EXPLORING AN FET MATHEMATICAL LITERACY PROFESSIONAL LEARNING COMMUNITY (PLC) AS A SPACE THAT CONTRIBUTES TO TEACHER KNOWLEDGE

By

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DECLARATION

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

I, Joseph Godfrey Mshengu, Student number 214581934, declare that:

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2. This thesis has not been submitted for any degree or examination at any other university.

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_____ _____

Student Name Date

_____ _____

Name of Supervisor Signature

DEDICATIONS

This thesis is dedicated to my loving wife Jabu, my daughter Nokuthula and my son Sduduzo for the love, support and encouragement they gave me through this journey. Most of all, I will not forget them for allowing me to utilise family time to embark on this thesis.

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LIST OF ABBREVATIONS

CAPS	Curriculum and Assessment Policy Statement
CK	Content Knowledge
KC	Knowledge of Context
PCK	Pedagogical Content knowledge
KLC	Knowledge of Learners and their Characteristics
Math Lit	Mathematical Literacy
KPV	Knowledge of educational ends, Purposes and Values
Doe	Department of education
FET	Further Education and Training
GPK	General Pedagogic Knowledge
KZN	KwaZulu Natal
PLCs	Professional Learning Communities
TIMMS	Trends in International Mathematics and Science Study

ABSTRACT

According to the Trends in International Mathematics and Science Study document, there was a high failure rate in grade 9 Mathematics, and the new subject Mathematical Literacy was introduced in grade 10 to grade12 as an alternative for learners who did not do well in Mathematics. Since this was a new subject, teachers of Mathematical Literacy were encouraged to work collaboratively as clusters in order to be able to face challenges of teaching this new subject and to review their classroom practice as Mathematical Literacy teachers collectively. This idea of working as a cluster was drawn from the Integrated Strategic Planning Framework for Teacher Development which encouraged the formation of professional learning communities for teachers teaching the same subject. The objective of this study is to explore the types of teacher knowledge acquired by Mathematical Literacy teachers participating in the cluster and to further explore if this cluster reflected the characteristics of an effective professional learning community.

The study is located within the interpretive paradigm and adopts a qualitative case study approach. Purposive sampling was used to select four Mathematical Literacy teachers to serve as participants of this study. Semi-structured interviews with the participants were conducted and two Mathematical Literacy cluster meetings were observed. The study is based in uMgungundlovu district in KwaZulu-Natal. The conceptual frameworks that underpin this study are Shulman's domains of teacher knowledge which identified the types of teacher knowledge teachers need to have to be efficient in their practice, and Brodie's characteristics of an effective professional learning community.

The findings of this study show that participants mainly acquired general pedagogical knowledge, pedagogical content knowledge, content knowledge, and curriculum knowledge during cluster meetings. General pedagogical knowledge and pedagogical content knowledge were mentioned most often because teachers focussed mainly on classroom management and teaching methods to make the subject matter understandable to learners. Knowledge of learners and their characteristics was not mentioned often, and knowledge of context and Knowledge of educational ends, purposes and values were the knowledge domains least mentioned or acquired by participants. In addition it was also noted that four of the characteristics of an effective professional learning community were identified during cluster meetings: collegiality, professional collaboration, shared trust and shared values, goals and

visions. Therefore, the Mathematical Literacy professional learning community can, to some extent, is regarded as an effective professional learning community. This study recommends that more time should be allocated for Mathematical Literacy teachers to meet at least once every month. A further recommendation is that subject advisors facilitate learning activities that focus on and develop all seven domains of teacher knowledge.

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CHAPTER ONE

INTRODUTION OF THE STUDY

1.1 Introduction and background

This chapter introduces the study and presents background information. This is followed by a discussion of the focus, purpose and rationale of this study. In addition the research questions which are the backbone of this study are outlined. Next, a brief overview of the conceptual framework underpinning this study is discussed. The methodological approach as well as the design and sampling used in this study are outlined. The chapter concludes with the overview of the chapters in the dissertation.

According to the TIMMS report (2003-2015) there was a high rate of learners who failed mathematics in grade 9 therefore in 2006, Mathematical Literacy (Math Lit) was introduced into the FET band (grade10 to grade12) . The introduction of Mathematical Literacy in the FET band was met with mixed feelings by both learners and teachers. For the learners if they were doing Math Lit they were categorised as retarded or slow, because it was viewed as a generic type of mathematics for the weaker learners.

For the teachers there was anxiety about a new subject being introduced. Initially it was believed that any teacher can teach Math Lit but at a later stage it was noted that a teacher needs to have a strong mathematical background in order to be able to teach Math Lit. For this reason, teachers decided to work collaboratively. It was different for teachers than learners because some teachers viewed Math Lit positively and even called it "Democratic Mathematics'' because it was introduced after the apartheid era.

The Integrated Strategic Planning Framework for Teacher Education and Development (ISPFTED) (2011-2025) recommends the formation of professional learning communities (PLCs) as one of the requirements of teacher development, and clearly outlines that PLCs should be established by the year 2017 in South Africa. In addition, the ISPFTED pointed out that teacher knowledge and practice are statements that describe what teachers need to know and be able to do to carry out their core function professionally and effectively. It further

states that there is a need to develop more specific teacher knowledge and practice standards for each subject.

1.2 Focus and purpose

The purpose of this study is to explore the types of knowledge teachers acquire by participating in an FET Mathematical Literacy (Math Lit) PLC in Imbali circuit, UMgungundlovu district. The focus of this study was on FET (grade 10-12) mathematical literacy teachers who regularly come together as a cluster and professional learning community. This study also aims to explore the extent to which this FET Math Lit PLC is effective. In the PLC, teachers are expected to exchange knowledge, skills, and ideas to assist each other (DBE, 2011; Brodie, 2013; Brodie & Borko, 2016).

1.3 Rationale

As a teacher participating in the Mathematical Literacy PLC in the Imbali cluster, I was interested to explore to what extent this PLC serves as a space that contributes to teacher knowledge. The findings can inform the administrators/policy makers with regard to the type of guidance and supervision needed to ensure that the PLCs are supervised and directed towards the goal of ensuring that the teachers participating acquire knowledge that will influence change in their classroom practise and hence, improvement in learner achievement.

This study further looked at the relationship between teachers' professional knowledge and the knowledge acquired through participating in the PLC and its application in the classroom context for effective student learning. Magnusson, Krajcik and Borko (1999) assert that when a teacher is planning and teaching any subject he/she must apply knowledge from different domains. They also pointed out that teachers with differentiated and integrated knowledge will have greater abilities than those who have limited and fragmented knowledge.

In a handful of studies, Myende (2016) examined teacher development in PLCs and Zulu (2017) focused on teacher learning in PLCs. De Clercq and Phiri (2013) also conducted a study in Mpumalanga to understand the type of learning by teachers in clusters and the nature of the clusters. These studies highlighted a gap and need for further research which stimulated my interest to research PLCs.

Being informed by the Integrated Strategic Planning Framework for Teacher Education and Development, the FET Math Lit teachers decided to work collaboratively in the form of PLCs/clusters. The earlier studies about PLCs only focused on teacher development and teacher learning in PLCs without looking at the types of teacher knowledge acquired by teachers participating in the PLC

1.4 Research questions

This study was guided by the following research questions:

1. What types of teacher knowledge do further education and training Mathematical Literacy teachers acquire by participating in a professional learning community?

2. To what extent is this professional learning community effective in contributing to Mathematical Literacy teachers' knowledge?

1.5 Key concepts and conceptual framework

This section outlines key concepts related to this study, namely; teacher knowledge and professional learning communities. The conceptual framework is also explained.

1.5.1 Types of teacher knowledge

The literature discusses different types of knowledge that teachers need to have to be effective in their practice in the classroom (Grossman, 1990). Shulman (1987) asserts that there are types of knowledge which guide teachers' behaviour during classroom practise and it is termed craft knowledge.

Shulman (1987) discussed the seven domains of teacher knowledge. The first domain is Content Knowledge (CK) which she described as understanding, skills and dispositions to be learned by learners. The second domain is General Pedagogical Knowledge (GPK) which she described as principles and strategies of classroom management. The third domain is

Pedagogical Content Knowledge (PCK) which is teachers going beyond the knowledge of the subject matter to make it understandable to others. The fourth domain is Curriculum Knowledge (Cur.K) which is the materials and programs to be followed to teach. The fifth domain is the Knowledge of Learners and their Characteristics (KLC) which describes knowing how learners should be taught according to their thinking abilities. The sixth domain is knowledge of the educational context (KC) which refers to knowledge of cultures and characteristics of communities where the school is situated. The seventh domain is the knowledge of educational ends, purposes and values (KPV) which refers to understanding the policies and historical background of education(Shulman,1987)

In addition, Grossman (1990) drew from Shulman's domains and developed four domains which she outlined as follows: Content Knowledge which is described as the deep understanding the teacher must have of the concepts of the subject. Pedagogical content knowledge is the type of knowledge which enables the teacher to teach effectively, irrespective of the subject specialisation. General pedagogical knowledge refers to the organisation and classroom management, assessment strategies and general understanding of the classroom organisation, and finally he came up with curriculum knowledge which he referred to as knowledge of the curricular programs and materials or topics of a specific subject at any given level or across the grades.

Knight (2002) maintains that the abovementioned types of knowledge are propositional, meaning they are the knowledge of principles, ideas and concepts coming from books. However, he pointed out that propositional knowledge underpins practical knowledge which includes both what one has acquired in their minds and what they can put into action (Knight, 2002).

1.5.2 Professional Learning Communities (PLCs)

Bolam, McMahon, Stoll, Thomas, Wallace, Greenwood, Hawkey, Ingram, Atkinson and Smith (2005) assert that a PLC refers to a group of teachers sharing and critically debating their practice regularly in a reflective, collaborative and inclusive learning oriented, growth-promoting way of operating as a collective enterprise. However, DuFour (2004) argues that there is no clear definition of a PLC, but when a group of teachers come together and work

collaboratively with their focus on learning rather than teaching and hold themselves accountable for results, they can then be defined as a PLC.

Brodie (2013) argues that professional learning communities (PLCs) are teachers who critically interrogate their practice in an on-going, reflective and collaborative manner to promote and enhance student learning. My study will seek to understand the types of knowledge teachers acquire and the extent to which the PLC where the study was conducted displays the characteristics of an effective PLC. Jafaar (2009) as cited by Brodie (2013) discusses four characteristics of an effective PLC namely to have a challenging focus, have trust, collaborate professionally and finally engage in rigorous enquiry. Literature will be discussed in more details in Chapter Two.

