psychology process of elaboration and acquisition. Illeris (2009) contends that for learning to occur both of these processes must be actively involved.

2.2.3 Collaborative professional learning

Collaborative learning can be explained as on-site learning which offers valuable professional development (Lassonde & Israel, 2010). These scholars contend that collaboration assists teachers in overcoming the challenges that they encounter in their day to day teaching practice. However, Dillenbourg (1999) contends that learning does not always happen in collaborative interactions.

Spark (1998) contends that as schools work hard to improve their academic performance, many of them use collaborative professional learning to improve learners' attainment. He further asserts that collaborative learning is a kind of professional development in which teachers work together to develop their knowledge and skills. It is through the reciprocal actions of the individuals in a collaborative team that teachers can "become aware of or question their own (tacit) beliefs and understandings" (Meirink; Meijer & Verloop, 2007, p. 147). This resonates with Putman and Borko (2000) who further suggest that learning as a team is enhanced when people with different ideas, conceptions and opinions work collectively. In this form of professional development, teachers share ideas, materials and expertise that aim to improve learners' achievement. Collaborative professional learning engages teachers in clusters that operate together to improve classroom practices. In these clusters, teachers work towards common objectives and vision. This teacher collaboration leads to collective effectiveness whereby teachers believe that they can contribute positively to the instructional practices and learners' achieving together (Williams, 2010).

Schmoker (2005, p. 137) asserts that "collaborative professional learning is the best, least expensive, most professionally rewarding way to improve schools". It is the way in which teachers work collectively to attend to the problems and challenges that cause learning difficulties and hinder learner progress. This includes creating and discussing assessment techniques and drawing up turnaround strategies for effective teaching and learning. The ultimate focus is on student learning and improvement of performance. According to Spark (1998) collaborative professional learning demands that teachers meet regularly within their schools, clusters or circuits to make meaning of the knowledge, share knowledge and disseminate knowledge about teaching and learning throughout the schools or cluster.

Newmann and Wehlage (1995) corroborate that common vision, regular instructions about learning aims and strategies, and shared responsibility, increase teacher effectiveness. They

contend that collaborative activity enhances teachers' practical competence and shared responsibility. Furthermore, Newmann and Wehlage (1995, p.31) assert that "When teachers collaborate productively, they participate in reflective dialogue to learn more about professional issues, they observe and react to one another's teaching, curriculum and assessment practices, and they engage in joint planning and curriculum development".

According to the research conducted by Hord (2004, p. 7) on collaborative professional learning, five themes emerged that are regarded as critical features for collaborative learning of teachers in clusters: "shared values and vision, collective learning and application of learning, supportive conditions and shared practice".

Harris (2004) affirms that when teachers learn collaboratively in communities of practice, they have the ability to produce the required solutions to their classroom challenges. This view stresses the demand for teachers across all subjects to work together if they want to enhance their classroom practice. A collaborative effort is crucial in bringing about change in both teaching practices and learner performance (Greenlee, 2002). Meirink (2010) claims that collaboration is mutually dependent and its most important goals are advancement and professional development of teachers' competence and learners' achievement which I believe are the central components of teaching and learning.

Ainscow, Muijs and West (2010) suggest that schools should make use of collaboration as an approach to support those schools which are facing difficulties and challenges in academic performance. In a similar vein, they put forward that teachers and schools in a collaborative atmosphere obtain skills that they would not have obtained in isolation which assists to capacitate and strengthen teachers to act in response to learner different abilities.

Dooner, Mandzuk and Clifton (2007) advise that teachers should welcome the necessities innate in the collaborative process, however, it must be noted that teachers come with their own beliefs of team work. Therefore, it is imperative that they outline each other's activities so that they connect together to develop a collective practice. Out of expediency, teachers organize their actions to attain the same vision that, in time, direct expected contributed actions (Weick, 1995). The team collectively share history and culture (Selznick, 1992) which eventually offer the strength and certainty that are significant for sound collaborative work to take place (Weick, 1995). Dooner et al. (2007) argue that a lot needs to be done to change the team of individuals into a learning community. Scholars such as DuFour (2004), Rismark and Solvberg (2011), Horn and Little (2009) and Thompson Gregg and Niska (2004)

highlight that collaborative learning occurs effectively in professional learning communities (PLCs).

Fullan (2007) advocates that teacher learning should be collaborative. This means that teachers need to belong to a particular learning group or community in order share their ideas, knowledge and skills which consequently should enhance learner achievement. Goodnough (2005) highlights that the main aim of forming and sustaining collaborative partnership is known. Goodnough (2005) further argues that the challenge lies with how to create and sustain collaborative partnerships. However, Fullan (2005) accentuates the significance of collaboration as a way of improving continuous teacher learning.

The study conducted by the National Staff Development Council in Nations demonstrated high performance on the Programme for International Student Assessment (PISA) and the Third International Math and Science Study (TIMSS) (Wei, 2009). The National Staff Development Council further recognises that the professional development chances given for teachers in nations with high student assessment, results in high student performance (Wei, 2009). The study also reveals the following strategies that are prevalent for these nations: “duration for professional learning and collaboration are included in teachers working hours, continuous professional development is contextualised and focuses on the content, wide range of opportunities for both formal and informal in-service development and school governance programmes that include new teachers when making decisions about curriculum, assessment and professional development” (Wei, 2007, p.44).

Arguing along similar lines is Williams (2010) who asserts that collaboration, as a form of professional development, assists to create a culture of learning for the teachers. Correspondingly, Rosenholz (1989), in a study of 78 schools, found that schools that were successful were having a shared purpose and focus, teacher collaboration and teacher efficiency. Hatch (2007, p. 350) asserts that “collaboration brings teachers together to assess their students understanding; design; plan and implement new instructional practices; and reflect on their own teaching”. Likewise, Wei (2007) affirms that in the collaboration context, teachers must look at their own practices and their students’ work. Through collaboration, teachers become aware of their own beliefs (tacit), practical knowledge and understanding (Meirink et al., 2007). Putman and Borko (2000) further maintain that team learning is increased when individuals with different views and thoughts work together. The main outcome of teacher in this mathematics cluster put forward is collective efficacy, whereby

teachers maintain the belief they can have a positive influence on instructional practices and student achievement as a team.

Collaborative learning is the move towards learning that involves groups of teachers working together to discuss teaching and learning challenges and problems or come up with new teaching approaches. Smith and McGregor (1992) argue that collaborative learning is underpinned by the following assumptions: learning is a societal activity, learning is an active process, teachers benefit from each other's knowledge and opinions, and communication and active engagement promote learning and learning takes place when teachers critically meditate on their own knowledge and skills. On the other hand, Dillenbourg (1999) claims that collaborative learning is a challenging concept that is difficult to describe. He adds that collaborative learning happens in a setting where at least two people learn or make an attempt to learn together.

Johnson, Johnson and Stanne (2000), Kagan (1994) and Slavin (1995) argue that although collaborative learning differs in different contexts, there are three common aspects which are characteristic of most collaborative learning. The first aspect comprises positive interdependence, which means that each group member accepts that they are part of the group and are accountable to each member for learning the information. They add that positive interdependence is refined when individuals share the same purpose and rely on each other for help and motivation. The second aspect they mention is individual and group accountability which outlines that each member is held responsible for his or her part of work and admits that each member is responsible to the group. They conclude that supporting, assisting, and working as a team by means of group communication is the third area of collaborative learning.

Since this study focuses on and aims to examine collaborative learning of the senior phase mathematics teachers who engage in the 1+9 Mathematics cluster as a PLC, this discussion on collaborative learning is of utmost importance and relevance to this study.

2.2.4 Professional Learning Communities

Jansen, Cumnock and Conner (2010) define the concept Professional Learning Communities (PLCs) as the organisations of motivated people sharing learning, vision and new methods and approaches that will enhance the opportunities for learners' learning. Louis (2002) asserts

that professional learning communities describe collective people sharing and critically questioning their practice on a continuous basis.

Teachers strongly argue that professional learning communities provide a significant and different type of professional development because they are established within the school districts educational policies and the actual contexts of schools and the teachers located in schools. From this perspective, McLaughlin and Telbert (2006) contend that professional learning communities can interpret knowledge from the district into an understanding of a particular school's daily practice. In the same vein, Jessle (2007) concurs that developing a professional learning community is one of the key influential strategies to improve learner performance. DuFour, Eaker and Many (2006) argue that PLCs should be described as a process rather than as a weekly meeting. On the other hand, Hord (2004) contends that PLCs are platforms where teachers and managers meet in order to constantly look for and share personal practices and learning, then respond to their learning with the aim of enhancing their efficacy as professionals to benefit their students.

Similarly, DuFour (2007) asserts that schools use professional learning communities to increase the capability to change and improve learner achievement as well as classroom practice. He claims that an increasing number of schools have put into operation professional learning communities as a strategy for ensuring sustainable change that improves quality teaching and learning. McLaughlin and Talbert (2006, p. 3-4) describe professional learning communities as "organisational structures in which teachers work collaboratively to reflect on their practice, examine evidence about the relationship between practice and student outcomes, and make changes that improve teaching and learning for the particular students in their classes". The 1 + 9 mathematics intervention programme that my study focuses on is a professional development programme that involves senior phase mathematics teachers participating in a professional learning community where teachers join forces and engage with mathematics concepts and challenges experienced with different mathematics topics and work collectively to make sense of the misconceptions that learners have.

The international literature affirms that PLCs intend to offer supportive and conducive environments for the continuing of learning and development of teachers to ensure a better learning and attainment of learners (Stoll et al., 2006). Similarly, Curry (2008) contends that PLCs intend to increase teacher efficacy as professionals for the benefit of learners. It is widely acknowledged that PLCs can enhance and improve teaching practice and learner

performance (Bolan et al., 2005; Horn, 2005; Katz & Earl, 2010; Louis & Marks, 1998; MacLaughlin & Talbert, 2000; Slavit et al., 2009; & Stoll & Louis, 2008).

The Integrated Strategic Planning Framework for Teacher Education and Development in South Africa 2011- 2025 (ISPFTED) outlines suggestions to establish and support teachers' developmental requirements, and PLCs are one critical aspect of the plan. In addition, the document draws attention to the significance of the establishment of PLCs (DBE & DHET, 2011). This document further highlights that the main objectives of the PLCs are to analyse the results of systemic assessments such as the Annual National Assessment (ANA) and National Senior Certificate (NSC); to develop an understanding of the Curriculum Assessment Policy Statements; to learn how to explain and utilise the curriculum support materials; and to work as a team to learn from technological devices such as video recordings of teaching and other learning resources (DBE & DHET, 2011).

Drawing from this document, the ISPFTED locates teachers as professionals and views PLCs as a means for teachers' professional learning. The underlying premises of the PLCs are that teachers should take control of their own development; each teacher should be able to identify his or her weaknesses and utilise the learning opportunities available within the PLCs to respond to their challenges; and PLCs should assist and support teachers to incorporate their own professional knowledge with recent research-based knowledge about content and practice (DBE & DHET, 2011).

Rentfro (2007) argues that the PLC strategy provides schools with a framework to develop teacher capacity to operate as members of high-achieving, collaborative teams that pay attention to improving student learning. Earker, DuFour and DuFour (2007) suggest PLCs should be structured according to these three principles: firstly, PLCs assume that the main mission of prescribed education does not only ascertain that students are taught but also ensure that students learn. Secondly, there should be a culture of collaboration with educators who participate in a PLC knowing that working hard collectively assists them to accomplish their main purpose of learning for all, and therefore, they should build frameworks to enhance a collaborative culture. Thirdly, PLCs should evaluate their effectiveness on the basis of students' performance and focus on results. DuFour, DuFour, Earker and Karhanek (2004) contend that schools should develop a shared mission, vision, values and goals; collaborative teams that operate interdependently to accomplish common goals; and a focus on outcomes as proved by commitment to on-going improvement. They assert that schools that operate in

this way have a clear purpose and a collaborative culture, are action oriented and dedicated to on-going advancement, and have a strong leader who supports teachers to be future leaders. Rentfro (2007) affirms that in PLCs, teachers engage in activities such as writing common assessments, planning curriculums, sharing teaching duties and working together to identify at-risk learners, and trying to respond to each learner.

DuFour, Eaker and DuFour (2005) corroborate with DuFour and Marzano (2011) that student success can be enhanced through teacher professional development programmes, mainly professional learning communities. They believe that improving student success should be a collaborative attempt of all staff of each institution, contrary to the notion of teacher isolation. These scholars envisage the reflection of “a group of teachers who meet regularly to share, refine and assess the impact of lessons and strategies continuously to help increasing numbers of students learn at higher levels” (DuFour et al., 2005, p. xiv).

Hellner (2008) asserts that teacher learning and professional growth for individual teachers no longer maintain standards for teacher change. Hellner (2008) argues that to improve and stay effective, teachers are required to take charge of the external transformation and not be guarded by it. He adds that doing so requires that teachers work together in teams, collectively. Based on the above arguments Stoll et al. (2011) bring to light that in the education sector, the PLC offers a pathway to a learning team: one which encapsulates collective people who are engaged in an active, reflective, collective learning-oriented, and growth- promoting strategy towards the challenges, problems and obstacles of teaching and learning (Stoll, et al, 2011).