1.5.3 Conceptual framework

This study will adopt Shulman's (1987) seven domains of teacher knowledge as a conceptual framework. Shulman's domains of teacher knowledge will further be used to analyse data to address the first research question: What types of teacher knowledge do FET Math Lit teachers acquire by participating in a PLC?

This study will further use Brodie's (2013) eight characteristics of an effective PLC as conceptual framework, which are shared values and vision, having trust, collaborating professionally, engaging in rigorous inquiry, sharing and critically debating their practice regularly, focus on student learning and thinking, use of actual classroom information and reflection on the part of the teacher. This will be used to analyse data to address the second research question: To what extent is the PLC effective in contributing to Math Lit teachers' knowledge? The conceptual framework will be discussed in detail in Chapter Two.

1.6 Methodological approach

This study adopted a qualitative methodological approach which is guided by the assumption that reality is subjective (Krauss, 2005). The intention of my study is to explore the types of knowledge teachers acquire from participating in a Math Lit PLC. A qualitative methodological approach was suitable for my study because as a researcher I observed the activities that took place in the FET Mathematical Literacy PLC and also conducted semi-structured interviews with the teachers who took part in the PLC to collect data regarding the

types of teacher knowledge acquired. I was further guided by the ontological assumption that reality can be supported by the viewpoints of the individual.

1.6.1 Research design

A case study research design was adopted in this study. According to McMillan and Schumacher (2010) a case study examines a bounded system, a case, over time in depth, employing multiple sources of data found in the setting. The case may be a program, an event, an activity, or a set of individuals bounded in time and place. The researcher defines the case and its boundary.

This study adopted an exploratory case study, because as a researcher I intended to explore the Math Lit cluster/PLC at its context, which when Math Lit teachers meet and collaborate as a cluster

1.6.2 Sampling

Sampling refers to selecting the relevant participants for your study from a bigger population in order to collect data (McMillan & Schumacher, 2010).

This used purposive sampling because as a researcher I was looking for participants (teachers) who were easy to reach, approach and who participated in the Mathematical Literacy PLC in Imbali circuit.

1.7 Overview of the dissertation

Chapter One presents the background, focus and purpose of the study as well as the rationale of the study, key concepts, methodological approach and research design, and outline of the conceptual frameworks.

Chapter Two presents the literature review and the detailed conceptual frameworks of the study on teacher knowledge in professional learning communities. This chapter explains relevant key concepts on teacher knowledge and professional learning communities. The

conceptual framework of Shulman's domains of knowledge and Brodie's characteristics of effective PLCs is also explained.

Chapter Three describes the interpretive paradigm, qualitative methodological approach and exploratory case study research design. The research context, sampling strategy, data collection instruments and ethical considerations are also described.

Chapter Four presents the data and discusses the analysis of data. The findings of the study are also highlighted.

Chapter Five summarises the findings on the types of teacher knowledge acquired by the FET Mathematical Literacy teachers participating on the PLC and the characteristics of an effective PLC. The recommendations and the conclusion of this study are also discussed in this chapter.

1.8 Conclusion

The focus and purpose of the study have been discussed in this chapter. The rationale and motivation to conduct this study was also discussed. The background information and research questions of the study were presented in this chapter. An outline of relevant key concepts and the conceptual framework was further discussed.
In the next chapter, the literature review on teacher knowledge and professional learning communities as well as the conceptual framework is discussed.

CHAPTER TWO

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2. 1 1ntroduction

The literature review begins with an outline of professional development. This is followed by a discussion of professional learning communities (PLCs) and characteristics of an effective PLC. These discussions are supported by national and international literature. This is followed by a discussion of mathematical literacy as a subject. In conclusion, this chapter outlines the conceptual frameworks underpinning this study, namely Shulman's domains of teacher knowledge and Brodie's characteristics of an effective PLC.

2.2 Professional development

Professional development is defined by many authors as the phenomenon where a professional seeks deeper understanding and insight into his/her profession. It involves undergoing workshops and further trainings related and relevant to that particular profession. According to Adey (2004) as cited by Bertram (2011) the starting point for any successful professional development process is the nature of an intervention which is underpinned by evidence that it really works to enhance the quality of learning.

Darling–Hammond (1994) defines professional development as a process of enhancing teachers' professional status by expanding the knowledge base upon which the profession draws teachers' awareness. On the other hand, Day (1999) asserts that professional development refers to the means by which teachers and other members of the teaching profession improve their knowledge and skills to develop the personal qualities required in their profession. Sometimes professional development is called Continuing Professional Development (CPD).

In the South African context, CPD refers to the process whereby teachers improve their skills, knowledge and attitudes while they are employed (Hendricks & Bosschott, 2009). The Department of Basic Education has run a number of workshops which focus on how to teach

the curriculum (Bertram, 2011) however, learner achievement has not significantly improved. Guskey (2000) defined professional development as the process and activities designed to improve professional knowledge, skills and attitudes of educators to improve learning of their students. Avalos (2010) contends that professional development is about learning how to learn and transforming knowledge into practice for the benefit of learner performance. In this definition, professional development is defined in relation to learning and knowledge. Darling-Hammond and Richardson (2009) argue that the content of teachers' professional development should be centred on student learning and involve active teaching, assessment, observation and reflection. In addition, they maintain that peer observation of practice, shared analysis of students' work and information, and engagement in study groups will satisfy all the learning needs of teachers. Borko (2004) asserts that in order to understand teacher development we must study it within multiple contexts. For teachers as professionals, one component of their professional development is professional learning communities (PLCs) which is a concept discussed below.

2.3 Professional Learning Communities (PLCs)

According to Stoll (2011) there is no single definition of a PLC, but the broad agreement is that it is an inclusive and mutually supportive group of people with a collaborative, reflective and growth-oriented approach towards learning more about their practise in order to improve learner performance. Moreover, Hargreaves (2002) defines PLCs as teachers who grow and improve their professional practice by sharing and reflecting together on their experiences and practices. Furthermore, Dufour (2004) pointed out that a PLC is a collective learning that is aimed at improving student learning.

Brodie and Borko (2016) assert that a PLC is another aspect of teacher development where teachers come together and share their vision of improved learner performance. They further state that although the formation of PLCs was a Department of Education initiative; teachers need to play an active role in their learning.

Aipinge (2007) as cited by De Clercq & Phiri (2015) asserts a PLC is a form of teacher development whereby teachers from neighbouring schools are brought together to improve the quality of education by enabling the sharing of resources, experience and expertise among clusters by pooling resources from several schools to be shared equally. Jita and Ndlalane

(2009) contend that clusters (PLCs) encourage teachers to assist one another in understanding their practice in the form of collaborative learning, In addition, Hord (2009) states that PLCs are communities of professionals caring for and working to improve student learning together, by engaging in continuous and collective learning on their own. Furthermore, the author pointed out that PLCs have a consistently positive impact on student achievement, and is good for those teachers who still believe in professional reflection and collaboration as best ways to achieve good results (Hord, 1997). Jita and Mokhele (2014) contend that PLCs enhance content knowledge and pedagogical content knowledge. It also benefits teachers to have an opportunity to collaborate, share and reflect on their experiences.

A PLC refers to a group of teachers sharing and critically debating their practice regularly in a reflective, collaborative, inclusive learning oriented, growth-promoting way of operating as a collective enterprise (Bolam, et al. 2005). Brodie (2013) argues that professional learning communities (PLCs) are teachers who critically interrogate their practice in an on-going, reflective and collaborative manner to promote and enhance student learning. Weindling (2005) refers to teachers who work collaboratively as collaborative professionals. He further points out in his study that in American schools where there was collaboration between teachers a high level of student achievement was noticed (Weindling, 2005). This suggests that collaborative professionals are synonymous with a professional learning community (PLC) because the emphasis is on teachers working collaboratively and seeing better student performance. Weindling, (2005) goes on to argue that there are a number of government policies that show that teachers are required to work collaboratively.

Weindling (2005) conducted research in English schools and found that teachers who were the participants in his study agreed that working collaboratively improved their teaching and made them reflect on their practices and further improved pupils' learning. PLCs were established in countries like China, America, Israel and Switzerland. According to Brodie & Borko (2016) the key issue associated with PLCs is collaboration among school teachers. Fataar and Feldman (2016) and DuFour (2004) agree that the focus of PLCs is how students learn what teachers teach. In PLCs teachers get a chance to take a lead in reflecting and responding to their practice to foster educational change (Loughran, Berry & Mulhall, 2012). During PLC gatherings, teachers are expected to equip each other with knowledge and skills that will enable them to address the challenges they experience in teaching and learning specific subject matter (Hammond et al., 2009). In addition, they contend that teachers are likely to practice what they learned from the PLC in their classrooms (Hammond et al, 2009).

According to Vescio, Ross and Adams (2007), who conducted a study in America, discovered that well developed PLCs have a positive impact on both teaching practice and students' achievement. On the other hand, Hammond et al. (2009) contend that in American schools where teachers were participating in PLCs actively, there was less absenteeism of students and there was also a reduction in the number of drop outs. According to Bolam et al.'s (2005) study which was conducted in Europe, the idea of the formation of PLCs was for increasing sustainable improvements and pupil learning. However, as per international literature the aim of PLCs is to provide supportive and engaging environments for the on-going learning and development of teachers and schools to enable better learning outcomes of learners (Brodie & Borko, 2016). They further contend that in the South African context, the Integrated Strategic Planning Framework for Teacher Education and Development (ISPFTED**)** contains the recommendation of the formation of PLCs as one the requirements of teacher development, and clearly outlines that PLCs should be established by 2017.

According to Brodie and Borko (2016), in South Africa there is no tradition of collaboration between teachers and this can have a negative impact on PLCs. The teaching profession does not get the respect it deserves, for instance teachers are not well paid and there is a lot of teacher criticism in the press (Brodie & Borko, 2016). It is also noted in South Africa that the changeover of teachers from school to school affects the sustainability of PLCs (Brodie & Borko, 2016). In addition, the implementation of PLCs in South Africa is the initiative of the DBE; and that PLCs are viewed as something to be done to and for teachers instead of by and with teachers (Brodie& Borko, 2016). It is noted that in South Africa, there are tensions prevailing amongst some members of PLCs due to individual differences (Brodie & Borko, 2016). However, collective goals and norms for participation have to accommodate individual differences (Brodie & Borko, 2016).

According to DBE (2011), the idea of PLCs in South Africa extends beyond the school gates, meaning even the district support teams and neighbouring schools can become part of the PLC. It is further noted that no matter how hard the teachers push for PLCs, PLCs do not represent an immediate solution to teachers' lack of knowledge and skills (Brodie & Borko, 2016).

2.3.1 Teacher learning in PLCs

Teacher learning is a complex phenomenon which can be understood from different perspectives. The complexity theory assumes that "there are various dynamics at work in social behaviour and these interact and combine in different ways such that even the simplest decisions can have multiple pathways" (Opfer & Pedder, 2011, p.378). Lave and Wenger (1991) assert that learning is regarded as a social practice which needs interaction among people, activities and settings. They further maintain that learning is a social practice which is always situated in a broader community. Teachers who work in a PLC are encouraged to talk more with one another and reflect systematically on their practice and to facilitate a sustainable shift in practice for the benefit of their learners' achievement (Lave & Wenger, 1991) as cited by (Brodie & Borko, 2016). However, Brodie and Borko (2016) contend that PLCs need to be considered as spaces where collective learning driven by teachers' and learners' needs to take place.

Before the time of PLCs, schools were designed in such a way that an individual teacher worked alone without being given time to share instructional practices and assess students and managerial decisions with others (Hammond, Wei, Andree, Richardson & Opharnus, 2009).

It is believed that the role of PLCs is to strengthen teachers' professionalism by providing the setting and necessary support for groups of teachers and school managers in determining their developmental needs (DBE, 2011). According to ISPFTED teachers are viewed as professionals and PLCs as a space for their professional learning where teachers are expected to take control of their own development (DBE, 2011). In addition, DBE (2011) has stated that PLCs will help teachers to link their professional knowledge with the latest researched knowledge about content and practice, and therefore be able to take control of their own learning.

Zulu (2017) also conducted a study on PLCs where she focused on teacher learning in PLCs. The study's key findings (Zulu, 2017) indicated that teachers collaborated by supporting one another using team teaching willingly without being instructed by any departmental official or subject advisor. In addition, teachers collaborated during cluster meetings and outside cluster meetings in different ways like sharing teaching resources such as textbooks, worksheets and activities, tests and examination question papers, working together to plan

different ways in which to teach particular topics. Summarily, according to Zulu (2017), teacher learning does take place in clusters.

De Clercq and Phiri (2013) conducted a study in Mpumalanga to gain an in-depth understanding of the kind of learning in clusters and the nature of teacher clusters. The key findings on the study by De Clercq and Phiri (2013) was that the clusters are not working effectively because teachers in clusters only focus on moderating leaners' work and not on other development activities. However, it was also noted that they are the initiative of the DBE and therefore, cannot be regarded as a PLC.

The abovementioned studies did not focus on teacher knowledge, I therefore decided to conduct a study on PLCs focusing on teacher knowledge acquired by Mathematical Literacy teachers participating in PLCs, which I considered was missing from previous studies.

2.3.2 Characteristics of effective and sustainable PLCs

According to Bolam et al. (2005) an effective PLC must have at least some of the following characteristics: shared values and vision, collective responsibility, focus on pupils' learning, collaboration focused on learning, reflective professional enquiry, openness, networks and partnership, inclusive membership, mutual trust, respect and support. In addition, to these values, Vescio et al. (2007) mentioned shared values and norms. On the other hand, DuFour (2004) reiterates that the mission of PLCs is not that students are taught but to ensure that they learn. DBE (2011) added the following characteristics: mutual trust and respect, constructive critique, regularity, collaborative and reflective enquiry, coherent responsive change in practice and collective responsibility for student learning. Furthermore, Hord (2009) added that an effective PLC must have the following characteristics: shared and supportive leadership, supportive structural conditions, and supportive relational conditions. However Hord (2009) asserts that members are expected to meet regularly to review the progress of their community. The author highlights that the principal needs to play a leading role in the formation of a PLC in his/her school by setting time aside for the PLC members to meet. Moreover, Marzano (2007) as cited by DuFour, (2011) contends that PLCs must ensure that students have access to the same knowledge and skills, and also need to monitor student learning on a daily basis. According to Brodie and Borko (2016), the aim of PLCs is to generate collective change in practice where all teachers need to pull towards the same direction so that the learners can experience the link.

Dufour et al. (2008) identified several characteristics of the PLC. Firstly, a shared mission, vision, values and goals focused on student learning. Secondly, a collaborative culture which promotes learning as he emphasised that working together is highly valued. Thirdly, a collective inquiry into best practices and the emphasis is on sharing ideas with the group members. Fourthly, a commitment to continuous improvement highlighting that the main purpose of PLCs is to promote teacher learning and improving student achievement. Finally, a results orientation which means PLCs are result oriented. Stoll (2011) asserts that a functioning PLC should have the following characteristics: collaboration, collective responsibility, teacher -driven trust and relationships, groups and individual learning.

Vescio, Ross and Adams (2008) suggest that PLCs need to engage more teachers as collaborative endeavours. In other words, teachers need to be fully involved in PLCs. Steyn (2013) outlines the following characteristics of the PLC: a shared vision for learning and responsibility, a primary focus on teaching and learning, uninterrupted improvement, a collective investigation of teaching practice, reliance on reflection, experimentation and dialogue, scheduled opportunities for collaboration, and a genuine commitment to learning. A cluster having most of the abovementioned characteristics can therefore be regarded as an effective PLC. Brodie (2016) contends that for a PLC to be regarded as effective it must have the following characteristics: shared values and vision; have trust; professional collaboration; engage in rigorous enquiry; sharing and critically debating their practice regularly; focus on student thinking and learning; use actual classroom information and encourage reflection of the teachers.

The above characteristics of an effective PLC by different scholars have some common characteristics which are sharing among teachers; collaboration; focus on student learning; reflection by teachers on their practice; common vision and values. I can therefore conclude that a group or cluster of teachers reflecting some of the characteristics mentioned above can be regarded as an effective PLC.

2.3.4 The benefits of Professional Learning Communities

Gordon (2008) asserts that knowledge is constructed and accomplished when individuals collaborate to share ideas or problems of different perceptions and come up with one meaning. On the other hand, Dodge and Kendall (2004) as cited by Myende (2016) argue that the benefits of being in a PLC include discovering the application of concepts in a subject, working together to address challenges, mentoring colleagues and adapting other members' points of view.

Caskey and Carpenter (2012) concur that teachers within the PLC learn to share classroom practices in order to improve their own teaching. This allows teachers to be committed in working collaboratively with other members. Myende (2016) argues that teachers often learn from one another; it assists them in improving their knowledge of teaching. However, teacher discussions and working together will allow teachers to participate fully and thus; their knowledge of teaching is strengthened.

According to McLaughlin & Talbert (2006) PLCs help to build and manage knowledge to improve practice. Therefore, professional learning communities offer the opportunity for teachers to reflect on different types of knowledge and daily problems of their practice. Dufour et al. (2008) argues that professional learning communities should eventually benefit and meet the needs of learners. The main objective of PLCs is to work together to improve results of the learners.

2.4 Teacher knowledge

Shulman (1987) who is regarded as the key scholar on teacher knowledge identified seven types of teacher knowledge namely, content knowledge, curriculum knowledge, general pedagogical knowledge, pedagogical content knowledge ,knowledge of learners and their characteristics ,knowledge of educational context, and knowledge of educational ends, purposes and values. The abovementioned types of teacher knowledge by Shulman (1987) will each be discussed in details below.

2.4.1 Content Knowledge (CK)

Shulman (1987) argues that Content Knowledge is defined as the knowledge of subject matter/content that the teacher teaches in the classroom. Grossman (1990) concurs with Shulman's description. In addition, Shulman (1987) points out that content knowledge is organised using Bloom's cognitive taxonomy. However if a teacher has a strong content knowledge he/she is able to explain the subject matter in different, interesting ways. Windschitl (2004) describes content knowledge as knowing and understanding the concepts, laws and principles of the subject.

2.4.2 General Pedagogical Knowledge (GPK)

Shulman (1987) asserts that GPK is knowledge whereby a teacher maintains, controls and organises the class. In addition, he contends that class discipline and organisation of learners, class rules and interaction between a teacher and learners are the components of general pedagogical knowledge. These are principles and strategies of classroom management (Shulman, 1987). According to Grossman (1990) this knowledge includes features like how learners learn in classroom, the curriculum that is offered, and the method of instruction and how the classroom is managed. Straker (as cited in Bertram, 2011) explains that general pedagogical knowledge includes the different teaching and assessment strategies used by the teacher as well as classroom management strategies. Windschitl (2004) describes general pedagogical knowledge as organising learners and materials to be used.

2.4.3 Pedagogical Content Knowledge (PCK)

This is described as the knowledge of presenting content or subject matter in such a way that learners understand it. According Shulman (1987), PCK is the knowledge that combines content and the presentation of subject matter to a broad range of learners who have different abilities and interests. Grossman (1990) contends that PCK is teaching the subject content in a way that is accessible to learners. Similarly, Bertram (2011) asserts that PCK is the way in which the teacher rearranges the content knowledge so that the learners are able to understand it. According to Windschitl (2004), pedagogic content knowledge can be defined as learners' prior knowledge at different ages.

2.4.4 Curriculum Knowledge (Cur.K)

Curriculum knowledge is the knowledge of what should to be taught to a particular grade of learners(Shulman,1987) and Grossman (1990) concur that this is the knowledge of the curricular programs and materials or topics of a specific subject at any given level or across the grades. However, Grossman (1990) argues that curriculum knowledge is a component of PCK.

2.4.5 Knowledge of Learners and their Characteristics (KLC)

Shulman (1987) describes KLC as knowing the learners and their different learning abilities. She further pointed out that teachers need to know that learners have different levels of intelligence (Shulman, 1987).

2.4.6 Knowledge of educational contexts (KC)

Shulman (1987) and Grossman (1990) both describe this as the knowledge of factors that influence teaching. In addition, they describe it as the knowledge of the school setting, culture of the school, the community and the resources available in the school.