DuFour, Eaker and DuFour (2005) affirm that the implementation of PLCs is of paramount importance, affordable and a valuable way of improving and developing teachers and schools. They accentuate that it is crucial to place teaching and learning in the middle of professional learning communities of teachers because this produces positive results in a school.

2. 3 Features of effective PLCs

DuFour, DuFour and Eaker (2008, pp. 15- 17) outline the following six features of effective PLCs: “shared mission, vision, values, and goals focusing on learning, a collaborative culture with a focus on learning, collective inquiry into best practice and current reality, action

orientation: learning by doing, a commitment to continuous improvement, and results oriented". This also resonates with DuFour and Marzano (2011) who explains that through PLCs, teachers form collaborative teams in which the members function co-dependently to accomplish common objectives for which they are equally accountable.

Similarly, Senge (1990) indicates that there is no learning organisation without a shared vision. This view is echoed by DuFour and Eaker (1998) and Senge (1990) who adds that when collaborative team members share a common vision, beliefs, and values, these attributes carry more weight than a mission statement that team members seek to accomplish. They further contend that offering the PLC a vision statement emphatically does not offer the drive to keep the PLC moving forward in accomplishing its objectives. Pankanke and Moller (2007) add that a vision that takes into consideration student learning, has been regarded as the trait of a real professional learning community.

Similar studies conducted by Newmann (1991, 1994, 1996) and Kruse and Louis (1995) correspond with this study. These scholars classify learning communities as an important component of schools aiming to improve the classroom practices and students' academic performance. This resonates with Newmann (1996) who highlights the conditions that encouraged the development of learning communities which include among others the following: the shared governance that enhances teachers authority above school policy and practice; co-dependent work structure, teacher groups that support working together; staff development that increases practical skills in line with the mission of the school; deregulation that offers independence for the school to put into practice a vision of high educational principles; and parent participation in a wide range of school relationships. This corresponds with Kruse and Louis (1995) who point to reflective dialogue, deprivatization of practice, a collective focus on student learning, collaboration, and values and norms that are distributed as the features required for an effective professional learning community. Therefore, it is clearly evident that collaboration is the central feature of teacher professional learning within the professional learning communities that requires teachers to make goals, approaches, materials, questions, challenges and outcomes known (DuFour, 2007).

Further studies around the effectiveness of professional learning communities have also shown that shared vision for teaching and learning, shared and supportive leadership, collective learning and application to practice, shared personal practice and supportive conditions that include both relationships and structures contribute tremendously to the

effectiveness of the PLCs (Hord, 2008). In similar vein, Andrew and Lewis (2007) contend that having a shared vision and common values and a sense of purpose has been found to be crucial in sustaining PLCs. A shared value base ensures a framework for a shared, collective, ethical decision making (Hord, 2004). Hord (2004) suggests that PLCs have a collective responsibility and members are equally accountable. Newmann and Wehlage (1995) claim that collective responsibility assists to maintain commitment and answerability and puts pressure on those who do not participate fully.

Louis (1995) argues that reflective professional inquiry is a key attribute of PLCs. He contends that regular investigating of what teachers do in the classroom, by means of physical inspection, mutual planning and curriculum development are equally important. In the same way, Hargreaves (2003, p. 163) notes that “professional learning communities

demand that teachers develop grown up norms in a grown up profession - where different debate and disagreement are viewed as the foundation stones of improvement”. Arguing along similar lines is Louis (1995) who maintains that cooperative learning is also observable through collective knowledge structure where the PLCs interact, participate in serious discussion and reproduce information and understanding.

2.4 Professional learning communities and teaching practice

The motivation for PLCs is based on the principle that they improve student learning performance by improving teacher knowledge and teaching practices (Vescio, Ross & Adams, 2008). Buysse, Sparkman and Wesley (2003) suggest that knowledge is located in the lived experiences of teachers and is best realized through critical reflection with others who share common experiences. This suggests that teachers in PLCs share their classroom challenges, capabilities, skills and knowledge. They do this by supporting each other and sharing lesson plans and assessment tasks. Furthermore, Buysse, Sparkman and Wesley (2003) affirm that actively involving teachers in PLCs will advance their professional knowledge that results in improved learner achievement.

Collaborative professional learning is highlighted as one of the most important characteristics of professional learning communities. Furthermore, the expectation is that PLCs should promote teaching practice, collaborative learning and professional development of teachers. The ultimate objective remains that of improving learner attainment. Andrew and Lewis (2002) maintain that teachers who participated in a professional learning community known

as Innovative Design for Enhancing Achievement in Schools (IDEAS) showed changes in their teaching practices. This is highlighted by the following quote in their study: “I find that my teaching has improved and find that I understand more about what I am doing, why I am doing this, and I find that’s been an improvement” (Vescio et al., p.246).

Dunne (2000) stresses that taking part and being a member of a PLC prepares teachers with the required skills in teaching and learning, which would also enable learners to master the subject content. Similarly, Louis and Marks (1998) argue that the continued existence of PLCs in a school, circuits or clusters contributes enormously to the levels of social support for achievement and greater levels of authentic pedagogy. Correspondingly, Strahan (2003) states that as a part of the transformation process, teachers who work collaboratively develop a shared school vision and mission which encapsulates guiding principles which comprise of honesty, respect, discipline and merit.

It is clear that PLCs support and motivate groups of teachers to involve themselves in a range of activities which include among others developing lesson plans, setting of common papers and other curriculum related activities. Andrew and Lewis (2002) further contend that participation in a PLC leads to a change in teaching culture. In the same vein, Vescio et al. (2007) contend that a change in a school culture illustrates that forming a PLC adds to an essential move in the teachers’ daily practice that they bring to the classroom. To this end, Vescio et al. (2007) reveal that collaboration, a focus on student learning, teacher authority, and continuous teacher learning were common characteristics that learning communities display. Since the aim of this study was to explore the collaborative learning of the senior phase mathematics teachers, I examine the extent to which teacher participation in the 1+ 9 mathematics intervention programme as a professional learning community enhances collaborative learning and how the discussions and sharing of knowledge and teaching strategies assist them to be better mathematics teachers.

2.5 Conceptual framework

This study is framed by the concept of collaborative learning from Brodie’s (2013) framework of collaborative learning and professional learning communities. In this study I have also used the features of effective PLCs to generate, analyse and interpret data (Vescio

et al., (2008). This framework provides an insight about the social nature of learning which is linked to the core features of collaborative learning which describes how teachers learn. Furthermore, this conceptual framework will help me to analyse the data generated from the five participants.

2.5.1 Brodie's framework of collaborative learning and professional learning community

Collaboration involves working together with one or more people, towards attaining a common objective (Dillenbourg & Schneider, 1995). Brodie (2013) argues that collaboration, accurate examination, trust and care are essential but not adequate for the flourishing of a professional learning community. The most important aspect is the focus or content that is what the cluster collaborates to inquire into or what is being learned (Brodie, 2013). Brodie (2013) further argues that a crucial aspect of professional learning communities involves collective and caring nature because teachers learning individually from teacher development programmes do not sustain performance for learners. Furthermore, Brodie (2013) contends that learning is collaborative and must be sustained by the departments, schools and principals. Brodie (2013) asserts that the key to the effectiveness of the professional learning communities are the skills and knowledge that the lead teachers of clusters require in order to implement activities for teachers and sustain the collaborative nature of the teacher learning process. Brodie (2013) argues that a lack of proper thinking, planning and dedication results in PLCs not achieving their objectives.

2.5.2 Characteristics of effective professional learning communities

The following features have been employed to allow the researcher to obtain an in-depth understanding of the professional learning communities and what characterises them. These features would also permit the researcher to investigate what features of the professional learning communities are displayed in the collaborative learning of clusters.

In general, there are four critical features that surface as common descriptors of PLCs (Vescio et al., 2008). First, collaboration that promotes changes in teaching culture. Second, a focus on learner learning where the goal of the teachers' work is to improve learning for low and underachieving learners. Third, teacher authority which means the ability of teachers to make decisions regarding both the processes of their learning communities and aspects of

school governance. Fourth, continuous teacher learning which means that participation in learning communities facilitates professional development that is driven by the needs of teachers as they are naturally engaged in effort to accomplish their goals. These features allowed me to understand to what extent the mathematics cluster is an effective PLC.

2.6 Chapter summary

This chapter outlined literature in relation to teacher professional development, teacher learning, collaborative learning and professional learning communities. This chapter furthermore outlined the conceptual framework that underpins the study namely Brodie's framework of collaborative learning and professional learning communities and Vescio et al.'s characteristics of effective PLCs. The following chapter focuses on the methodological approaches and research design process of the study.

CHAPTER THREE

METHODOLOGICAL APPROACH AND RESEARCH DESIGN

3.1 Introduction

This chapter provides a detailed account of the interpretive research paradigm and the qualitative methodological approach. Next, the case study research design, purposive sampling, data collection instruments and procedures and the analysis of data are outlined. The chapter concludes by discussing issues of trustworthiness, ethical considerations and limitations of the study.

3.2 Interpretive research paradigm

All research studies are based on a number of fundamental philosophical hypotheses about what represents an applicable research study and which research method(s) is or are appropriate for the development of knowledge in a particular study. Mackenzie and Knipe (2006) contend that it is the selection of a paradigm that sets down the purpose, motivation, explanation, and expectations for the research. They further argue that without choosing the paradigm as the first step, there is no basis for subsequent choices about methodology, methods, literature or research design. The term ‘paradigm’ may be defined as “a loose collection of logically related assumptions, concepts, or propositions that orient thinking and research” (Boglam & Biklen, 2005, p. 22). Similarly, Cohen and Manion (2011, p. 38) corroborate that “it is the philosophical intent or motivation for undertaking the study”. In the same way Naughton, Rolfe and Siraj-Blatchford (2001) assert that a paradigm comprises three features: a belief about the nature of knowledge, a methodology and criteria of validity. The above assertions resonate with Scotland (2012) who adds that ontology (what constitutes reality), epistemology (how knowledge can be crafted, obtained and conversed), methodology (concerned with why, what, from where, when and how the process of data generation unfolds) and methods (deals with detailed technique and procedures used in the data generation process) are components of such philosophical assumptions. In view of the above assertions, Bertram and Christiansen (2014) claim that what the researcher wants to observe and investigate, the type of questions that the researcher wants to ask, how to collect

data and the understandings linked to the data collected are subsequently predisposed mainly by the theoretical assumptions that the researcher holds on to.

For this study, I adopted the interpretive paradigm as the lens through which I explored and observed the collaborative learning of the senior phase mathematics teachers during their participation in the Professional Learning Communities. The focus of my study seeks to understand and explore the social experiences that is, the collaborative learning of the Senior Phase mathematics teachers in a PLC. Based on the focus of the study, I found the interpretive paradigm most appropriate for this study. Furthermore, my study is located within the interpretive paradigm since the interpretive paradigm acknowledges that there are various truths since reality is subjective and constructed from a person's life actions, background and social interaction (Denzil & Lincoln, 2011; Van Rensburg & Smit, 2008). The above claim corresponds with the view of Guba and Lincoln (1994) who corroborate that the ontological position of the interpretive paradigm is relativism which centres on the notion that reality is subjective and as a result is not the same from one person to the other. Due to the subjectivity of reality, Guba and Lincoln (1994) argue that truth can arise from different understanding through dialogic discussion such as one-on-one interviews.

According to Niewenhuis (2007), researchers in the interpretive paradigm believe that meaning and knowledge are acts of interpretation, and for this reason there is no subjective knowledge which is independent of thinking, reasoning humans. Agger (2006) agrees that interpretive researchers seek to understand social action on the level of the meaning that people attach to it. In the same vein, Reeves and Hedberg (2003) assert that the interpretive paradigm emphasises the requirements for analysis in a particular setting.

Kaplan and Maxwell (1994) contend that the interpretive paradigm seeks to describe the subjective meaning that lies behind social action. Similarly, Cohen et al. (2011) affirm that the interpretive paradigm allows for the interpretation of the world from the participant's point of view. Creswell (2012) claims that the interpretive paradigm is embedded in the notion that different realities are in existence. These assertions correlate with my study since it depends on the experiences of the Senior Phase mathematics teachers to obtain an insight into their different experiences of collaborative learning as well as their participation in mathematics professional learning communities. Similarly, Davey (2006) maintains that the interpretive paradigm expresses significant social interpretations of how people build and sustain their social world. For these reasons, I believe that the interpretive paradigm is most

suitable for this study, since this study explores the subjective realities and experiences of collaborative learning of Senior Phase mathematics teachers in a professional learning community.

3.3 Qualitative approach

Regarding methodology, Creswell (2012) contends that the interpretive paradigm is usually correlated with the qualitative research approach. Qualitative research refers to the enquiry whereby the researcher collects data during the course of interacting with chosen participants in their contexts (McMillan & Schumacher, 2006). Slavin (2007) affirms that qualitative research accentuates a comprehensive account of the social setting, aimed to study a social phenomena. This assertion is supported by Creswell (2013) who asserts that the qualitative research approach is associated with the following aspects: generating textual data or evidence in the context where participants experience the issue, the construction of interpretation of what the researcher observes, hears and understands and the researcher develops an intricate and a holistic view of social phenomena. Mouton (2011) suggests that qualitative research seeks to understand and explain the phenomenon. Qualitative researchers seek to understand the phenomenon through the meanings people assign to them (Maree, 2011). This study aims to explore the collaborative learning experiences of Senior Phase mathematics teachers in the professional learning community. Consequently, this study collected textual data or evidence at the site where research participants learn collaboratively and observe how they participate in the PLC. Drawing from the above assertions, I believe that a qualitative approach is appropriate for this study.

The purpose of this study was to explore how mathematics teachers learn collaboratively and to observe their participation in the PLC. Mouton (2011) asserts that the most important aim of a qualitative approach is to understand the actions of the society and not to generalise them to the wider community. Furthermore, Chilisa and Preese (2005) highlight that a qualitative approach is an investigation in which researchers conduct their research about people's experiences in their natural environment, using different instruments such as interviews and observations. Platton (2001) adds that the qualitative approach examines phenomena in a particular situation, where they unfold naturally. Furthermore, Platton (2001) affirms that a qualitative study yields findings not arrived at by means of numerical process or other means of qualification. Creswell's view is further supported by Denzil and Lincoln (2003) who

argue that a qualitative approach enables researchers to acquire the verbal descriptions, analysis and interpretations of the participants. These assertions further underline my rationale for selecting a qualitative approach to achieve the aims my study.

3.4 Case study research design

Bertram and Christiansen (2014) describe the research design as the systematic process or plan of how data that are required to respond to the research questions are generated and further scrutinised. Likewise, Yin (2003) describes the research design as the logical plan that illuminates the way in which the research study is to be carried out. Yin (2003) further maintains that research design specifies how all of the main parts of the research study, namely the sample, groups, measures, treatments or programmes, function together in an endeavour to address the research questions. Having located my study within the interpretive paradigm, I have adopted a qualitative approach and case study research design in this study.

According to Leavy (2011), there is no consensus on the definition of a case study. Some scholars view case study as a method, methodology, or research design. However, Hesse-Biber and Leavy (2011) contend that it is inappropriate to consider a case study as a method, methodology or research design. They further argue that other researchers conceptualise a case study as a paradigm. However, Hesse- Biber (2011) reveals that a case study is trans - disciplinary and trans- paradigmatic. Ritchie and Lewis (2003) assert that the most important characteristics describing a case study are the diversity of perceptions which are embedded in a specific setting. In the same vein, McMillan and Schumacher (2001) indicate that a case study explores a bordered system over time in detail, utilising multiple sources of data found in the context. In this study, the case study was employed as the research design because my study aims to capture the experiences of participants as they collaboratively learn and participate in the context of a PLC (Cohen, Manion & Morrison, 2011). My choice of selecting a case study is in line with Leavy (2011) who claim that a case study is an empirical inquiry that examines a contemporary phenomenon with its real life context. Hesse-Biber and Leavy (2011) further argue that a case study examines a phenomenon when the boundaries between phenomenon and context are not clearly obvious. This assertion resonates with Thomas (2011) who stress that the case study tries to understand the

phenomenon that is being studied and gives the chance to go through the question to understand the organisational activities. This corresponds with Thomas (2011) who contends that a case study is an in-depth study of one particular phenomenon which is observed from different perspectives. In addition, Merriam (2009, p. 81) explains a case as “a single unit, a bounded system”. Therefore, in this study the case was the collaborative learning of the senior phase mathematics teachers in the context of a PLC. Baxter and Jack (2008) caution novice researchers about the significance of considering what the case is and Huberman (1994) concurs with Merriam (2009) that a case study is a phenomenon of some sort of happening in a bounded system. Stake (1995) and Yin (2003) suggest that placing boundaries of case is very significant. Taking the views of the above scholars into cognisance, my study was located at Maphumulo Circuit and is bounded in time and place (Creswell, 2003) and activity (Stake, 1995).

Yin (2003) outlines three categories of case studies, namely, explanatory, exploratory or descriptive. This study will use an exploratory case study design since it aimed to explore collaborative learning in the 1+ 9 mathematics PLC. He further gives a distinction between holistic and multi-case studies, while Stake (1998) distinguishes case studies as intrinsic, instrumental or collective. However, this study warranted me to employ an exploratory case study since it explored the collaborative learning of mathematics teachers within a PLC. An exploratory case study is described by Yin (2003) as the type that explores those situations in which the intervention being assessed does not have one set of outcomes.

One of the major reasons for adopting case study as an appropriate research design in this study was the strengths highlighted in literature. Nisbet and Watt (1984) outline the following strengths of a case study: immediately understandable, speak for themselves, are strong on reality, and they provide insight into other related situations and cases, and in this way assist in the understanding of other associated cases. Furthermore, Yin (2012) posits that good case studies benefit from having various sources of substantiation. Similarly, McMillan and Schumacher (2001) assert that case studies employ a range of sources of data found in the setting. Nieuwenhuis (2010) corroborates that the strength of a case study is its application of different sources and methods in the process of generating data. Furthermore, Yin (2012) contends that one of the benefits of case studies is the close relationship between the researcher and the participants while allowing participants to tell their stories. Participants could express their opinions of real life through stories and this assists researchers to understand the participants' behaviour (Yin, 2012). These scholars further affirm that case

studies are good techniques to study unusual events and offer a good source of information about conduct.

On the contrary, Rule and John (2011) argue that case studies have received criticism on the basis of non- representativeness and not having numerical generalisability. Furthermore, Baxter and Jack (2008) concur that findings of case studies may not be generalizable except when the researchers see their relevance. These scholars further note that case studies are not easily open to cross-examination; consequently, they may be discriminatory, unfair, personal and subjective. They conclude that case studies are liable to suffer from the problem of observer bias, even though efforts are made to attend to reflexivity and it is hard to make distinct cause-effect conclusions. In this study, I have drawn on the strengths of case studies and taken cognisance of these limitations.

3.5 Research questions

The following research questions guided this study:

- 1) How do Senior Phase mathematics teachers collaborate and learn in the 1 +9 mathematics clusters?
- 2) To what extent is this 1 + 9 mathematics cluster an effective Professional Learning Community?

3.6 Research context

The study was conducted at the Maphumulo Circuit under the Ilembe District. Five senior phase mathematics teachers were selected from five secondary schools to participate in this study. Most of the schools in this circuit are rural schools which have limited resources. This area is characterised by high poverty and unemployment of parents with most of them relying on social grants. Most of the schools are 'No Fee Schools' and are in quintile one and learners receive food from a feeding scheme.

3.7 Purposive sampling

The belief that supports the notion of sampling is that a small set of observations can provide a realistic interpretation of what can be anticipated in the whole population (Royce, 2004).

Sampling can be conceptualised as a decision making process where the researcher decides on which people, context, phenomenon or behaviours to incorporate in the study from the whole population (Bertram & Christiansen, 2014). For this study, purposive sampling was used to select participants. I purposively selected five senior phase mathematics teachers because I believe that they possess the information that will assist me to address the research questions. Furthermore, these participants were chosen on the basis that they are the holders of data that I needed for my study (Fraenkel & Wellen, 2007). My sampling strategy is also supported by Cohen et al. (2012) and Creswell (2012) who assert that purposive sampling is the strategy of choosing participants judged to be representative of the population under investigation. Similarly, Scott and Morrison (2007) describe purposive sampling as activities involved in choosing a subset of persons from a larger population. It is based on these assertions that I chose to use purposive sampling in my study.

The research participants include five senior phase mathematics teachers from five different high schools who were teaching mathematics in Grades eight and nine, who also attended the 1+ 9 Mathematics Intervention Programme. Participants were selected according to their significant features (Niewenhuis, 2007). The participants comprised three male teachers and two female teachers between the ages of 30 and 48. All participants were selected from the schools under ILembe District at the Maphumulo Circuit. However, the aim of the study was not to generalise the findings but to obtain an in-depth understanding of how senior phase mathematics teachers collaborate and learn in a PLC in the 1 + 9 Mathematics Intervention Model.

3.8 Methods of data generation

Creswell (2009) asserts that research methods refer to the type of data generation, analysis and interpretation that researchers intend to employ for their research. Arguing along similar line are Bertram and Christiansen (2014) who contend that research primarily relies on empirical data or support that are either generated or collected from research participants. McMillan and Schumacher (2010) mention four methods of data generation, namely, observation, interviews, document analysis and the use of audio visual materials. However, in this study, I used semi-structured interviews and observations in order to address the research questions mentioned above.

3.8.1 Semi- structured interviews

In this study I used semi-structured interviews (**Appendix F**) to collect data that addressed the critical research questions. The rationale behind choosing semi-structured interviews stemmed from the fact that this type of interview allowed me the opportunity to sit one-on-one with Senior Phase mathematics teachers and pose questions on the research focus. Shedman (1991) argues that semi-structured interviews are useful in qualitative research because they give the option of following up a response with another question. Similarly, Creswell (2012) maintains that a one-on-one interview is a process that allows the researcher to ask questions and record responses one participant at a time. According to Cohen et al. (2011) semi-structured interviews are a guide that is organised and is adequately open-ended to allow researchers to make extensions, probes and follow-ups where necessary. In the same way, Henning, van Rensburg and Smit (2004) advocate the utilisation of semi-structured interviews in qualitative research because they give flexibility for the researcher to probe for more information during the interviewing process. The use of semi-structured interviews allowed me to get an in-depth understanding from the Senior Phase mathematics teachers engaging in the PLC. Correspondingly, Walliman (2009) corroborates that semi-structured interviews are a tool that is easy to handle. Yin (2012) emphasises that semi-structured interviews offer more fluent and broader material than other types of data generation methods.

Hesse-Biber and Leavy (2011) further note that when using semi-structured interviews, the researcher is likely to allow new topics that the interviewee did not think of. They further highlight that in this type of interview the researcher selects the order and wording of the questions during the interview. Similarly, Dawson (2009) concurs that semi-structured interviews are the most prevalent type of interviews employed in qualitative social research. This type of data generation method allowed me a greater flexibility in terms of ordering the questions, probes and cues between me and the respondents. Semi-structured interviews allowed my participants an opportunity to open up and talk without restraint. Semi-structured interviews encourage interviewees to respond openly to questions in his or her own terms (De Vos, Strydom, Fouche & Delport (2011). This allowed me to generated rich, in-depth data from my participants.

Dawson (2009) further contends that an interview is a particular form of communication between people for a particular objective related to the agreed subject matter. Furthermore,

De Vos, Strydom, Fouche and Delport (2011) contend that interviews grant the participants the space to tell their stories about their real life experiences and perceptions of collaborative learning within the PLCs. Ribbins (2007) adds that interviewing people helps to explore their views in ways that cannot be obtained by other means of research methods such as questionnaires and report findings that are as near as possible to their words. Correspondingly, Scott and Morrison (2007, p. 133) state that “through interviews, participants could yield different kinds of data and explain in detail what they wanted the researcher to capture; while allowing the researcher to probe further and ask for clarification”.

One of the main reasons for choosing to utilise semi-structured interview was its adaptability and the voice that it gives to the participants. Greeff (2011) highlights that semi-structured interviews are used to obtain an in –depth view of a participant’s belief about or a description of a particular event. Scott and Morrison’s view is further supported by Greeff (2011) that semi-structured interviews offer much flexibility between the researchers and the respondents, and allow the researcher to follow up on issues of interest that come to light in the interview. Greeff (2011) concludes that semi-structured interviews allow the participants to bring in an issue that the researcher had not imagined. Gillham (2000) also adds that semi-structured interviews are utilised to produce very rich data.

Brynard, Hanekom and Brynard (2011) argue that the use of semi-structured interviews may create discomfort and make the participants scared of telling the truth about their perceptions. Furthermore, they contend that power relations might have an influence on the process and may cause participants to be afraid of telling their stories. In order to triangulate and reinforce the data generated in this study, I used observations as the second method of collecting data.

3.8.2 Observations

Mertens (2009) accentuates that observations are a powerful and significant data collection method that is vital to transformative work. Bless and Higson-Smith (2000) describe observation as a data generation method that uses a direct observation of the participants in the study. To collect rich and descriptive data, I observed senior phase mathematics teachers engaging with activities within the PLC (**Appendix G**). However, since I am a member of this Mathematics PLC, I collected data using participant observation. Strydom (2010)

describes participant observation as elemental to all research methods. Furthermore, Best and Kahn (2003), Mertens (2009) and Yin (2009) assert that observation usually comprises detailed notation of particular human actions or behaviours, physical settings, real-world circumstances and the context surrounding the events and behaviours. The current study observed five senior phase mathematics teachers participating and learning collaboratively in the PLC. Actions and behaviours of teachers were observed and recorded on the observation schedule. As I have mentioned above, I used participant observation which Alston and Bowles (2009), Cohen et al. (2011) and Creswell (2009) view as a common strategy used in flexible designs with the key benefit being openness.