2.4.7 Knowledge of educational ends, purposes and values (KPV)

Shulman (1987) is the only author with this category of knowledge. Grossman (1990) classified this type of knowledge as a component of PCK, where the teacher has to know the purposes and values of teaching a subject in a specific grade.

Grossman (1990) draws on Shulman and outlines four types of teacher knowledge namely; subject matter knowledge which he describes as the knowledge of the content of the subject area which is regarded as major facts and concepts within the field. Knowledge of context is described as the knowledge teachers need to have to understand the context in which they teach to adapt their general knowledge to school settings and individual students. Pedagogical content knowledge is the type of knowledge which enables the teacher to teach effectively irrespective of the subject specialisation. General Pedagogical Knowledge refers to the organisation and classroom management, assessment strategies and general understanding of the classroom communication.

Knight (2002) maintains that the abovementioned types of teacher knowledge are propositional, and describe the knowledge of principles, ideas and concepts in books. However, he points out that propositional knowledge underpins practical knowledge which includes both what one has acquired in their minds and what they can put into action.

2.5 Mathematical Literacy as a subject

According to National Council on Education and the Disciplines (NCED) (2001), as cited in Brombacher, (2007) all citizens are expected to be mathematically or numerically literate in the twentieth century. It was further noted that "the introduction of computers has created the world that is represented through numbers, graphs and tables and statistics in the variety of forms" (Brombacher, 2007, p.13). However Brombacher (2007) concluded that there is a need to introduce a subject that will include mathematical needs of adult life namely; the ability to read numbers and count, to tell the time, to pay for purchases and to give change, to weigh and measure, to understand straight forward timetables and simple graphs and charts and to carry out simple calculations. It was made clear that the main focus is on the ability to apply mathematics rather than to understand its abstract ways needed by professional mathematicians. Hence, mathematical literacy was introduced as a new subject in South Africa in the FET band in 2006.

Brombacher (2007) describes mathematical literacy as a situated concept which is determined by the context of the individual. In addition, he states that the challenges of the mathematical literacy teacher are the focus on both local and global contexts and the development of both situated and abstract competencies that can be applied globally.

As mathematical literacy was introduced after the apartheid era in South Africa, it is sometimes referred to as mathematics for democracy.

Brombacher (2007) asserts that unlike traditional mathematics programmes, mathematical literacy teaches people to manage their finances, to understand the impact of hire-purchase agreements on their income and to recognise that there are no free cell phones as some advertisements might be misleading. However, it is noted that mathematics and mathematical

Literacy both deals with numbers and other mathematical knowledge and skills, but they are different because they serve different purposes.

2.6 Conceptual framework

This study used Shulman's seven domains of teacher knowledge and Brodie's notions of effective PLCs as conceptual frameworks. Shulman's domain of teacher knowledge will assist in analysing the first research question which is "What types of teacher knowledge do FET Math. Lit teachers acquire by participating in a PLC?"

Grossman (1990) contends that pedagogical content knowledge (PCK) has the influence in all types of teacher knowledge because it helps teachers to assist their learners in understanding what they are being taught. In addition, general pedagogical knowledge and content knowledge are also important to ensure that a teacher possesses the required expertise (Magnusson, Krajcik & Borko, 1999). They further describe PCK as the type of knowledge that transforms other types of knowledge in teaching.

This study also used Brodie's (2013) notion of effective PLCs. This was useful for answering the second research question which is: To what extent is this PLC effective in contributing to Math. Lit teachers' knowledge? Brodie (2013) defines professional learning communities (PLCs) as teachers who critically interrogate their practice in an on-going, reflective and collaborative manner to promote and enhance student learning. This study aims to examine the extent to which the mathematical literacy PLC is effective. Jafaar (2009) as cited by Brodie (2013) discusses four characteristics of an effective PLC which are having a challenging focus, having trust, collaborating professionally and finally, engaging in rigorous enquiry. In addition, Brodie (2013) outlines several characteristics for the PLCs to be effective such as a focus on student thinking and tasks, use of actual classroom information, encourage reflection on the part of teacher, and promote the development of professional learning communities. According to Brodie and Borko (2016), PLCs aim to enhance teacher effectiveness as professionals for the benefit of students.

The above literature is reviewed in relation to this study because most of the literature reviewed is about teacher knowledge and PLCs, however this study explore the types of teacher knowledge acquired by Math Lit teachers participating on the PLC.

2.7 Conclusion

This chapter discussed the professional development of teachers. It also discussed professional learning communities (PLCs) as one of the examples of professional development. In addition, a brief discussion of teacher learning in PLCs and characteristics of effective PLCs was outlined. The chapter also discussed teacher knowledge outlining the different types of teacher knowledge. Mathematical Literacy as a subject was also discussed. To conclude, the conceptual frameworks of the study were outlined. In the next chapter, the research design and methodology adopted in the study will be discussed.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

The previous chapter reviewed literature on professional learning communities and teacher knowledge. It also presented the conceptual framework based on Shulman's (1987) domains of teacher knowledge and Brodie's (2016) characteristics of effective professional learning communities. This chapter presents a discussion of qualitative methodology and the interpretive paradigm is also discussed thereafter, because interpretive paradigm falls under the framework of qualitative research approach. The case study research design is also discussed. In addition, the context of the study and sampling of participants, methods of collecting data and data analysis are discussed. To conclude, the chapter discusses trustworthiness and ethical considerations related to this study.

3.2 Research approach

This study adopts a qualitative approach, which is guided by the ontological assumption that reality is subjective or can be supported by individuals' viewpoints. In the qualitative approach, the researcher is the key to collecting data for the research and this ensures trustworthiness and credibility (Creswell, 2007).

The qualitative methodological approach was suitable for this study because as the researcher, I observed the activities taking place in the Mathematical Literacy PLC and I also conducted semi-structured interviews with the teachers taking part in the PLC to collect data regarding the types of teacher knowledge acquired.

3.3 Research methodology and design

According to Cohen, Manion and Morrison (2011) a research methodology is a series of steps used to collect data in order to come up with answers to the research questions. Creswell (2014) contends that a research methodology is the activities and planning of the study. On the other hand, McMillian and Schumacher (2010) describe a research methodology as the procedure followed when conducting a study.

3.4 Research paradigm

There are a number of theoretical paradigms a researcher can choose from namely: positivist, critical, pragmatist and interpretive paradigms (Mackenzie & Knipe, 2006). This study is situated within the interpretivist paradigm. The study was concerned with the understanding and interpretation of experiences of Mathematical Literacy teachers in an Imbali cluster PLC. According to Cohen, Manion and Morrison (2012), the main aim of the interpretivist paradigm is to understand how participants view and experience the world. Moreover, Maree (2007) asserts that the interpretivist paradigm describes how people make sense of their world and how they find meaning in a particular action. In addition, Burton, Brundrett and Jones (2008) describe the interpretivist paradigm as involving insight, deeper knowledge and understanding of human behaviour and relationships.

The adoption of the interpretive paradigm for this study afforded me the opportunity to understand and make sense of teachers' views, their experiences of teacher knowledge and professional learning communities based in their contexts. The nature of knowledge in the interpretivist paradigm is understood as socially constructed by those in the research process and my role as a researcher, as stated by Robinson (2002), was to understand the complex experiences from the participants point of view.

This paradigm allowed the researcher to gain a deeper insight into understanding the types of knowledge Mathematical Literacy teachers acquire from participating in the PLC. Cohen et al. (2012) assert that in the interpretivist research paradigm, individuals are observed and studied with their views, behaviours and attitudes. According to Cohen et al. (2012) the interpretivist paradigm uses certain methods to collect and generate data. This includes interviews, observations, general conversations, notes and memos. Therefore, these methods are ideal for data collection in this study supported by the interpretivist paradigm as it aims to explore if the PLC serves as a space that contributes to teacher knowledge

3.5 Research design

The research design is defined as the entire plan for a proper research study (Perry & Nichols, 2015). There are a number of types of research designs such as surveys, action research, experimental research and case studies to mention a few. This study adopted a case study research design.

3.5.1 Ontology and epistemology of the case study

Maree (2007, p.53) describes an ontology as "the study of nature and form of reality or truth". The ontology underpinning this exploratory case study is people in their social context, their interactions and relationships and how they understand their reality. Maree (2007) further states that the researchers create their findings based on the responses of the participants. This study used a nominalist position because interaction with participants was in their context which is where they hold their cluster meetings. An epistemology is how we discover the truth or method of knowing reality (Maree, 2007). According to Maree (2007) an epistemology investigates why people act in a particular way and data is collected using the experiences and voices of the participants. In this study, the interviews with teachers were conducted to find out the types of knowledge they acquire by participating in the PLC.

3.5.2 Definition of a case study

According to Maree (2007), case study research tries to understand how participants make meaning of a phenomena and how they behave and act in a specific situation. McMillan and Schumacher (2010) assert that: A case study examines a *bounded system*, a case, over time in depth, employing multiple sources of data found in the setting. The case may be a program,

an event, an activity, or a set of individuals bounded in time and place. The researcher defines the case and its boundary (p.24).

Rule and John (2011) contend that there are many definitions of the case study. However they define a case as a problem that exists within a particular person or institution. In addition, they define case study as an examination of a case in order to get knowledge and understanding about that case. Furthermore, they point out that case study is a comprehensive study of a particular case within its context to generate knowledge and understanding. According to Yin (2003), a case study refers to acquiring knowledge about the situation through observation and experience rather than through theory, especially when there are no boundaries between the case and its context. On the other hand, Cohen, Manion and Morrison (2011) describe a case study as the methodological approach that is designed to study and explain a single instance of a system in action. Furthermore, they pointed out that a case study is a study of a particular system such as a school or a community.

3.5.3 Types of case studies

Yin (2003) identified three types of case studies namely; an exploratory case study, a descriptive case study and an explanatory case study. He described an exploratory case study as the type that investigates situations where the intervention is evaluated and he pointed out that it can be used as a pilot study for other studies. A descriptive case study describes a phenomenon in its context. On the other hand, an explanatory case study explains relationships in real life phenomena. According to Yin (2003), a researcher can use either a single case study or multiple case studies. Single case studies investigate a phenomenon in its context, while multiple case studies look at differences within a number of cases to replicate the findings across them. This study is a single exploratory case study, because it intends to obtain a better understanding of the type of knowledge acquired by Math Lit teachers participating in the PLC. An exploratory case study research design provided me as the researcher with rich descriptions to obtain more meaningful insights into whether the Mathematical Literacy PLC served as a useful space to contribute to teacher knowledge. In addition, it allowed me to understand the phenomenon of teacher knowledge in its context (Rule & John, 2011).