Robson (2002) claims that in observation the researchers are not interested in people's views, their emotions or attitudes, they observe their actions and listen to what the participants say. During the observation process, I was involved in the research situation as the participant observer. Cohen et al. (2000) concur that the benefits of participant observation are that the researcher is able to establish continuous behaviour as it takes place and is able to make appropriate remarks about its essential characteristics. Similarly, Creswell (2009) suggests that the advantage of observation is that data are presented in the natural setting, which in this study was the mathematics PLC. In generating data in the natural location, it was possible to capture the neutral behaviour of the participants; in addition, observation allowed me an opportunity to collect data on non-verbal behaviour of the participants. Moyles (2007) notes that the most important benefit of observation as a research instrument is that it provides the right of entry and insights into various social relations and physical settings. In the same way, Creswell (2009) posits that observations allow a researcher a first-hand understanding with the participants. On the contrary, using observation as a data collection method might interrupt the observed group which might lead to nervousness and discomfort.

3.9 Data Analysis

Data analysis is a rigorous procedure in qualitative research that involves handling of data, organising data into manageable units, ordering and comparing, combining data, looking for patterns, finding what is significant and what is to be understood (Hoberg, 1999). Similarly, Bogdan and Biklen (2005) define qualitative data analysis as handling the data, organising data, separating data into convenient units, coding data, synthesising data, and looking for patterns. The purpose of data analysis was to determine patterns, concepts, themes and

meaning from the responses of the participants. The data analysis process occurred as described below.

In this process I organised and explained the data and tried to make meaning of the data with regards to the participants' description of the situations. It was during this process of data analysis, where I observed patterns, themes, categories and regularities (Cohen et al., 2011). It was imperative to reduce the quantity of data in order to make meaning and understanding of what my participants were saying. In this case, the thematic analysis approach was utilised. Wellington (2000) describes the process of thematic analysis as the procedure of summarising, coding and organising qualitative data into themes, clusters and categories. Gall, Gall and Borg (2005, p. 315) refer this as interpretational analysis because it includes a "systematic set of procedures to classify the data to ensure that important themes, construct and patterns emerge". Cohen (2007, p. 480) adds that "a code is a word or abbreviation sufficiently close to that which it is describing for the researcher to see at a glance what it means".

Cohen et al. (2011) corroborate that the process of data analysis involves breaking down the different parts of written data into convenient units. The reason behind this is to examine, compare, identify causal links and categorise data. Yin (2003) argues that it is necessary to look for patterns from the data that may describe or recognise underlying links in the data base. According to McMillan and Schumacher (2001) qualitative data analysis is an inductive process of analysing and categorising data. Inductive reasoning starts with the raw data where the researcher looks for the particular patterns and themes.

The data generated from the semi-structured interviews with five Senior Phase mathematics teachers were transcribed verbatim to textual data. This was followed by coding and grouping the frequently emerging ideas. Finally, the common ideas that came up were grouped into themes. Themes were interpreted and then applied to provide analysis of the findings with regard to the research questions. Data collected through participant observations were also analysed using what the participants say and their views to strengthen the results of the study. The data from observation was incorporated with the themes that emerged from the semi-structured interviews.

3.10 Issues of trustworthiness

In essence, the following principles or measures underlie the true value of the qualitative research: credibility, dependability, confirmability and transferability (Guba & Lincoln, 1999). In this study the above principles were taken into consideration with the aim of enhancing the value of the data collected from the research participants. These principles are explained in detail in the next sub-sections.

3.10.1 Credibility

The extent to which the study captures the real meaning of the case study and reflects the reality and lived experiences of the participants is known as the credibility of the study (Guba & Lincoln, 1999). Blanche (2006) asserts that credibility is established during the course of the study. Data discussion and analysis were cross-checked with the participants with the aim of substantiating the researcher's understanding of the raw data. This process is described by Polit and Beck (2008) as 'member checking' and it also allows for the verification of themes, categories, interpretations and conclusions drawn from the study with participants.

3.10.2 Dependability

Dependability is an inquiry audit which usually examines the data, findings, interpretations, conclusions and recommendations to confirm that the findings of the study are supported by the data collected (Vilakazi, 2009). In the same vein, Vilakazi (2009) contends that the data can be verified by the research supervisor to determine whether the results of the research are definitely supported by the data. Guba (1999) affirms that the self-reliant, distanced and critical eye enhances and contributes to the trustworthiness of the study. Therefore, I worked closely with my supervisor to ensure trustworthiness.

3.10.3 Confirmability

Another construct of trustworthiness is confirmability which is an internal agreement between the researcher's understanding and the real data (Bassey, 1999). Bassey (1999) further states that to gain confirmability, the raw data collected can be sufficiently certified with their data sources. This puts the weight on the need to ask whether the findings of the study could be checked by another (Guba & Lincoln, 1999). In this study, confirmability was verified by communicating respondents' word for word when trying to understand data and

this allowed me to illustrate the evidential unfairness for the points of view made in the study (Rule & John, 2011). Interview transcripts were given to the participants to verify and remark on the accuracy of what they said during the interviews.

3.10.4 Transferability

The final principle of trustworthiness is transferability. This construct refers to the extent to which the study can be applied to another setting (Guba & Lincoln, 1999). Transferability happens when the researcher becomes aware that the case is related to other similar cases (Rule & John, 2011). Rule and John (2011) describe transferability as the extent to which the findings of the research study can be transferred to a similar context. In this study, semi-structured interviews and observation were employed. De Vos, Strydom, Fouche and Delpont (2011) stress that if a study utilises various data collecting methods, transferability is reinforced.

3.11 Ethical issues

In this study, ethical considerations were taken into account. Schumacher and McMillan (2010) highlight that research ethics mainly focus on what is normally appropriate and inappropriate when engaged with the research participants. Creswell (2012) stresses that it is important to address issues of ethics when conducting research. Miles and Huberman (1994) posit that the following ethical issues need to be attended to: informed consent, autonomy of the participants, non-maleficence, and beneficence. This study adhered to these ethical issues and the detail of each is given below.

3.11.1 Approval

In order to conduct this study, permission was obtained from the University of KwaZulu-Natal Research Ethics Committee (**Appendix A**) and the KwaZulu-Natal Department of Education (**Appendix B**) before I started with the generation of data. Furthermore, informed consent was also sought from the principals of the five selected senior phase mathematics teachers to allow me to enter their premises and conduct interviews with them (**Appendix D**). I also requested permission from the senior phase mathematics subject advisor to conduct cluster observations (**Appendix E**). Letters of approval were obtained and have been attached as appendices to this study.

3.11.2 Informed Consent

Dutheim and Wassenaar (2001) emphasise that participants must agree to participate in a study. In this study research participants gave their informed consent in writing (**Appendix C**). The rationale of the study was explained to the participants. Participants were made aware that their participation in the study was voluntary and that they can withdraw from the study at any given time. Lichman (2011) corroborates that an essential principle of conducting research with humans is that voluntary consent is crucial. Robin and Babbie (2005, p. 71) affirm that “participation should at all times be voluntary and no one should be forced to participate in a project”. Each participant was given a pseudonym to ensure their anonymity (Curtis; Murphy & Shields, 2014).

3.11.3 Non-maleficence

Babbie (2007) cautions that the core ethical issue of social research is that it must not harm participants. Mertens (2009) indicates that ethical guidelines in research are important to avoid any potential hurt to the participants. Taking this into cognisance, it was essential that I gave participants reasonable assurance that they would not be harmed during the course of the study. Furthermore, the issue of confidentiality was addressed by giving participants an assurance that the information that they gave would not be disclosed to anybody.

3.11.4 Beneficence

According to Bertram and Christiansen (2014) beneficence is described as the benefit of the study. This could be advantageous to the researcher or the participants. However, in this regard, the benefit of the study was to contribute to the body of knowledge in the area of collaborative learning in the Professional Learning Communities. Participants were advised that there was no financial benefit during or after the research study.

3.12 Limitations of the study

In my view the first limitation that needs to be highlighted in this study is that it was a small scale study that consisted of five Senior Phase mathematics teachers, who were the primary sources of data collection on collaborative learning (CL). Therefore, findings of this study cannot be generalised to the entire population of cases (Rule & John, 2011). The second

limitation is that being a participant observer might have had some elements of bias that might have had an effect on the discussion and analysis of data. Furthermore, my personal attributes such as my position as a Head of Department in my school and a senior phase mathematics teacher might have had an influence on the data collected.

3.13 Summary of the chapter

This chapter discussed the research process and the philosophical assumptions of the interpretive paradigm which underpinned the study. The qualitative approach and case study research design was also explained. In addition, the purposive sampling of the participants and a detailed account of the data generation instruments and procedures were outlined. The process of data analysis, issues of trustworthiness and ethical issues were discussed. Finally, this chapter highlighted the limitations of the study that might have influenced the findings. The following chapter provides the detailed discussion of findings that emerged from the semi-structured interviews and participant observation of the five Senior Phase mathematics teachers as research participants.

CHAPTER FOUR

DATA PRESENTATION AND DISCUSSION

4.1 Introduction

The previous chapter outlined the research design and methodology that was employed to address the research questions guiding this study. This chapter presents and discusses the data that was generated through cluster observations and semi-structured interviews of the five Senior Phase mathematics teachers who were the participants in this study. The presentation of data and the analysis of themes is organised according to the research questions repeated below. During this process many common themes emerged from participants' responses that are also related to these research questions:

1. How do Senior Phase mathematics teachers collaborate and learn in the + 9 mathematics cluster?
2. To what extent is this cluster an effective Professional Learning Community (PLC)?

4.2 Profiles of the participants

Prior to the presentation and discussion of the data generated through semi-structured interviews with the five participants, I outline a brief profile of each participant in order to provide readers with background information about the participants. To ensure anonymity each participant and school was given a pseudonym. I have used direct quotations of participants to allow their voices and experiences to be authentic and clearly articulated. Bertram and Christiansen (2014) argue that using direct quotations help to present accurately what the participants have said.

4.2.1 Mr Smangaliso

Mr Smangaliso is 31 years old and is a high school mathematics and mathematical literacy teacher at 'Sunrise High School'. Mr Smangaliso has been teaching in this school for nine years. He completed the National Diploma in Electrical Engineering studying full time at Mangosuthu University of Technology. He then completed the Post Graduate Certificate in Education part time at the University of South Africa (UNISA). He is a level one teacher and he teaches Mathematical literacy in Grades 11 and 12 and Mathematics in Grade 9. When I asked Mr Smangaliso about the experiences of teaching mathematics in the senior phase, he responded *"Teaching mathematics is not an easy task since the majority of learners have a mentality that mathematics is a difficult subject, so as a teacher, you must teach maths and simultaneously try to remove that mentality"*. Mr Smangaliso majored in mathematics literacy at the University of South Africa.

4.2.2 Ms Thembi

Ms Thembi is 37 years old and is a post level one teacher. She holds a Secondary Teaching Diploma from Indumiso College of Education and an Advanced Certificate in Education which she obtained from the University of KwaZulu-Natal. She is a high school teacher at 'Babheke High School' and has been teaching in this school for 12 years. She is teaching Mathematics from Grades 8 to 12. Her school is located in a deep rural area and there is a poor learning culture among learners. When I asked her how her participation in the mathematics cluster developed her classroom practices and teaching strategies, she explained *"I have grown a lot after participating in this mathematics cluster in terms of content and have learned different approaches"*. She emphasised that, as teachers, they are doing their best to bring back the culture of learning with the assistance of parents.

4.2.3 Mr Bheki

Mr Bheki is a level one teacher in a rural school called 'Phezulu Secondary School' in the Ilembe District. Mr Bheki is 34 years and has been teaching in this school for three years. He holds a Diploma in Public Administration from the University of South Africa and a Post Graduate Certificate in Education (PGCE) also from UNISA. When I asked him about some of the challenges of teaching mathematics in the Senior Phase, he highlighted that *"mathematics is one of the challenging subjects on the educators' side in terms of delivering knowledge to the learners"*. He is teaching mathematics in Grades 8 and 9 and he showed passion about teaching senior phase mathematics.

4.2.4 Ms Kubheka

Ms Kubheka is very passionate about teaching mathematics in the senior phase. She is 33 years old and holds a Bachelor of Science degree majoring in Botany from the University of KwaZulu-Natal (UKZN). She also has a PGCE from UKZN. She has taught at ‘Malombo Secondary School’ for ten years. She is currently teaching Life Sciences in Grade 10 and Mathematics in Grade 9. She also revealed that she is studying towards Bachelor of Education Honours with UNISA. When I asked Ms Kubheka why she would encourage other mathematics teachers to participate in the 1+ 9 mathematics programme, she responded “*I would encourage mathematics teachers to participate in this programme so that they can be involved in team work and import more approaches and skills to impart to their learners*”.

4.2.5 Mr Khuboni

Mr Khuboni is 35 years old and is a Head of Department in ‘Ikusasa Secondary School’ in the Ilembe District. He holds the National Professional Diploma in Education (NPDE) and the Advanced Certificate in Education (ACE) which he obtained from UKZN. He is currently teaching Mathematics in Grades 8 and 9 and IsiZulu in Grade 10. When I asked Mr Khuboni to describe his experiences of teaching mathematics and to elaborate on the success and challenges he experienced, he responded “*mathematics is a very funny and interesting subject to teach, good mathematics teaching open the world for the success of learners, however, learners tend to have a negative attitude towards mathematics*”. He emphasised that he loves to lay a strong foundation for mathematics in the General Education and Training Band (GET).

The next section discusses the teachers’ understanding of collaborative learning and professional learning communities.

4.3 Teachers’ understanding of collaborative learning

The participants at the time of this study were teaching Grades 8 and 9 mathematics in schools that are located in the rural areas of Maphumulo. Participants showed a very good understanding of collaborative learning and they reiterated it is a kind of learning where teachers come together to talk about their teaching and learning Mr Khuboni stated that:

“I think collaborative learning is based on the model that knowledge can be created with population where members actively interact by sharing experiences”

However, when Ms Thembi was asked what she understood by collaborative learning, she responded

“I think it is a process where two or more people come together to learn in order to share various ideas, solutions and approaches”.

Ndlovu (2016) asserts that one of the Department of Education initiatives was to form clusters as an important space where collective teacher learning would occur. Duncombe (2004) and Armour (2004) contend that collaborative learning is a process where a teacher interacts with or talks to other teachers with a purpose of improving their own or others understanding of teaching approaches. Participants emphasised that through clusters, they form communities to learn collectively and share resources. They further explained that during collaborative learning they work as members of the professional learning community of mathematics, giving up a degree of personal independence in exchange for attaining a collective ability to respond to crucial questions of teaching and learning as well to respond to challenges they encounter in their daily classroom practices (Eaker, DuFour & DuFour, 2002). Similarly, Spark (1998) concurs that collaborative learning is the kind of professional development in which teachers work together to develop their knowledge and expertise.

Furthermore, Ainscow, Muijs and West (2006) argue that schools should use collaboration as a method to support those schools which are experiencing challenges in academic achievement. Fullan (2005) further argues that the importance of collaborative learning is a way of improving continuous teacher learning. Lassonde and Israel (2010) corroborate that collaborative learning is an on-site learning which offers effective professional development. Lassonde and Israel (2010) posit that collaboration with committed teachers can also help in dealing with challenges.

4.4 Data presentation and discussion

This study is qualitative and interpretive in nature, therefore, thematic analysis was chosen to classify and code the data generated through the semi-structured interviews and cluster observations to make meaning of how senior phase mathematics teachers collaborate and learn in clusters. The semi-structured interview transcripts and cluster observations were read through many times to identify common words or phrases. These common words or phrases were then grouped into themes. The themes that emerged from the data collected were

underpinned by the above assertions. The next section discusses the themes that emerged for Research Question 1.

The following themes were identified: discussing effective teaching strategies, sharing experiences and resources, setting common assessment tasks and focusing on content knowledge and skills.

4.5 How do senior phase mathematics teachers collaborate and learn in the 1+ 9 mathematics cluster?

4.5.1 Discussing effective teaching strategies

The data generated from the semi-structured interviews and cluster observations revealed that one of the main activities that teachers engaged in during collaborative learning is the discussion of effective teaching strategies. Teachers reiterated that they come together to explore and enquire about the new teaching methods and techniques that can assist them in developing their mathematics teaching practices. Mr Smangaliso responded in this way:

1+ 9 mathematics intervention programme helped me in getting strategies on teaching different aspects effectively, and it has helped me a lot in the classroom as we discuss teaching methods.

Ms Thembi added that in this mathematics intervention programme she has grown a lot and has learned different teaching approaches when introducing her lessons in various topics. This is what she said:

I have grown a lot after I participated in the 1 + 9 mathematics programme and I have learned different teaching approaches.

Through my observations, it was evident that teachers discuss different instructional practices that could provide the best outcome in mathematics. The above responses resonates with the Integrated Strategic Framework for Teacher Education and Development (ISPFTED) which stresses that teachers should take full responsibility for their own learning and development (Brodie, 2016). In the same way, during collaborative learning teachers reflect on their teaching strategies which are based on how they will teach a particular mathematics concept and how will they know if the learners have learned it (DuFour, DuFour, Eaker & Karhanek, 2004).

Similarly, Mr Khuboni posits that participation in the 1 + 9 mathematics programme equipped teachers with various teaching strategies and methods. This is how he responded:

Participation in the 1 + 9 mathematics programme equip educators with various and diverse teaching strategies and methods. Unpacking of lesson plans help educators to understand all aspects.

It was clear from the cluster observation that teachers were busy working on the lesson plans trying to simplify and address misconceptions in particular topics such as algebraic language, functions and relationships and geometry. The data generated from cluster observation further confirm that teachers come up with different teaching approaches to teach different topics such numeric and geometric patterns. It was evident that experienced teachers shared their methodological approaches with the novice teachers. Ms Kubheka also shared the same sentiment. This is how she responded:

I learned new methods and how to apply new strategies when teaching. I also gained different strategies to teach different sections in mathematics.

Mr Bheki further corroborated that the 1 + 9 mathematics cluster focused on learning new teaching strategies with the aim of improving teachers' classroom practice. This is illustrated in his response:

It was basically in the sharing of teaching strategies and improves each other.

Aligning the above responses of the participants with literature, DuFour and Eaker (1998) assert that PLCs create a space that encourages personal development as teachers mutually cooperate to accomplish what they cannot achieve in isolation. Furthermore, the research conducted by Brodie (2013) outlines how an expanding of content knowledge in the communities could lead to new teaching practices where teachers are assisted to employ their new understanding in practice. Correspondingly, Darling-Hammond and McLaughlin (1995) claim that the idea of practice that underpins reform agenda needs most teachers to reconsider their own practices, to construct new classroom roles and expectations about learner achievement. They further assert that assisting teachers to reconsider practice requires professional development that involves teachers in both teaching and learning and building a new vision of what, which and

how teachers should learn. Similar views are echoed by Vescio, Ross and Adams (2007) who argue that the main principle of a PLC is to improve learning by developing teaching practice. The eleven research articles that Vescio, Ross and Adams (2007) reviewed, supported the notion that being part of a learning community leads to changes in teaching practice. However, in their review of the research articles, five studies highlighted detailed teacher change in the classrooms. The findings of these studies revealed that the teaching of teachers who participated in learning communities become more learner-centred and over time these teachers increase the utilisation of methods such as changes in the pace of instruction to cater for different levels of learner content mastery. On the other hand, Louis and Mark's (1998) study revealed that the participation of teachers in the professional community, contributes hugely to social support for attainment and higher levels of real pedagogy.

4.5.2 Sharing experiences and resources

The research data generated from the semi-structured interviews and cluster observation highlight that during collaborative learning teachers share their experiences and teaching materials. The cluster observation highlighted that those teachers who have been in the field for many years were always willing to share some of their experiences and expertise on how to assist learners with learning difficulties. It was also evident that experienced teachers share their knowledge on how to design lesson plans that include all learners in ways that enhance learners' development in mathematics. The sharing of experiences and resources was pointed out by Mr Smangaliso who said that:

We get together to share ideas and everyone is free to seek for clarity whenever the need arises. I like the way teachers share skills and ideas as well as respect shown to one another.

Similar views were expressed by Mr Khuboni who contends that teachers come together in clusters to actively interact by sharing their expertise. This is what he said:

During collaborative learning teachers actively interact by sharing experiences and teaching materials. Subject specialists within the phase, help other teachers to get a better understanding of the subject. Most of our successes as individuals are shared so that we work with somebody's strength.

The information obtained from the cluster observation further confirms that teachers with adequate teaching resources share their resources with teachers from under resourced schools. Ms Kubheka also confirms that in their cluster, teachers work together to solve problems and do lesson presentation. She explained that:

Teachers respond very quickly if I am asking for help in mathematics and I also contribute something to other teachers

The above view is supported by Brodie (2016) who contends that teachers should develop and share their classroom experiences and materials with other colleagues. She further argues that teachers learn in and through practices and discuss meaning with other teachers in order to achieve one common goal. She adds that participation of teachers in one or more learning communities develops changes in their practice.

Ms Thembi also expressed similar views on the sharing of ideas and resources in their mathematics cluster. She responded in this way:

“One of the most powerful strengths of our cluster is group participation during discussions, doing presentation and sharing helpful mathematical ideas”

Similar views were expressed by Me Bheki who put forward that being part of this mathematics cluster has assisted him to access teaching materials easily. This how he responded:

“Participation in the mathematics cluster has equipped me with different skills to teach different topics in mathematics. I am able to access teaching materials and be able to rate myself with other schools in terms of curriculum coverage”

Similarly, Eaker, DuFour and DuFour (2002) assert that to improve the performance of the school that can enhance learners' achievement; collective effort and members' contribution is significant. These scholars further argue that teacher participation in clusters address teachers' needs to work regularly with other teachers to evaluate their learner's learning. It can be argued that teachers collaborate and share one another's strengths to achieve a shared vision. However, de Lima (2001) and Grossman (2001) note that teacher's frequent interaction and intensity can enhance the potential for conflict since members work more closely together to share their experiences and

practice. Furthermore, DuFour and Eaker (1998) stress that in order to minimise conflict, teachers learn to reach an agreement on effective group norms.

It is evident that involving teachers actively in PLCs will expand their professional knowledge which results in improved learner performance (Buysse, Sparkman & Wesley, 2003). According to Lave and Wenger (1991), the social theory of learning holds the premise that learning is a social practice which encompasses interaction among person, activity and context. These scholars view learning as developing teamwork in a practice rather than as an achievement of an individual. Brodie and Borko (2016) further argue that teachers who develop and share teaching approaches and resources and question each other's ideas and practices will acquire knowledge and skills differently than a teacher who relies on his or her head of department about what to teach and when to teach it.

4.5.3 Setting common assessment tasks

When the participants mentioned assessment tasks, they all highlighted that one of the main focuses of their cluster meeting was to set standardised assessment tasks. They emphasised that common tasks helped them to track their learners progress in terms of the mathematics concepts they teach in a particular period of time. Participants further confirmed that common tasks also assisted teachers to respond to the learners' misconceptions. Ms Thembi explained:

We even set a standardised assessment task as a cluster which helps a lot and discuss misconceptions in mathematics.

Mr Smangaliso also mentioned that one of the strengths of their cluster meeting is the setting of the common assessment tasks. His response was:

I would say the most powerful strengths of our cluster is to assist each other as well as prepare assessment tasks together.

Mr Khuboni also highlighted that the main focus of their cluster is to develop teachers in terms of the content and methodology. This is how he responded:

“The main goal was to develop teachers in terms of content and methodology. We are now able to make our learners love the subject and perform activities in class with passion”

Mr Bheki also reiterated that participation in the mathematics is important because they prepare common assessment tasks for their learners which enable teacher to measure the performance of learners by using standardised assessment tasks. He responded in this way:

“Participation in the mathematics is important in the sense that the papers are set by the cluster members with the guidance of coordinators or facilitators.”

During the cluster observation, teachers were busy dividing topics among their groups with the aim of embarking on the setting of common assessment tasks. Topics were distributed according to the teachers’ subject content knowledge of a particular topic in mathematics such as numeric and geometric patterns, measurements and space and shape. Ms Kubheka highlighted that using common assessment tasks with her learners had developed her confidence in teaching mathematics. This is what she said.

Preparing common tasks together make me confident in class. We also write a pre-test before we deal with lesson presentation and also write a post –test after the session. This helps us understand whether we have learned something.

During observation of the cluster meetings, it was noted that teachers brought together different questions from different topics to set common assessment tasks. The topics included space and shape (geometry), data handling and measurements (area, volume and surface area). It was also observed that teachers discussed the levels of questions to be included in the assessment tasks that is, lower order, middle order and higher order questions. Teachers were guided by the Curriculum Assessment Policy Statement (CAPS) to allocate marks to the different questions depending on the cognitive level of each question. The above responses and observations are in line with Brodie (2016) who accentuates that becoming competent in and confident with the knowledge base forms part of professional learning and that this knowledge must be utilised to make good decisions.

This is in line with DuFour, DuFour and Eaker (2002) that teachers use these common assessment tasks to monitor the progress of their learners and give support to those learners who need it. All participants shared similar views that the setting of common

assessment tasks was one of the main focus of cluster meetings. Participants concurred that this activity involved discussion and moderation of assessment tasks by facilitators in order to ensure high quality. During cluster observations it was evident that teachers come together to discuss their learner's performance after the assessment tasks had been administered. This discussion led to the diagnostic analysis which then resulted in the subject improvement plan in order to address the challenges.

4.5.4 Focusing on content, knowledge and skills

Mr Khuboni mentioned that in their mathematics cluster, discussion of content and sharing of knowledge and skills are the main focus of their collaborative learning. He added that in their cluster they have strong cluster facilitators. This is what he said:

The main goal of our cluster is to develop teachers in terms of content and methodology. We have strong cluster coordinators in terms of content. They give us support, goal oriented and good planning.