3.5.4 Strengths and weaknesses of case studies

According to Mackenzie and Knipe (2006) case studies are flexible and can use different methods of data collection and data analysis. In this study, semi-structured interviews and observations were used. The information provided can be easily understood without any special skills in interpretation. Findings can be used by larger communities and contribute to policy making decisions, institutional and personal development (Swanborn, 2010). Cohen et al (2007) assert that one researcher can investigate a case study and unexpected events can be incorporated.

However, case studies may be vulnerable to inaccuracies because of the influence the researcher might have on the facts and decisions they make. According to Cohen et al. (2007) the results of the case study may not be generalizable, except where other researchers use the similar case study for further research. Gate keepers in the case study can limit the study and reserve information needed for the research (Cohen et al. 2007).

3.6 Research Questions

This study was guided by the following research questions:

1. What types of teacher knowledge do further education and training Mathematical Literacy teachers acquire by participating in a professional learning community?

2. To what extent is this professional learning community effective in contributing to Mathematical Literacy teachers' knowledge?

Both the above questions are addressed through the responses by the participants and observation of cluster meetings.

3.7 Research context

The research context is the place where the data is collected and in this study, the research context was one of the secondary schools in uMgungundlovu district where the FET Math. Lit teachers meet as a cluster/PLC. From this cluster six Math Lit teachers were invited to participate in the study. The school that is used as the venue for the cluster meetings has a

spacious school hall that can accommodate a number of teachers who want to do some activities and work in groups. It was also chosen as the meeting venue because it is a central location and all teachers can easily get there.

3.8 Sampling strategies

Sampling refers to selecting relevant participants for your study from a bigger population in order to collect data (McMillan & Schumacher, 2010). According to Ritchie and Lewis (2003), there are different types of sampling methods, such as snowball sampling, purposive sampling and convenience sampling etc. In many cases, purposive sampling is used as an appropriate method to focus on participants with in-depth knowledge based on the issue being studied (Cohen et al. 2011). In this study, I used purposive sampling because I was looking for participants who are mathematical literacy teachers who participate in the Imbali Mathematical Literacy PLC in UMgungundlovu district. Therefore, I invited six FET Mathematical Literacy teachers because they have knowledge Mathematical Literacy as a subject and are also members of the cluster. The invitation to participate was driven by the research questions of the study where the first question aimed to understand the type of knowledge acquired by FET Mathematical Literacy teachers. The second question aimed to understand if the cluster was functioning as an effective PLC. In purposive sampling, researchers "hand-pick the cases to be included in the sample on the basis of their judgment of their typicality or possession of the particular characteristics being sought." (Cohen, Manion & Morrison, 2009, p.156). I invited participants based on their expertise and knowledge and potential to answer the two research questions.

3.9 Data collection instruments

To answer the research questions, semi-structured interviews and observations of cluster meetings were used to collect data in this study.

3.9.1 Semi-structured interviews

According to Lauer (2006, p.37), "an interview is a survey that is administered verbally either individually or in groups". Interviews allow the researcher to access participants' experiences, views and how they perceive the world. The semi-structured interview often

asks open-ended questions and probes the responses. Semi-structured interviews permit the researcher to query, ask further questions and provide a more relaxed and friendly environment in which to collect data (Robinson, 2009).

Braun and Clarke (2013) contend that the interviewee is asked a number of open-ended questions related to the study and the respondents are expected to answer them in their own words. This is one way of collecting qualitative data.

During the interview, the interviewer is able to clarify questions for the participants if need be (Brynard, Hanekom & Brynard, 2014). According to Curtis, Murphy and Shields (2014), semi-structured interview questions are set in advance but the researcher can easily be changed to enable the participants to give their opinions. The interviewees may feel more content having a conversation with a researcher as opposed to filling out papers in a survey. The semi-structured interviews were suitable for my study because I obtained the responses directly from the participants and probed for more information and clarified questions where needed. I conducted all semi-structured interviews individually with each participant. Some interviews were conducted after school hours, some in libraries and some in restaurants. Semi-structured interviews were carried out to understand the teachers' perceptions of the Mathematical Literacy cluster regarding the types of teacher knowledge acquired and aimed to examine mathematical literacy teachers' understanding of activities they were involved in during PLC meetings. As a researcher, l also arranged follow- up interviews where necessary.

3.9.2 Observations

Observation is defined as a data collection technique which relies on direct observation of the participants in the study (Bless & Higson-Smith, 2000). The challenge with collecting data using observation is ensuring that your presence as a researcher does not affect the behaviour of the participants in the setting. In this case, the observation was based on describing the activities in a Mathematical Literacy cluster. Therefore, the observation schedule was designed indicating activities and periods of each activity. This helped me to record each activity and the duration of activities in cluster meetings. Observations can either be overt or covert (Burton & Bartlet, 2009). Informal and covert observation means that those who are being observed will not be aware. During the formal and overt observation, those who are being interviewed are aware that they are being observed and this may influence socially desirable responses (Burton & Bartlet, 2009). In addition, the authors point out that it is

important to consider the research ethics when observations are being conducted (Burton & Bartlet, 2009). This study used formal and overt observations, because as a researcher I made the participant aware that I am observing the activities in the cluster meeting and recording their responses in my observation schedule.

According to Bless and Higson-Smith (2000) observation is a data collection method which relies on direct observation of participants by the researcher in the study. A good observation protocol needs to have clear guidelines regarding what is to be observed (Lauer, 2006). Observations were suitable for this study because they helped me to collect data to address the second research question. As a researcher, I observed the activities taking place in the Mathematical Literacy PLC. I used the observation schedule to be guided on what to observe during the activities that took place during the PLC. All activities were recorded on the observation schedule. However, like other data collection tools, observations have limitations.

When the participants are being observed they sometimes perform better to impress the observer (Cohen et al.2011). This can affect the credibility of the study. However, Kraus (2005) argues that many researchers believe that to understand what is going on one need to be immersed in it. Observation allowed me to be part of the Mathematical Literacy cluster. This allowed me to have in-depth insights into teachers' activities during their cluster meetings. Observations allowed me as a researcher to examine the PLC and the extent to which it was effective related to the literature.

Burton and Bartlet (2009) highlight that the strengths of observation are that it is easy to see how people behave in their context and detailed data can be generated in a short space of time. They further note that the weaknesses of conducting observations are that sometimes it can be difficult for the researcher to observe and write at the same time. It can also be difficult to observe a large or scattered population. It is also important for the researcher to follow ethical principles before starting observations (Burton & Bartlet, 2009).

3.10 Data Collection Methods

The table (Table1) gives the outline of the data generation plan:

Table 1

Research Question	Data generation method/instrument	Data source	Anticipated analysis	Time Line
1. What types of teacher knowledge do FET Math Lit teachers acquire by participating in a PLC?	Semi–structured interviews, using the interview schedule	Imbali cluster FET Math Lit teachers.	Shulman's (1987) seven domains of teacher knowledge: • Content knowledge • Pedagogical Content Knowledge. • General Pedagogical Knowledge. • Knowledge of Context. • Curriculum Knowledge. • Knowledge of learners and their characteristics. • Knowledge of educational purposes and values.	February-July 2018
2. To what extent is this PLC effective in contributing to Math Lit	Observations of cluster meetings using the observation schedule.	Observing Imbali Math Lit cluster meetings.	Brodie's (2013) eight characteristics of an effective PLC. • Shared values and vision.	February-July 2018.

teachers' knowledge?			• Professional collaboration. • Have trust. • Engage in rigorous enquiry. • Sharing and debating the practice regularly. • Focus on student learning and thinking. • Use of actual classroom information. • Encourage reflection on the part of a teacher.	

Summarily, data was collected using semi-structured interviews and observations of cluster meetings. Participants were made aware that their activities were being observed using the observation schedule. Observation can either be semi-structured or unstructured. During the unstructured observation the observer is unsure of what he/she wants to observe. However, with the semi- structured observation the observer is clear about what he/she wants to observe guided by the observation schedule (Cohen et al., 2014). This study utilised structured observation as activities in cluster meetings were observed using the observation schedule which was prepared beforehand.

3.11 Data Analysis

According to McMillian & Schumacher (2001) data analysis is the process whereby data is arranged into categories and patterns and relationships are identified in order to find meaning in it. Maree (2007) asserts that when analysing data, qualitative researchers start from a specific data which leads them to categories and patterns that result into general themes and conclusions.

In this study, thematic analysis was used to analyse data from the semi-structured interviews. The semi-structured interviews were recorded using a digital voice recorder. The audio-recorded information was transferred from the voice recorder to the computer system to be transcribed manually. The common phrases or words were identified and colour coded. Cohen et al. (2011) describe coding as assigning of a category label to a piece of data responses that have been collected. Coding allows the researcher to identify similar information. In analysing the data, I grouped the responses to each research question together and analysed them separately. After this, I coded the responses using key terms that were common in the responses. Themes were then developed after coding the data.
Lodico, Spaulding and Voegtle (2010, p.185) describe themes as a "big idea that combines several codes in a way that allows the researcher to examine the questions guiding the research". This process helped me as a researcher to find common concepts and ideas to find meaning in the data. I went back to the participants to ensure that my interpretation of their responses were accurate.

Brodie's (2013) characteristics of an effective PLC were used to identify the characteristics of an effective PLC when Math Lit teachers interacted during cluster meetings. When the Math. Lit teachers were interacting during cluster meetings some characteristics of an effective PLC were identified and they were noted and led the researcher to conclude whether the cluster where the study was conducted can be regarded as an effective PLC.

3.12 Trustworthiness

Trustworthiness is important in a qualitative case study. Rule and John (2011, p.107) contend that "trustworthiness promotes scholarly rigour, transparency, and professional ethics". On

the other hand Maree (2007) claims that trustworthiness is the way in which the researcher promotes the findings in the study for the public to see it as high quality and worth consulting. It is accomplished by ensuring credibility, transferability, dependability and confirmability in a qualitative study.

Transferability is described as the way in which the reader of the study can take the findings and use them in other contexts; while credibility is a declaration by the researcher that the conclusions of the study are drawn from the data collected. Dependability is the degree at which the public accepts the findings of that particular study (Maree, 2007). Rule &John (2011, p.107) contend that "confirmability addresses concerns about the researchers' influences on the study"

To ensure that this study was trustworthy, I presented my position as a researcher to the participants and stated that I would do my best not to influence the activities of the cluster as I am a member of the cluster and also a Math Lit teacher. I explained to them that I am not there to judge their activities and knowledge, but to observe and disseminate the findings as part of my master's dissertation research study. I combined the information from semi-structured interviews and observations of cluster meetings and analysed and reported the findings. In addition, I verified the data and findings with the participants as another way of ensuring trustworthiness of the case study. Keeping the field notes during cluster meeting observations also ensured the trustworthiness of this study to enable future researchers to use my findings (Baxter & Jack, 2008). Using pseudonyms for my participants in discussing the findings also contributed in the trustworthiness of this study.

3.13 Ethical Considerations

Curtis, Murphy and Shields (2014, p.37) define ethics as matters of "compassion for the rights of others and respect for human dignity". According to McMillan and Schumacher (2010, p. 117), "Ethics are considered to deal with beliefs about what is right or wrong, proper or improper, good or bad". Once again, the rules of carrying out research are important in producing unbiased data. Thus, where necessary, pseudonyms were used. McMillan and Schumacher (2010, p. 122) assert that, "confidentiality can be ensured if no one has access to individual data or to the names of the participants except the researcher(s)

and that the subjects know who will see the data before they participate". This is to protect the subjects from undue harassment.

As a researcher I requested permission to conduct this study from the KwaZulu-Natal Provincial Department of Basic Education and I was granted permission. I also applied to the University of KwaZulu-Natal Research Ethics Committee for ethical clearance to proceed with this study. The ethical clearance was granted and then I proceeded with the study. The participants were given informed consent forms to sign before participating in the study, where it was clearly stated that they can withdraw from the study as participants should they wish to do so. The purpose of the study and information pertaining to the study was explained to the participants. The informed consent letters also explained the instruments to be used to collect the data to ensure that all participants were informed about the data collection methods and the duration of data collection. As a researcher I made sure that the participants were not exposed to unethical and uncomfortable questions which may have been stressful and too many procedures which may have been unpleasant. The interview schedule was piloted with the colleagues to ensure that there are on elements of insensitivity in the interview questions. This ensured that all participants were ethically protected.

After transcribing the interviews, transcripts from the interviews were returned to participants to check that the information had not been misinterpreted. This assured that the integrity of participants was protected and they could participate voluntarily in the study. Participants were given pseudonyms to ensure their anonymity and confidentiality. Maree (2007) asserts that anonymity of participants is another ethical issue that needs to be considered when doing research.

Curtis et al. (2014) contends that confidentiality is another important ethical issue to consider when undertaking research. Information provided by the participants is protected and not shared with other people. To maintain confidentiality, I stored all the transcripts in my supervisor's office in the university where they will be stored for five years and then destroyed.

Researchers need to make an effort to be honest with and sympathetic towards participants at all times (Maree, 2007). As a researcher I did that throughout this study by making sure that after the interview I give back the transcript to the participant to give him/her a chance to see

if the interview was correctly transcribed.

3.14 Conclusion

This chapter presented a discussion of the research design and methodology of the study. The chapter discussed the qualitative methodological approach and the interpretivist research paradigm. The case study research design and its strengths and weaknesses were also discussed. The context of the study and sampling of participants was also discussed. Methods of generating data and analysis were also described in this chapter. The ethical issues and trustworthiness considered in this study were outlined. The next chapter provides a detailed discussion of the data collected, its analysis and findings.

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

4.1 Introduction

This study focused on exploring the extent to which the Mathematical Literacy PLC served as a space that contributed to FET Mathematical Literacy teacher knowledge and whether the cluster functioned as an effective PLC. In this chapter, I present and analyse the data collected based on the activities that took place during cluster meetings, and teachers' views as cluster participants through semi–structured interviews. The data consisted of observations of cluster meetings and recorded semi-structured interviews with four participants who teach Mathematical Literacy in the FET band (grades 10-12). In presenting the data the actual responses of the participants are presented in italics. This study was guided by the following research questions:

1. What types of teacher knowledge do further education and training Mathematical Literacy teachers acquire by participating in a professional learning community?
2. To what extent is this professional learning community effective in contributing to Mathematical Literacy teachers' knowledge?

Deductive analysis was used to analyse data in this study, because the themes were deducted from the conceptual framework. Shulman's domains of teacher knowledge were used as themes to address research question one. Brodie's characteristics of effective PLCs were used as themes to address research question two.

This chapter begins with an outline of the profiles of the four participants. Secondly, I present and describe data based on semi-structured interviews conducted with four cluster participants and observations of two cluster meetings.

4.2 Profiles of participants

I used pseudonyms instead of real names to protect the identities of the four teachers who participated in this study. Participants comprised of three females teachers and one male teacher who were teaching Math Lit in grades 10-12. Their biographical data includes information such as their general teaching experience and their qualifications and experience as Math Lit teachers.

4.2.1 Qondie

Qondie is a female teacher with 11 years teaching experience and has been teaching Math Lit for three years. At the time of the study she was teaching grade 11. Her qualifications are a Bachelor of Science (BSc) in Maths and Biochemistry as well as a Post Graduate Certificate in Education (PGCE). Although Qondie is not qualified to teach Math Lit, she seems to be enthusiastic about teaching the subject. She pointed out, *Even when I encounter a problem regarding the subject matter, I am not afraid because I know the cluster members are there with support through the WhatsApp group which we all have access on, or the matter can wait until the following cluster meeting.*

4.2.2 Fezile

Fezile is a male teacher with twenty six years of teaching experience and has been teaching Math Lit for twelve years. At the time of this study, he was teaching grades 10,11and 12. His qualifications are a Secondary Teachers' Diploma (STD) with Maths and Accounting as major subjects. He further pursued an Advanced Certificate in Education (ACE) in Mathematical Literacy (Math Lit) and he obtained a B.Ed. Honours in Mathematical Literacy which is the maximum qualification in Math Lit so far. It was evident that he enjoyed teaching Math Lit as he explained:

To me it looks like what we do here as a cluster is about all that is needed for our members to be efficient and effective in our Math Lit teaching, because we all seem to be worried about better performance of our learners.

4.2.3 Khethiwe

Khethiwe is a female teacher with 16 years teaching experience and has been teaching grades 10 to 12 Math Lit for 12 years. At the time of the study she was teaching grade 12. Her qualifications include a Secondary Teachers' Diploma (STD) with Mathematics and English

as her major subjects and an Advanced Certificate in Education (ACE) in Mathematical Literacy. She pursued her studies further and obtained a B.Ed. Honours degree in Math Lit She showed great excitement at being a member of the PLC and said:

Teachers no longer struggle alone; they consult with each other on anything. Besides, if one has a problem, it becomes a problem of every member as we deal with it together; we do not wait for cluster meetings we just call each other.

4.2.4 Thuliswa

Thuliswa is a female teacher with four years teaching experience and has been teaching Math Lit for four years. For the first two years she taught grade 10, during her third year she taught grade 11 and was teaching grade 12 at the time of this study. She had a B.Ed. degree with Math Lit and Technology as her major subjects. Commenting on being a member of the PLC she said: *The way I teach is not the same as another teacher. This is because all teachers teach differently and so are learners when it comes to learning. When I am teaching, I might not reach out to all my learners but if many teachers teach together, there is a greater likelihood that most learners are going to get something out of it.*

The following section outlines participant's views on the concept of PLCs.

4.3 The concept of PLCs

According to the ISPFTED document (2011), the formation of PLCs was initiated by the Department of Basic Education and was approved as a space for teacher collaboration. It is therefore, through PLCs that teachers form clusters to share, discuss, and reflect on their daily classroom practice. My data is drawn from the four participants who were Math Lit teachers from different schools but belonged to the same cluster in the Imbali circuit. I interviewed participants at different times to allow them to share their views regarding the learning activities that took place at cluster meetings. The data was generated through individual semi-structured interviews and observation of two cluster meetings using the observation schedule. This chapter presents the data in line with the two research questions. The first research question focused on the types of knowledge acquired by participating in the PLC. This data was collected by observing the activities that took place during cluster meetings and semi-structured interviews with the participants. The second research question aimed to understand

the extent to which the cluster functioned as an effective PLC by interviewing the participants and observing cluster meetings. Different scholars have different views about the concept of PLCs, as discussed in detail in Chapter Two. Brodie (2013) concurs that above all, teachers within the PLC learn to share classroom practices in order to improve their own teaching.

4.3.1 Participant's views on PLCs

All participants during the semi-structured interviews agreed that working together in a PLC/cluster helped to ease the load of the teachers in the subject. They all seemed to be positive about the concept of PLCs and expressed that it was good to work as a cluster. Fezile emphasised: *Working as cluster also resulted in teachers moving at a similar pace in the curriculum coverage, since learners wrote their assessment tasks at the same time. This encouraged teachers to work hard to catch up with their colleagues and master aspects of their subject which they found difficult.*

At the beginning of her teaching career Thuliswa did not understand why she needed to be part of the PLC, but later on she saw the need and her view on the concept was, "*Participating in the PLC became a safe space which broke down fears and barriers to sharing".* Even the most experienced teacher like Qondie saw the need of being a member of the PLC and she also pointed out that: *Working as a cluster help in learning to work together, to improve our planning and preparation of lessons, and solve professional problems, as well as share skills and resources with others*. To echo the view of other participants regarding the concept of PLCs, Khethiwe said: *I personally feel that it is nice as teacher to belong in the PLC because whatever problem you encounter in teaching the subject, you know you are never alone, your fellow cluster members are there to support you*.

This discussion highlights that all the participants were positive about the concept of PLCs and suggested that it helped them to work together and share resources, assessment tasks and lesson plans as well as resolving professional problems.

According to Brodie and Borko (2016), the aim of PLCs is to generate collective change in practice where all teachers need to pull towards the same direction so that the learners can learn holistically. The responses of the participants concur with Brodie and Borko (2016) because it is evident that all teachers in the PLC have the common goal of their learners performing well in Math Lit. Qondie pointed out: *As I mentioned earlier on, we moderate and analyse our learners' performance for the term and try to identify the areas that need*

immediate attention in their understanding and share ideas how to help them using different methods and approaches when teaching.