Mr Khuboni's view was supported by Ms Thembi who pointed out that she had gained a lot in terms of content, knowledge and skills in the cluster meetings. She indicated that she had learned different skills of approaching different mathematics topics with confidence. She responded:

I have grown a lot after I participated in this cluster in terms of content. I am now clear with everything and I have learned a lot from my colleagues.

Mr Smangaliso further mentioned that he had gained the skill of making mathematics interesting and easy for his learners. He also mentioned that he liked the way of sharing knowledge and skills with the facilitators who always displayed respect to one another. This is what he had to say:

I have gained skills of simplifying things for the learners in order for them to easily understand the different mathematics aspects. I like the way teachers share skills and ideas as well as respect shown to one another.

The information obtained from the cluster observation confirmed that teachers focus on subject content knowledge and skills to develop their mathematical understanding. It

was also evident that facilitators of this mathematics cluster paid particular attention to discuss the content that should be taught to the learners.

This observation corresponds with Kartz and Dack (2003) who contend that facilitators who are responsible for the quality learning opportunities for teachers should be prepared with skills and knowledge that would assist them to lead the PLC. Arguing along similar line is McLaughlin and Talbot (2001) who assert that PLCs would not function effectively if they do not have strong, site-based facilitators. They further argue that these PLCs will not be able to promote teacher learning or learner attainment.

Brodie (2013) corroborates that one of the critical successes of the PLCs are the facilitators who should use their skills and knowledge to design and implement suitable learning activities for teachers. Furthermore, Brodie (2013) points out that facilitators should have skills to manage the collaborative learning process for the PLCs to be sufficiently secure to accept weak points and challenges for them to develop. She contends that facilitators should allow appropriate outside experts to help the community develop and learn.

Furthermore, Brodie (2013) suggests that collaborative learning is important. However, the main focus should be on the content that teachers learn when they are in cluster meetings. On the other hand, the data collected from observations of cluster meetings also showed that teachers do not only discuss content in cluster meetings, they also teach one another. Facilitators took the lead and taught topics that they identified as problematic, for example numeric patterns and transformation geometry. The data collected from observations also revealed that teachers support one another with different teaching approaches to present different sections in mathematics. Brodie (2016) emphasises that facilitators who have knowledge and skills are highly needed as efforts to develop teachers increase worldwide. She argues that there is a dire need to prepare these novice facilitators to be capable of assisting teachers and supporting high quality learning platforms. Brodie (2016) adds that it is imperative to identify effective facilitators of PLCs. Furthermore, City, Elmore, Fiarman and Teitel (2009) suggest that in order to improve learner achievement, relationships between teacher, student and content should be reinforced. However, Brodie and Borko (2016) argue that the main objective of PLCs should be that teachers improve their practices, knowledge and skills. In contrast, PLCs should not revolve around current practices but invigorate the existing

practices (McLaughlin & Talbert, 2001). According to Brodie and Borko (2016) teachers should broaden their practice when new knowledge comes up. They further argue that the goal of PLCs is to assist teachers to build their experience in order to engage with new concepts.

Harris (2009) contends that collaborative learning is correlated to teamwork that includes cooperative and coordinated endeavours by individuals working together to accomplish their common cause. This assertion resonates with Swanepoel, Erasmus and Schenk (2010) as well as Steyn and Van Niekerk (2012) who claim that during collaborative learning teachers share ideas and have common purpose and objectives that aim to improve learner achievement. This is in line with Duncombe (2004) and Amour (2004) who argue that collaborative learning is the space where teachers work collaboratively to improve their own or others understanding of any pedagogical issues such as subject content knowledge, pedagogical content knowledge (PCK) or curriculum knowledge.

The following discussion elaborates on the themes identified for Research question 2: To what extent is this cluster an effective PLC?

Themes that emerged were: discuss challenges and solutions, sharing common goals, vision and ideas, enhance commitment, confidence and motivation and stimulates collaborative learning culture.

4.6 To what extent is this cluster an effective Professional Learning Community (PLC)?

4.6.1 Discusses challenges and solutions

Participants highlighted that they addressed challenges in their cluster through discussions. They further asserted that after robust dialogue among themselves they arrived at one solution with the assistance of experienced teachers in the field of mathematics. This view was supported by Ms Thembi. This is how she responded:

We come together to discuss challenges and share solutions and approaches in order to achieve a certain goal that we have set up for ourselves. We also participate in the discussion of misconceptions that learners have in mathematics.

A similar view was echoed by Ms Kubheka who confirmed that in the mathematics cluster they talked about the challenges that they encountered when teaching mathematics. This is what she had to say:

Our cluster works as a team in sharing challenges that we experience daily with learners. We are involved in discussion and finally agree with one thing and we all contribute openly.

Mr Khuboni corroborates that one of the main activities that they do in their cluster is discussion and lesson presentation. He responded in this way;

We discuss learning activities and highlight the most important areas to emphasise. We also discuss misconceptions that most learners have in certain aspects so as to warn our learners against them.

It was also evident from the data obtained through cluster observations that teachers engaged themselves in trying to find the solutions to problems that they encountered in classrooms. The data obtained from cluster observations also revealed that teachers came to cluster meetings with different teaching challenges they had experienced in different sections in mathematics and asked facilitators to give clarity about their concerns.

What emerged from the participants responses was that teachers in this cluster continually learn together. This view resonates with Hord's (2009) view of the type of learning within professional communities as a habitual activity. Correspondingly, it has been found that application of practice and collective learning promote seeking solutions to questions about what learners should learn, and how teachers know it has been learned and how teachers can address learning challenges (Cohen & Hill, 2001; DuFour, 2004). This is in line with most researchers who concur that supportive conditions must be met for PLCs to be effective. These conditions are structural in that schools should allow time and space for teachers to meet and discuss (Hord & Sommers, 2008). Another condition is characterised by trust, respect, caring relationships, risk taking and reflective dialogue (DuFour & Eaker, 1998; Hord, 1997).

In the same way, Hord (1997, p. 37) contends that a professional learning community must operate as a democratic environment that "allows dissent and debate among its members, and this can result in increased understanding and learning of the members".

Similarly, in cluster meetings, teachers work as a team and engage in dialogue to examine their classroom practices and learner's achievement and also develop and put in place effective instructional practices (Darling-Hammond & Richardson, 2009). Furthermore, Snow-Renner and Lauer (2005) suggest that the formation of clusters as spaces where teachers learn should address how teacher learning occurs and allow teachers to transform their teaching.

4.6.2 Sharing common goals, vision and ideas

All participants agreed that the sharing of common goals, vision and ideas strengthened their cluster and encouraged them to work together as a team. They also highlighted that working together in a cluster had increased their commitment and built their capacity.

Mr Khuboni responded in this way:

Our goal is to stimulate a good learning culture of mathematics, so that we work together to achieve that goal. Our main goal is to develop teachers' content and methodology. The activities that we engaged ourselves with drives the entire cluster focused.

Mr Smangaliso shared a similar view and responded in this way:

Having a common goal motivates us as mathematics teachers to perform beyond our best. Our vision as a cluster is to produce learners that do not just pass mathematics, but learners who understand mathematics and are able to apply it whenever need be.

Ms Thembi added that their mathematics cluster is driven by one common goal and vision to improve the percentage pass in mathematics in the senior phase. This is what she said:

The goals that we seek to achieve in our cluster are to improve the pass rate and for learners to have a positive attitude towards mathematics.

When Ms Thembi was asked about what was the main focus of their mathematics cluster, she responded as follows:

Our main focus of our mathematics cluster is to unpack lesson plans and discussing learning activities, share ideas and methods, set common tasks for assessment.

Arguing along similar lines, Ms Kubheka asserted that their mathematics cluster sought to improve mathematics knowledge and skills for the learners. This is what she said:

Our most important goal is to make our learners pass mathematics and promote the love of mathematics and also improve the ANA results. Having a common goal as maths teachers assist us to help learners in maths and understand their weaknesses and help them to solve problems in maths.

The information obtained from cluster observations confirmed that teachers in this mathematics cluster understood the significance of working together in order to realise and accomplish their collective goal of learning. It was also evident from the data obtained from cluster observations that teachers had one common vision about the achievement of their learners in mathematics. The degree of accountability and responsibility by all participants in the cluster was noted during cluster observations. Their view is supported by Fullan (2005) who asserts that when teachers work collaboratively; they develop their skills and develop a shared commitment and motivation to improve learner attainment. DuFour (2006) adds that teachers build frameworks that seek to promote a robust, collaborative culture that have PLC characteristics. DuFour (2006) further asserts that teachers collective discussion requires team members to put together objectives and strategies to enhance the classroom practice of each teacher and collectively.

This assertion of developing and sharing common goals, values and vision is further corroborated by DuFour and Eaker (1998) who contend that developing these aspects within a PLC is extremely important for the effectiveness and success of PLCs. This assertion resonates with the work of Bredeson (2003) who asserts that one of the main building blocks of a PLC is to develop a clear and focused mission and vision.

All participants noted that their cluster worked together to share their experiences and practices in order to improve learners performance in mathematics. During the cluster observations, it was evident that teachers collaborate to move towards one common goal with a clear vision in mind of ensuring that learners develop a positive attitude towards mathematics. This collaboration within the PLC is aligned with that of the Ministry of

Education's (2006) call for the creation of shared vision. The Minister of Basic Education highlighted the necessity of carrying this vision collectively. This idea of shared vision is further corroborated by Haberman (2004) and Carver (2004) who posit that the vision should be well-established in improving teaching practices and should clearly focus on learners' learning and achievement. Teaching and learning should be a lasting and strong experience that is embedded in this vision (Haberman, 2004; Carver, 2004).

4.6.3 Stimulates collaborative learning culture

Participants also shared how they stimulated a collaborative learning culture in their mathematics cluster. Ms Kubheka elaborated:

I think collaborative learning culture is an educational approach to learning and teaching that improves a group of teachers working together to solve problems. It is also about the collective effort or presentation from different teachers.

Ms Thembi shared the same view about a collaborative learning culture. This is what she said:

I think collaborative learning is the process where two or more people come together to work or learn together in order to share various ideas, solutions and approaches in order to achieve a certain goal they have set up for themselves.

The data collected through cluster observations revealed that teachers of this mathematics cluster understood how to enhance learners' interests and commitment in mathematics. It was also noted how teachers support and encourage each other on how to get their learners on board during teaching and learning of mathematics.

Ms Kubheka and Ms Thembi's responses are similar to DuFour, Eaker and Many's (2006) view that teachers also act in response to information which requires a sense of mutual accountability and changing practice instead of sharing ideas and resources. These scholars believe that the most challenging aspects of a PLC are to construct and sustain a collaborative society. The study conducted by Vescio, Ross and Adams (2007) found that collaboration is one of the attributes embedded in the communities of learning that helped to promote changes in teaching culture. Their study also revealed

that successful collaboration attempts include strategies and practices that stimulate sharing, reflecting, and taking the risk that necessitate change.

The findings of this study resonate with Meirink, Meijer and Verloop (2007) who assert that the professional learning communities' model heavily emphasised the practice of collaboration. Like DuFour's study (2003), this study also found that the most important characteristic of professional learning communities is collaborative team work. It was also evident from cluster observations that all participants believed that learning together in the form of clusters enhanced and stimulated a collaborative learning culture.

The view by DuFour (2003) is corroborated by Brodie (2013) who argues that collaboration is one of the attributes of effective and successful professional learning communities. All participants shared the same view that an element of collaboration leads to effectiveness and efficiency of PLCs which enhances the learning culture among teachers. DuFour (2003) highlights that there are different ways in which teachers learn together collaboratively; such as learning teams, grade and department teams. In the same way Eason-Watkins (2005) corroborates that one of the characteristics of effective PLCs is where teams of teachers work with their principals and other school teachers to create a space for problem solving, innovation, reflection on practice, and collaborative professional development to design and implement effective programmes. To this end, DuFour (2003) adds that the most important attribute of PLCs is collaborative work that leads to improved student achievement and teacher capacity. The above attribute was evident during cluster observation when teachers demonstrated leadership qualities when leading other teachers on different topics when they did lesson presentation and lead discussions on particular mathematics concepts.

4.6.4 Enhances commitment, confidence and motivation

All participants showed commitment, confidence and motivation to participate in the 1 + 9 mathematics cluster, and attended all cluster meetings that I observed. They shared the following views about motivation and commitment in this cluster. Ms Thembi responded in this way:

Teachers of this cluster are very motivated; you can see that by the attendance and full participation. They show commitment to the programme because they know that

this is going to help learners to pass mathematics, eh discussion of misconceptions in mathematics also increase our motivation to come to cluster meeting on a regular basis.

In the same vein, Ms Kubheka responded about this cluster as motivated and sharing learning vision:

Our cluster is motivated and sharing learning vision because we work as a team and share challenges that we experienced daily with learners. We are involved in discussion and finally agree with one thing and we all contribute openly.

Mr Khuboni responded in this way:

The learning activities that our cluster engaged in kept us motivated and focus on the same objective.

Mr Smangaliso's response was:

The commitment shown by teachers showed motivation and the way we keep up with our work and committed to extra classes in order to cover the lost time.