Khethiwe also emphasised: *To me, it looks like what we do here as a cluster is about all that is needed for our members to be efficient and effective in their Math Lit teaching, because we all seem to be worried about the better performance of our learners.*

On the other hand Vescio, Ross and Adams (2008) suggest that PLCs need to engage more teachers as collaborative endeavours. In other words, teachers need to be fully involved in PLCs. This idea was also evident in the responses of the participants as Khethiwe asserted: *The new teachers are also encouraged to share the new ideas regarding the subject with the group members in case there is something new learned recently from the tertiary institutions.*

Furthermore Brodie (2013) asserts that PLC members are expected to meet regularly to review the progress of their community. The responses by the participants concur with Brodie (2013) who said that PLC members have to meet regularly which was not happening in their PLC. Fezile said: *We meet at the beginning of each term. In my opinion this time is not sufficient. It would be much better if we meet at least every month to monitor progress and brainstorm the constructive ideas before a lot of damage is done.*

This response by Fezile suggests that the cluster members also feel that there is a need to meet regularly. Qondie emphasised: *I can say this time is not sufficient. It would be better if we were meeting at the beginning and at the end of each term, at least to give ourselves enough time to collaborate and share more ideas*

In addition, Thuliswa expressed the need to meet more regularly as a PLC and said: *We meet at the beginning of each term to discuss the work to be covered in that term. As far as I am concerned, that is not sufficient. It would be much better if we meet at least three times per term.*

These responses by the participants are similar to one of Brodie's (2013) characteristics of an effective PLC because they all see the need to meet more regularly as a PLC, even though they have a WhatsApp group.

4.4 Types of teacher knowledge evident during cluster meetings

This section presents data to respond to research question one: What types of teacher knowledge do FET Mathematical Literacy teachers acquire by participating in a PLC? The notes from the observations of the Mathematical Literacy cluster meetings and the responses from the participants during the semi-structured interviews were used to analyse the data in response to research question one.

I observed two cluster meetings before conducting the semi-structured interviews with the four participants who are FET Maths Lit teachers participating in the same PLC. I conducted one interview with each participant and did a follow up interview where there was a need to do so.

Below are the domains of teacher knowledge as outlined by Shulman (1987) as this study aimed to explore whether these types of knowledge were evident during cluster meetings.

Shulman (1987) outlined seven domains of teacher knowledge. 1.) Content Knowledge (CK), which he described as understanding skills and dispositions that are to be learned by students. 2.) General Pedagogical Knowledge (GPK) which he described as knowing principles and strategies for classroom management and organisation of the classroom. 3.) Curriculum Knowledge (Cur.K) which he referred to as materials and programs to be followed when they are teaching the subject matter. 4.) Pedagogical Content Knowledge (PCK) which he referred to as a teacher going beyond knowledge of the subject to how to simplify it and make it understandable for learners. 5.) Knowledge of Learners and their Characteristics (KLC) is described as a teacher needing to understand that learners have different levels of intelligence. 6.) Knowledge of Context (KC) which is described as knowing the community from where learners come from. 7.) Knowledge of educational ends, Purposes Values and historical backgrounds (KPV).

Based on Shulman's (1987) outline of the seven domains of teacher knowledge, I adopted the guidelines below to identify and analyse the different domains of teacher knowledge evident in participant's responses.

To address CK from the participants' responses, the key statements I looked for were related to subject matter or content of the subject (Math Lit). To address GPK, the key statements included words such as classroom management, group work and teaching methods.

To identify PCK, the key statements I looked for described teaching strategies that were used by participants to explain subject content so that all learners could understand (Shulman, 1987).

To address KLC, the key statements from the responses had to explain how participants accommodate both weak and strong learners and teach according to the different levels of learners while showing the uniqueness of each learner.

To identify KC, the key statements I looked for needed to show the knowledge of learners' background or the background of their families.

To identify KPV, the key statements of participants had to show the knowledge of policies and rules guiding the teaching of the subject (Shulman, 1987).

In trying to address research question one; I identified the types of teacher knowledge as stated by Shulman (1987) that the participants mentioned in the form of key statements in their interview transcripts in respect to participating in the Math Lit PLC. To affirm if there was any type of knowledge acquired by PLC members, I observed their activities during the cluster meetings and also used the responses of the participants during the semi-structured interviews.

Table 2: Participants' responses about the different domains of teacher knowledge

Domain of teacher knowledge (Shulman, 1987)	**Key statements from interview transcripts.**
CK	*We share things like how to approach and introduce different concepts to learners in our schools* (Qondie). *All this is for ensuring that the teachers handle the subject content the same way and at the acceptable pace* (Thuliswa)
GPK	*We also share ideas regarding methods of approaching different concepts of the subject* (Fezile). *During moderation we check if the marking that was done to learners work was correctly done according to the set marking guidelines. We also check if the recording of marks in the mark sheets was correctly done* (Khethiwe). *We also do the analysis of learner performance. Setting of common tasks is another activity that we do, the emphasis when setting a common task is that it must be balanced based on taxonomy levels as stipulated in the CAPS document* (Thuliswa). *We even come to a point of sharing suggestions regarding the classroom set up when teaching or introducing new concepts* (Qondie).
PCK	*The cluster members especially those who have been teaching Maths Lit for while take turns and share with us the different methods they use to simplify the subject matter for the learners to enable them to understand better* (Qondie*).* *Experienced teachers help by sharing the methods they use in their teaching to help learners understand the subject better (*Thuliswa). *Most of all we use this opportunity to share better methods of delivering the subject matter to struggling learners with the help of experienced teachers* (Fezile).

KLC	*Knowing to classify questions according to taxonomy levels (*Fezile). *We also look at the balance of taxonomy levels to see if it catered for all learners as expected* (Khethiwe). *We also discuss misconceptions faced by learners and try to brainstorm ideas/solutions to help them out because we all have a wish of seeing them passing at the end of the year* (Qondie). *I end up knowing that not only my learners have challenges with some concepts, but all learners do have challenges somehow somewhere and that boosts my confidence when teaching* (Thuliswa).
KC	*It is noted that learners from rural areas perform worse than those from urban areas* (Khethiwe).
Cur.K	*Knowing to classify questions according to taxonomy levels and changes in the curriculum for examples that the formula must not be used when you are calculating interest (both compound and simple interest.) as it was done before* (Khethiwe).
KPV	*We also look at the CAPS document making sure that our teaching and assessing is in line with the CAPS document* (Thuliswa). *It also makes us feel empowered when the subject advisor unpack the CAPS document for us* (Fezile).

Table 2 presents the key statements of the participants, from the semi-structured interview transcripts and observations of two cluster meetings. It illustrates that responses about the elements of GPK were most evident in the participant's responses followed by PCK and then CK and Cur K. This suggests that these types of knowledge are discussed and shared more often during PLC meetings. However, KLC was only considered when the common assessment tasks were set.

KC and KPV are the types of knowledge less often discussed and shared by PLC members during their cluster meetings. However, their main focus is CK and PCK because they are concerned about their classroom practices and learner performance. Shulman (1987) pointed out that teachers need all these types of knowledge to teach effectively but emphasised PCK because it is a combination of both the subject content and pedagogy. In addition, he asserts

that subject content and pedagogy are needed to understand how to organise content and present it so that learners of different abilities understand it (Shulman, 1987).

4.4.1 Content Knowledge (CK)

According to Shulman (1987), content knowledge relates to understanding the skills and dispositions that are to be learned by students. He further pointed out that it is the knowledge of the subject matter that needs to be taught. Grossman (1990) calls this type of knowledge subject matter knowledge.

From the responses of the participants during the semi-structured interviews it was noted that some discussions on content knowledge take place during Math Lit cluster meetings. Fezile confirmed, *We share things like how to approach and introduce different concepts of the subject to learners in our schools".* In addition Qondie shared, *All this is for ensuring that the teachers handle the subject content the same way and at the acceptable pace.* Khethiwe emphasised, *Experienced teachers help by sharing the methods they use in their teaching to help learners understand the subject better.* These responses confirm that Math Lit teachers acquire subject matter knowledge during cluster meetings.

In addition to these participants' responses, as a researcher, I noted that the CK is evident in cluster meetings when the cluster members discussed the subject matter, helping each other with the methods of approaching problematic concepts.

4.4.2 Pedagogical Content Knowledge (PCK)

Shulman (1987) defined PCK as the type of knowledge where a teacher is expected to go beyond the subject matter so it's accessible to others. He further pointed out that it is the combination of subject content and pedagogy. Grossman (1990) concurred that PCK is the ability to teach the subject content in a way that is accessible to learners. Furthermore, Magnusson et al. (1999, as cited by Bertram, 2011) described it as a unique category of teacher knowledge which assists teachers in helping their learners understand individual subjects.

From the semi-structured interviews with participants, their responses indicated that there is an element of PCK among the activities that take place during cluster meetings. Thuliswa confirmed, *Most of all we use this opportunity to share better methods of delivering the subject matter to struggling learners with the help of experienced teachers.* Qondie also

emphasised, *Experienced teachers help us by sharing the methods they use in their teaching to help learners understand the subject better.*

From my observations of the PLC meeting, it was also evident that a secondary school teacher who was confident about teaching the concept of taxation was requested by the cluster co-ordinator to share her method of teaching the concept with other fellow PLC members. She gave step-by-step notes that she used with her learners to teach taxation in a simple and understandable manner for them. This also illustrates the notion of PCK.

4.4.3 General Pedagogical Knowledge (GPK)

General Pedagogical Knowledge refers to knowing the principles and strategies of classroom management, and the organisation of the classroom (Shulman, 1987). Grossman (1990) argued that this domain of teacher knowledge includes how learners learn in the classroom, the curriculum that is offered and how the classroom is managed. In addition, Windschitl (2004) concurred that GPK is knowledge of how to organise learners and materials to be used in the classroom.

The responses by the participants during the semi-structured interviews on the activities during cluster meetings revealed that GPK is discussed during cluster meetings. Qondie explaine: *We even come to a point of sharing suggestions regarding the classroom set up when teaching or introducing new concepts*. Fezile alluded, *during moderation we check if the marking that was done to learners work was correctly done according to the set marking guidelines.* In the same vein, Khethiwe emphasised, *We also check if the recording of marks in the mark sheets was correctly done.*

During my observation of the PLC meeting, I also noted that some teachers expressed their classroom management problems, for example, the large number of learners in some classrooms. One cluster co-ordinator intervened as an experienced teacher and said that arranging desks in groups instead of rows work well with bigger classes and other teachers agreed. Those who were concerned about it agreed to try this strategy in their schools. It is therefore evident that GPK was discussed during cluster meetings.