It was evident from cluster observations that the participants' active participation in the cluster is what kept them motivated and committed. They embraced the cluster meeting as their own learning space and were not passive recipients. Facilitators were approachable and allowed teachers to take the lead on certain aspects. However, some participants shared their concerns about things that demotivated them about the programme. Mr Smangaliso and Ms Thembi highlighted that the programme mainly focussed on Senior Phase mathematics and that they lost teaching time with other grades that they teach. They responded in this way:

This programme is taking place during working hour, so we lose a lot of time with our learners and we sometimes end up failing to finish the Annual teaching Plan in time,

and Ms Kubheka was also not happy about the time they spent in the cluster meetings, and felt it was too long and too many aspects were discussed. This is what she said:

Long Annual teaching Plans yet I need to teach my learners and need to do revision before learners write exams, and when I am not at school, my learners are left behind.

However, DuFour (2003) contends that professional morale is strengthened when teacher learning teams create the outcome that the members have worked hard to accomplish. Brodie (2013) agrees that PLCs can offer a conducive and demanding platform for huge and vigorous teacher learning and development.

All participants expressed similar views that their commitment and motivation is driven by the vision that they want their learners to focus on learning. This vision is supported by Hollins (2006, p. 48) who states that PLCs are the way to move teachers to “collectively assume responsibility for making sure that all students learn”. This view is further supported by Robert (2010) who indicates that the whole idea behind using PLCs as the vehicle for teacher learning and development is to improve learners’ achievement. This is in line with DuFour (2004) who claims that the core mission that underpins PLCs is to make sure that learners learn which moves the focus from teaching to learning.

4.7 Summary of the chapter

In this chapter I have used thematic analysis to discuss the detailed analysis of findings generated during the semi-structured interviews from the five participants and the observations of cluster meetings. In this chapter I have also discussed eight themes that emerged from data analysis. The themes include: discuss effective teaching strategies, share experiences and resources, set common assessment tasks, focus on content, knowledge and skills, discuss challenges and solutions, sharing common goals, vision, ideas and experiences, stimulate collaborative learning culture and enhance commitment, confidence and motivation. I analysed and discussed these themes drawing on Brodie’s framework of collaborative learning and professional learning communities as well as features of effective PLC (Vescio et al., 2008). The next chapter moves on to discuss the findings of the study, recommendations and the conclusions of this study.

CHAPTER FIVE

FINDINGS AND RECOMMENDATIONS

5.1 Introduction

In the previous chapter I presented and analysed the data through a comprehensive discussion of how the participants collaborate and learn in the 1 + 9 mathematics cluster as the Professional Learning Community. This chapter discusses the findings that emerged from the data analysis that was presented in Chapter Four. Recommendations for further research are also outlined.

5.2 Discussion of findings

In this section I summarise the findings that emerged by taking into consideration the two research questions that underpinned the study. The eight themes that emerged from the data analysis process were summarised into three main findings that are related to grouped themes. This study aimed to address the following research questions:

1. How do Senior Phase mathematics teachers collaborate and learn in the 1 + 9 mathematics cluster?
2. To what extent is this 1 + 9 mathematics cluster an effective Professional Learning Community (PLC)?

5.2.1 Teachers collaborating to enhance teaching and learning

The discussion that follows is an account of the findings that came to light when five participants responded to how they collaborate and learn in a Professional Learning Community of the senior phase mathematics in the Maphumulo circuit. Eight themes that emerged from the data collected revealed some noteworthy insights on how participants collaborate and learn in the mathematics cluster.

Firstly, the results of the study revealed that participants met together as a cluster to discuss effective teaching strategies. These strategies include sharing of different methods and

strategies of teaching mathematics in a manner that would stimulate learners' interest in mathematics. Participants further indicated that they clarified and simplified misconceptions and errors that learners usually have in mathematics. Participants also stated that part of their learning activities included lesson presentations where experienced and lead teachers do lesson presentations on different mathematics topics that were problematic to teachers. The study revealed that these lesson presentations equipped teachers with different teaching approaches in the classroom. Participants also highlighted that their discussions involved different ways of how to engage learners more practically in the teaching and learning process. The study also found that participants discussed some innovative strategies to eliminate learner's negative attitudes about mathematics so that learners find mathematics enjoyable and develop a love of mathematics.

It was also clear from the cluster observations that participants engaged themselves with different mathematics concepts trying to simplify and assist one another with how to introduce or teach particular concepts such as numeric patterns, fractions and algebraic equations. Another interesting observation noted was the constructive arguments among the participants that led them to reach one common understanding on certain mathematics concepts. It was evident that such arguments help to develop and improve novice mathematics teachers and improve their mathematical skills. Brodie (2013) corroborates that professional conflict is encouraged because it promotes rigorous inquiry and growth. She further states that in order for professional conflict not to be personal, an ethic of care and trust is important.

Secondly, another insight that emerged was that being part of this mathematics professional learning community enabled participants to share their teaching resources and expertise. It was evident that participants shared teaching materials like textbooks, notes and any relevant reference materials in mathematics. It was also clear from the arguments put forward by participants that they worked as a team where they divided topics according to their level of expertise. This is further supported by Brodie (2013) that facilitators require skills and knowledge to plan and implement suitable learning activities for teachers. Brodie (2013) further suggests that skilled and knowledgeable facilitators are able to manage the collaborative culture of the process so that a Professional Learning Community is adequately safe to admit its weaknesses and strengths. It was also observed that during cluster meetings participants shared their concerns, reflected on their teaching strategies and made decisions based on their classroom teaching practices. Therefore, a key finding of this study is that the

1+9 mathematics cluster created collaborative learning spaces for all teachers that participated in this PLC.

5.2.2 Teachers collaborating to set common assessment tasks and discuss challenges

The study also revealed that the participants collaborated in a cluster to set common assessment tasks. Participants put forward that using common assessment tasks helped them to measure whether their collaborative learning in a PLC had addressed the challenges that they had encountered in their classrooms. The participants also contended that common assessment tasks helped them to evaluate and reflect on their teaching methods and lesson presentation in the classroom. It was evident that the analysis of learners' performance clearly indicated how each school performed so that drastic intervention measures were implemented to support teachers of underperforming schools. It was also noted that common assessment tasks were not used as a fault-finding mission but rather to ensure that all learners were assessed accurately. Another cluster observation was that participants were required to write pre- and post-tests before and after their cluster meetings. These tests served to evaluate what participants knew, needed to learn and what they had learned.

The findings of this study further revealed that members of the PLC focused mostly on the content, knowledge and skills they needed to impart to their learners. This is supported by Blank, de las Alas and Smith (2007) and Wenglinsky (2000) who stress that professional development that pays attention to learners learning and assists teachers to develop their pedagogical skills to teach particular kinds of content has a profound positive outcome on teaching practice. The data presentation chapter revealed that during cluster meetings participants focused on critical subject content that enhanced their subject knowledge and skills. Similarly, Brodie (2013) asserts that although collaboration is significant for learning to happen, the primary focus should be the content that is learned, knowledge and skills acquired when teachers are engaged in PLCs. Brodie (2013) further argues that since learning is professional, it is imperative that it is connected with other forms of knowledge of best practice and research. The findings of this study also revealed that the skills of simplifying, synthesising and investigating patterns and solving algebraic equations were mostly acquired by the teachers during cluster meetings. In the same vein, Hargreaves (2008) contends that intuition and craft knowledge must be connected to research knowledge so that both can be integrated. The above finding is in line with the national survey conducted by Garet, Porter,

Desimone, Birman and Yoon (2001) that revealed that teachers' knowledge and skills grew and their practice changed when they engaged themselves in professional development that was consistent, focused on content knowledge and included active participation.

The findings of this study further indicated that participants come together in clusters to discuss challenges and solutions. The study found that challenges that teachers encountered during teaching and learning were brought to the cluster meetings and facilitators and experienced teachers discussed strategies about how to solve these challenges. This also included discussing different responses about how to solve different problems and correct learners' errors. According to Ball and Bass (2003) this idea of correcting errors assists teachers to see learners as reasoning and reasonable thinkers. Brodie (2013) adds that if teachers are aware of the reasons why learners have made errors, they can begin to appreciate learners' understanding and find techniques to engage learners' existing knowledge to construct new knowledge.

5.2.3 Collaboration and commitment contribute to effective PLC

The features of the professional learning communities as outlined by Vescio et al. (2008) were used as the lens to analyse the second research question. The data generated through semi-structured interviews and cluster observations revealed that this cluster reflected four attributes of effective professional learning communities (Vescio et al., 2008).

The cluster reflected the following features: first, elements of collaboration that promote changes and that include strategies that open practice in ways that encourage sharing, reflecting, and taking the risks necessary to change. Second, members of the PLC focus to student learning rather than to teaching. The third element of a PLC that assists teachers to promote change in teaching culture, is teacher authority and the fourth element of the PLC is continuous teacher learning that supports overall changes in teaching cultures. Furthermore, the findings also revealed that this cluster displayed three significant characteristics: teacher capacity, leadership capacity and supportive condition (DuFour, 2003, & Hord, 2008).

All participants in this cluster demonstrated commitment to improve student learning. This attribute is the most important for an effective professional learning community. It was also evident from the data generated that participants shared common goals, vision and purpose to accomplish the main objective of the cluster. This finding resonates with Bredeson (2003) who affirms that one of the building blocks of a professional learning community is to

develop a comprehensible and focussed mission. Furthermore, learning community structures assist teachers to examine their practice through collaborative structures (Vescio et al., 2008).

The findings of this study also showed that the participants in this cluster worked together collaboratively in different ways to assist one another to carry out their responsibility of teaching. During cluster observations it was noted that participants worked harmoniously to create an environment where problem solving, reflection on practice and collaborative professional development was the main focus. Furthermore, the findings suggest that teacher capacity was one of the characteristics of this cluster. DuFour (2003) contends that better learner achievement is difficult without working on teacher capacity.

This study also revealed that it is imperative to have strong leadership and teacher authority when building a PLC. Teacher authority means the ability to make decisions about the processes of learning communities and elements of school government (Vescio et al., 2008). Brodie and Borko (2016) suggest that skills, knowledge and preparation of facilitators improve the quality of learning opportunities for teachers. Furthermore, McLaughlin and Talbot (2001) posit that PLCs are likely to be unsuccessful and will not succeed to promote teacher learning without strong facilitators. The findings of this study also showed that one of the main objectives of this PLC was to develop teachers professionally. All participants demonstrated motivation and finally, it was noted that all participants were willing to learn from one another in order to improve learner attainment. The participants indicated that participation in a learning community facilitates professional development that is driven by the needs of teachers as they are involved in efforts to achieve their set of goals (Vescio et al., 2008).

It was clear that the cluster mainly focused on academic results so that every participant took part in a continuous process of examining the current level of learner attainment. Another finding that emerged was that all participants worked collaboratively to sustain this cluster as an effective PLC. It was evident that this cluster held its members accountable for the kind of achievements that stimulated an ongoing improvement. This study highlighted that the success of a PLC mainly depends on the persistence, motivation and commitment of the teachers within it (DuFour, 2003), and the continuous learning of teachers (Vescio et al., 2008). The study revealed that there was a clear connection between the teachers' own professional learning opportunities within the PLC and changes in their practices and in student learning (Vescio et al., 2008).

This study is similar to the studies conducted by Louis et al. (2006) who found that developing professional learning communities appears to hold considerable promise for improvement. As such, it has become a 'hot topic' in many countries. Furthermore, this study shares some similarities with the study conducted by Hord (2004) that revealed that Professional Learning Communities appear to share five key features which also appear to be intertwined and working together with what I found in this study.

Another study that is in line with this study is the study conducted by Brody and Hadar (2015) who examined the trajectories of novice and experienced teacher educators in a three-year longitudinal professional development community who found that novice teachers showed a reflective inquiry towards their own teaching practice while others claimed expertise. In their study they found that some participants claimed that they have learned skills and knowledge which would help them advance professionally.

5.3 Recommendations and further research

The following recommendations are based on the findings of this study.

Firstly, it is recommended that teachers should be encouraged to participate in professional learning communities in their schools or collaborate with nearby schools. Teachers should use these PLCs as collaborative learning spaces to discuss challenges related to teaching and learning, share resources and support one another in terms of subject content, assessment and methodology.

A further recommendation is that School Management Teams (SMTs) should provide teachers with learning opportunities. Each school should have a School Development Team (SDT) that focuses on appraising and developing teachers about current teaching approaches.

It is also recommended that Circuit managers, District officials and the Provincial Department should ensure that the directorate that is responsible for teacher development encourages schools to implement PLCs in order to assist one another.

It is further recommended that teachers who participate in PLCs should be encouraged to: commit and contribute to collaborative teams, clarify purpose and priorities to learning, identify areas of concern and generate interventions, create common formative assessments and focus on learning (Dufour, 2003). Finally, it is recommended that each PLC should have a clear vision, mission and objective that it seeks to accomplish.

Given that the findings of this study highlight that PLCs create collaborative learning spaces for teachers to enhance their knowledge and skills and improve teaching and assessment strategies, further research needs to be conducted on the PLCs. In particular, further research could focus on factors that promote or hinder teacher learning in PLCs, the role of the SMT and Department of Education in supporting PLCs, addressing challenges within PLCs and how to enhance the effectiveness of PLCs. In addition, further research could also explore specific mathematics content knowledge and skills as well as content topics in different grades and contexts with regard to mathematics teaching and learning.

5.4 Summary of the chapter

In this chapter, the main findings that came to light from the analysis of data have been discussed. With regard to the findings that emerged from the study, recommendations have been given. It can be noted that this study highlighted how teachers collaborate and learn in the mathematics 1 + 9 cluster. In conclusion, this study provides a detailed outline of collaborative learning experiences of five mathematics teachers in the mathematics 1 + 9 cluster as a professional learning community.

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APPENDICES

27 January 2017

Mr Zeblon Sylvester Mbatha 205523927
School of Education
Pietermaritzburg Campus

Dear Mr Mbatha

Protocol Reference Number: HSS/0096/017M

Project Title: Exploring the collaborative learning of Senior Phase Mathematics teachers in 1 + 9 mathematics cluster at Maphumulo Circuit

Full Approval – Expedited Application

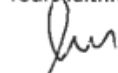
In response to your application received 23 January 2017, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

Yours faithfully



.....
Dr Shenuka Singh (Chair)
Humanities & Social Sciences Research Ethics Committee

/pm

cc Supervisor: Dr J Naidoo
cc Academic Leader Research: Dr SB Khoza
cc School Administrator: Ms Tyzer Khumalo

Humanities & Social Sciences Research Ethics Committee

Dr Shenuka Singh (Chair)

Westville Campus, Govan Mbeki Building

Postal Address: Private Bag X54001, Durban 4000

Telephone: +27 (0) 31 260 3587/8350/4567 Facsimile: +27 (0) 31 260 4609 Email: ximbap@ukzn.ac.za / snymanm@ukzn.ac.za / mohunp@ukzn.ac.za

Website: www.ukzn.ac.za



Founding Campuses:  Edgewood  Howard College  Medical School  Pietermaritzburg  Westville



APPENDIX B: ETHICAL CLEARANCE OBTAINED FROM DOE PROVINCE OF KWAZULU-NATAL

education

Department:
Education
PROVINCE OF KWAZULU-NATAL

Enquiries: Phindile Duma

Tel: 033 392 1041

Ref.:2/4/8/1136

Mr ZS Mbatha
PO Box 271
ILembe
4459

Dear Mr Mbatha

PERMISSION TO CONDUCT RESEARCH IN THE KZN DōE INSTITUTIONS

Your application to conduct research entitled: **"EXPLORING THE COLLABORATIVE LEARNING OF THE SENIOR PHASE MATHEMATICS TEACHERS IN THE 1 +9 MATHEMATICS CLUSTER AT THE MAPHUMULO CIRCUIT"**, in the KwaZulu-Natal Department of Education Institutions has been approved. The conditions of the approval are as follows:

1. The researcher will make all the arrangements concerning the research and interviews.
2. The researcher must ensure that Educator and learning programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, Educators, Schools and Institutions are not identifiable in any way from the results of the research.
5. A copy of this letter is submitted to District Managers, Principals and Heads of Institutions where the Intended research and interviews are to be conducted.
6. The period of investigation is limited to the period from 23 January 2017 to 07 June 2019.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Connie Kehologile at the contact numbers below
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report/dissertation/thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education.

Pinetown District

Dr. EV Nzama
Head of Department: Education
Date: 24 January 2017

...Championing Quality Education - Creating and Securing a Brighter Future

KWAZULU-NATAL DEPARTMENT OF EDUCATION

Postal Address: Private Bag X9137 • Pietermaritzburg • 3200 • Republic of South Africa

Physical Address: 247 Burger Street • Anton Lembede Building • Pietermaritzburg • 3201

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Facebook: KZNDOE....Twitter: @DBE_KZN....Instagram: [kzn_education](https://www.instagram.com/kzn_education)....Youtube:kzndoe

APPENDIX C: INFORMED CONSENT LETTER FOR SENIOR PHASE MATHEMATICS TEACHERS

School of Education

College of humanities

University of KwaZulu- Natal

Pietermaritzburg campus

Dear participant

INFORMED CONSENT LETTER

My name is Sylvester Mbatha. I am a Teacher Development Studies Masters student studying at the University of KwaZulu-Natal, School of Education (Pietermaritzburg Campus). As part of my degree requirements, I am required to conduct research. I have identified you as one of my research participants I therefore kindly seek your permission to be part of my research project. My study title: **Exploring the collaborative learning of the Senior Phase mathematics teachers in the 1 + 9 mathematics programme.**

The purpose of my study is to explore the collaborative learning of senior phase mathematics teachers in the 1+ 9 mathematics cluster. I am interested in knowing how senior phase mathematics teachers collaborate and learn in the 1 + 9 mathematics cluster. The study will also explore the types of learning activities that these teachers engage in. Therefore, I hereby request consent from you to participate in an interview, which may last for about 1 hour, with follow-up interviews if necessary.

The data generated will mainly be used for this study and not for any other purpose. However, you are not obliged to answer any questions that you are not comfortable to answer and are also free to withdraw from the study at any time. Your confidentiality is also ensured as the school name and teachers' real names will not be divulged. After completion of the study, data generated will be stored in my supervisor's office at the University of KwaZulu-Natal for safe- keeping for a period of five years after which it will be destroyed.

Your involvement is purely for academic purpose only, and there are no financial benefits involved.

I can be contacted at: Email: sylvestermbatha@yahoo.co.za Cell: 0797372777.

My supervisor is Dr J Naidoo who is located at the School of Education, PMB Campus of the University of KwaZulu-Natal.

Her contact details: email: naidooj@ukzn.ac.za; Tel : 0332605867.

For additional information, you may also contact the UKZN Research Office through:

Mr P.Mohun (HSSREC research Office) Tel: 031 260 4557 E-mail: mohunp@ukzn.ac.za

Thank you for your contribution to this research.

Z.S Mbatha

(Student)

DECLARATION

I.....(full name of participant)
hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participate in the research project.

I understand that I am at liberty to withdraw from the project at any time, should I so desire.

Additional consent where applicable

I hereby provide consent to:

Audio-record my interview

YES

NO

SIGNATURE OF PARTICIPANT

DATE

.....

.....

APPENDIX D: INFORMED CONSENT LETTER FOR SCHOOL PRINCIPALS

School of Education
College of Humanities
University of KwaZulu-Natal
Pietermaritzburg Campus

The principal

INFORMED CONSENT LETTER

My name is Sylvester Mbatha, a Masters student and a Departmental Head at Phakade Combined School. As part of my degree requirements, I am required to conduct research. I therefore kindly seek permission to conduct this research at your school. My study title is: **Exploring the collaborative learning of senior phase mathematics teachers in the 1 + 9 mathematics cluster at Maphumulo Circuit.**

Please be informed that I have sought the necessary permission in advance from the KwaZulu-Natal Department of Education and has been granted.

The study aims to explore how senior phase mathematics teachers learn and collaborate within the mathematics cluster. The study will examine how collaborative learning occurs in professional learning communities (PLCs). The study will also explore types of learning activities that senior phase mathematics teachers engage in.

Semi-structured interviews will be conducted with the senior phase mathematics teacher in your school. The participant will be interviewed for approximately 1 hour to 1 hour 30 minutes and each interview will be voice recorded.

Please note that there will be no financial benefits that the participants may accrue as a result of their participation in this research project. The identity of the participant will not be divulged under any circumstances. Participant's responses will be treated with strict confidentiality. Fictitious name will be used to represent the participant's real name.

Participation is voluntary, therefore, participants are free to withdraw at any time they wish without any negative or undesirable or penalty on their part.

The interviews will be tape recorded to assist me in focussing on the actual interview.
Participants will be contacted in time about the interviews.

For further information, please feel free to contact my supervisor, Dr J. Naidoo at
0332605867, Email, naidooj@ukzn.ac.za.

You may also contact the Research Office through P. Mohun, HSSREC Office, Tel 031 260
4557, Email: mohunp@ukzn.ac.za.

In addition, you can call me at 079 7372 777 or email me at sylvestermbatha@yahoo.co.za

Your anticipated positive response in this regard will be highly appreciated.

Yours sincerely

Z.S Mbatha (student)

SIGNATURE OF PRINCIPAL

DATE

.....

.....

APPENDIX E: INFORMED CONSENT LETTER FOR SENIOR PHASE SUBJECT ADVISOR

School of Education
College of Humanities
University of KwaZulu-Natal
Pietermaritzburg Campus

Dear Sir / Madam

INFORMED CONSENT LETTER

My name is Sylvester Mbatha, a masters student at the above institution and a Head of Department at Phakade Combined Primary school. As part of my degree requirements, I am required to conduct research. I therefore kindly seek permission to observe the senior phase mathematics cluster at the Maphumulo Circuit. My study title is: **Exploring the collaborative learning of the senior phase mathematics teachers in the 1 + 9 mathematics cluster at the Maphumulo Circuit.**

Please be informed that I have sought the necessary permission in advance from the KwaZulu-Natal Department of education and has been granted.

The study aims to explore how senior phase mathematics teachers learn and collaborate within the mathematics cluster. The study will examine how collaborative learning occurs in Professional Learning Communities (PLCs). The study will explore types of learning activities that senior phase mathematics teachers engaged in.

Senior phase mathematics teachers will be observed while engaging with the activities during their cluster meetings. Observation will last for the entire session.

For further information, please feel free to contact my supervisor, Dr J Naidoo at 0832313378, Email, naidooj@ukzn.ac.za.

You may also contact the Research Office through P, Mohun, HSSREC Office, Tel 031 260 4557, Email, mohunp@ukzn.ac.za.

In addition, you can call me at 079 7372 777 or email me at sylvestermbatha@yahoo.co.za.

Your anticipated positive response in this regard will be highly appreciated.

Yours sincerely

Z.S Mbatha

DECLARATION

I.....(full name) hereby confirm that I understand the content of this letter and the nature of the research project, and I hereby give permission to the above mentioned student to observe the 1 + 9 senior mathematics cluster at the Maphumulo Circuit.

SIGNATURE OF GET MATHEMATICS ADVISOR

DATE

.....

.....

APPENDIX F: INTERVIEW SCHEDULE

INTERVIEW SCHEDULE

Section 1: Biological Details

Age			
Gender	Male		Female
Educational qualifications			
Major subjects			
Work experience (No. of years teaching)			
Subject taught			

Section 2: **How do senior phase mathematics teachers collaborate and learn in the 1+ 9 mathematics cluster?**

- 1 How many years have you been teaching Mathematics for?
- 2 Describe some of your experiences of teaching mathematics. Elaborate on the success or challenges you experienced?
- 3 How has your participation in the 1 + 9 mathematics cluster developed your classroom practices and teaching strategies in mathematics?
- 4 Why would you encourage maths teachers to participate in 1+ 9 mathematics programme?
- 5 What do you understand by ‘collaborative learning’?
- 6 Describe the relationship between you and your colleagues during collaborative learning?
- 7 How often do you meet formally to engage in the professional learning activities? Do you think this is enough? Elaborate
- 8 What factors motivate you to participate in this cluster?
- 9 What factors demotivate you to participate in this cluster?
- 10 To what extent does working together with other maths teachers benefit you in your teaching?
- 11 Describe the type of activities that you do in the 1+ 9 mathematics cluster? Are you confident enough now in your lesson presentation?
- 12 Describe the knowledge and skills you have learnt in the 1 + 9 mathematics cluster?
- 13 What did you like most about participating in the 1 + 9 mathematics cluster?

14 What did you like least about participating in the 1 + 9 mathematics cluster?

SECTION 3: To what extent is this an effective PLC?

1 What are the most important goals that your mathematics cluster seeks to achieve?

2 Why is it important that as teachers of the mathematics cluster you must have a common goal?

3 What is the main focus of this 1 + 9 mathematics cluster?

4 Why would you describe your cluster as motivated and sharing learning vision?

5 How does learning together enhance opportunities for learners learning?

6 What do you think are the most powerful strengths of your cluster?

7 How important is sharing of ideas and meaning in your cluster?

8 How does this sharing of ideas and meaning happen?

APPENDIX G: OBSERVATION SCHEDULE

OBSERVATION SCHEDULE

Venue (Name of school):.....

Date:.....

Phase.....Grade (s).....

Subject:.....

Content area under discussion:.....

Duration of cluster meeting.....

No. of teachers:.....

Observer Name.....

Describe the focus of the cluster meeting.
Describe the participation and interaction between teachers.
Describe the knowledge and skills that teachers engage in.
Comment on how teachers share and negotiate meaning during activities.
To what extent does the cluster meeting display the following characteristics? 1. Shared values and vision

<p>.....</p> <p>.....</p> <p>2. Shared and supportive leadership</p> <p>.....</p> <p>....</p> <p>3. Collective learning and application to practice</p> <p>.....</p> <p>4. Shared personal practice</p> <p>.....</p> <p>5. Supportive conditions</p> <p>.....</p>
What challenges do teachers mention and strategies do they suggest to address these challenges?
What are creative ideas that teachers come up with to address the focus of the today meeting?