4.4.4 Knowledge of the Context (KC)

According to Shulman (1987), KC refers to the knowledge of the contextual factors that impact on teaching and learning. In addition, he pointed out that it also refers to being aware of the background of the community from where the learners come from. Similarly,

Grossman (1990) described KC as the knowledge of learners' family background, location of the school and the culture of the community from which learners come. During the interviews with participants, little information regarding KC was evident in their responses. However, Khethiwe pointed out, *It is noted that learners from rural areas perform worse than those from urban areas.* Qondie emphasised: *Although our school is situated at the semi-urban area, most of the parents of our learners are unemployed and the learners sometimes cannot afford to buy things like calculators on time, but as teachers we understand the socio economic background of the community.* These responses show that there is too little knowledge of context shared by teachers in this PLC.

As a researcher during the cluster meeting observation, I noted that little or no information was shared by the teachers regarding KC except that some of the learners' portfolio files were like second hand files from the previous year.

4.4.5 Curriculum Knowledge (Cur.K)

Curriculum knowledge is the knowledge of what should be taught to a particular grade of learners (Shulman, 1987). According to Grossman (1990) Cur.K is a component of PCK that includes curricular programmes and materials or topics of a specific subject at a given level or across the grades.

The responses by the participants showed that some information regarding Cur.K was discussed by Math Lit teachers during their cluster meetings. Thuliswa confirmed: *Knowing to classify questions according to taxonomy levels and changes in the curriculum, for example, that the formula must not be used when you are calculating interest (both compound and simple interest) as it was done before.*

Fezile alluded, *"Sometimes the subject advisor takes the opportunity and unpacks the CAPS document for us as a cluster*. Khethiwe emphasised, *"We also look at the CAPS document making sure that our teaching and assessing is in line with the CAPS document*. Qondie also commented regarding Cur.K and said: *Discussing the CAPS document help us to know how much time we are expected to spend teaching each concept to make sure you are on the correct pace that will see to it that your learners will cover all the content required for the departmental paper, because once a term the department set a common paper for schools to write.*

The above responses showed that Cur.K is evident during cluster meetings.

During my observation of the cluster meeting I noted the notion of Cur.K when the subject advisor discussed the common misconceptions of learners in both the first and second paper of the final exam for Math Lit.

4.4.6 Knowledge of Learners and their Characteristics (KLC)

Shulman (1987) described KLC as knowing the learners and their different learning abilities. He further pointed out that teachers need to be aware that learners have different levels of intelligence. Grossman (1990) argued that KLC is the component of PCK which focuses on learners' understanding of concepts and their misconceptions in the content that is being taught.

The responses of the participants during the semi-structured interviews suggest that learners have different levels of intelligence. Qondie emphasised: *When setting an assessment task, we also look at the balance of taxonomy levels to see if it caters for all learners as expected.* Fezile confirmed, *I end up knowing that not only my learners have challenges with some concepts, but all learners do have challenges somehow somewhere and that boosts my confidence when teaching.*

During the observation of the cluster meeting, I noted the notion of KLC when the subject advisor emphasised that teachers needed to include all taxonomy levels when setting assessment tasks to cater for learners with different intellectual abilities.

4.4.7 Knowledge of educational ends, Purposes and Values (KPV)

Shulman (1987) describes this type of knowledge as what teachers need to refer to when doing their work and also what they always need to take along with them as the main guide of their practice. Furthermore, Grossman (1990) concurred that this domain is a component of PCK and described it as the knowledge and beliefs of the purpose for teaching a subject to different grades.

The responses of the participants during the semi-structured interviews indicated that the Math Lit teachers in this cluster use the CAPS document as the main guide in their classroom practices. Having textbooks seems not to be sufficient without the help of the CAPS document. Fezile emphasized: *We also look at the CAPS document making sure that our teaching and assessing is in line with the CAPS document.* Khethiwe further confirmed: *We*

also discuss which books are good for learners to use and for teachers as reference tools. Thuliswa alluded: *We feel empowered when the subject advisor unpacks the CAPS document for us and emphasised that it is like a bible that we need to refer to every time we prepare our lessons.*

As a notion that KPV is evident during cluster meetings, I observed that the subject advisor used the opportunity to talk to teachers as a cluster to discuss the CAPS document. He emphasised that as teachers, we must make sure we use the CAPS document hand in hand with the text books to ensure that the curriculum is covered effectively and at an expected pace.

As a researcher, I noted that during cluster meetings the Math Lit teachers shared different types of teacher knowledge as outlined by Shulman (1987). Most elements of teacher knowledge could be identified. However, content knowledge (CK) and pedagogical content knowledge (PCK) were shared the most, especially when as a researcher, I observed the teachers sharing different methods of approaching different concepts of Math Lit and ways of making it easily understandable for learners. However, Shulman (1987) asserts that a teacher needs all the seven domains of knowledge to be effective in his/her classroom practice.

Jita and Ndlalane (2009) and Jita and Mokhele (2012) have done extensive research on teacher clusters and they have discovered that there is little evidence that they serve as an effective teacher development model. However, the findings of this study contrast with the above mentioned findings because this study found that some domains of teacher knowledge were discussed by Math Lit teachers more often than others during cluster meetings, which suggests that to a certain extent, the PLC served as a space that contributes to teacher knowledge.

Brodie (2013) states that while collaboration is imperative for learning to occur, the crucial element is the content that is learned when teachers meet in their professional learning communities.

4.5 Participants' understanding of the term Teacher Knowledge

The section below discusses participant's understanding of teacher knowledge in relation to the seven domains of teacher knowledge by Shulman (1987). The responses that follow elaborate on participant's understanding of teacher knowledge.

Qondie explained in detail: *I think knowing almost everything that you are expected to know as a teacher to be able to perform your classroom duties, for instance, knowing the subject you teach, the content of the subject, how to assess, how many assessment tasks are needed and knowing exactly what to teach and how to teach it in different ways to make it simpler for the learners, as well as how to set up the classroom for it to be conducive for teaching and learning..*

This response by Qondie shows some of the elements of the knowledge domains by Shulman (1987) for example, one can pick up, "*…subject you teach, the content of the subject…"* that can be identified as content knowledge. *"How to teach it in different ways to make it simpler for the learners"* shows that teachers know that they must have PCK although they do not use Shulman's terminology. GPK was also evident in the response, "*As well as how to set up the classroom for it to be conducive for teaching and learning"*.

Fezile concurred: *I think here we refer to the knowledge of the subject the teacher teaches, knowledge of basic administrative skills like recoding of marks, administering the class register. The teacher also needs to have knowledge of the community from where the learners he teach come so as to understand their background and the level of language to use when communicating with them. The teacher need to have good organisational knowledge in order to be able to organise his/her work and organise the class according to the requirements of that particular lesson. A teacher must also have the knowledge of other educational issues like policies and disciplinary measures to be followed.*

From Fezile's response, the principle of CK is evident, "*I think here we refer to the knowledge of the subject the teacher teaches"*. GPK can also be identified in, *"…knowledge of basic administrative skills like recording of marks, administering the class registers"*. In addition, KC is also suggested in this response: *The teacher also needs to have knowledge of the community from where the learners he teach come so as to understand their background and the level of language to use when communicating with them.*

KPV is also identified in this response, *"A teacher must also have the knowledge of other educational issues like policies and disciplinary measures to be followed".*

Khethiwe responded: *My understanding is that a teacher needs to have deep insight and knowledge of the subject he /she is teaching. The knowledge of what to teach and how to assess is the knowledge I think the teacher must also have. In general, I think teacher knowledge is what teachers know pertaining that subject, the content, the curriculum matters and policies guiding the teaching and assessment of that subject. The teacher must also know the strengths and weaknesses of his or her learners as informed by their performance and their behaviours.*

From Khethiwe's response CK can be identified in, *My understanding is that a teacher needs to have deep insight and knowledge of the subject he /she is teaching.* KLC is also suggested in this response, *"The teacher must also know the strengths and weaknesses of his or her learners as informed by their performance and their behaviours".*

Thuliswa alluded: *I think that refers to all the knowledge a teacher must have pertaining the subject he/she teaches, for example, knowing the subject policy, knowing the content to be covered in that particular grade guided by the CAPS document. A teacher also needs to know different methods of teaching the subject that will lead to better understanding by the learners. A teacher must also know when and what form of assessment must be given to learners e.g. test, assignment or investigation. Keeping records of all the work done in the classroom must also be known. The teacher must also know how to record marks using the provided templates.*

From Thuliswa's response CK can be noted, *I think that refers to all the knowledge a teacher must have pertaining the subject he/she teaches for example knowing the subject policy.* PCK can also be identified in, *A teacher also needs to know different methods of teaching the subject that will lead to better understanding by the learners.* Cur.K is also evident in this response *...knowing the content to be covered in that particular grade guided by the CAPS document.*

The discussion with all participants shows that teachers understand the domains of teacher knowledge as identified by Shulman (1987). However, they did not explain teacher knowledge using the terminology of the seven domains of teacher knowledge which Shulman elaborated on.

The next section presents and analyses data which addresses research question two: To what extent is this PLC effective in contributing to Mathematical Literacy teachers' knowledge?

Table 3: Aligning the responses to research question two with the themes and the conceptual framework

Description	Theme	Conceptual Framework
All the information shared in the PLC is practised commonly in classrooms and the revision material shared there is for everyone to use in his/her class with the intention of getting learners to perform well, I think we all have the common goal to improve learner performance because all PLC members conduct themselves correctly and give their positive contributions towards the factors that can help to improve learner performance.	Shared values, goals and vision.	Brodie's characteristics of an effective PLC.
Teachers exchange the scripts of their respective learners with each other and moderate whether the marking and allocation of marks was done correctly according to the standard marking guidelines, and also to check if the marks were recorded correctly on the SBA mark sheets	Have trust.	Brodie's characteristics of an effective PLC.

We set common assessment tasks together guided by the CAPS document ensuring that all cognitive levels are catered for. We also discuss the quality of common tasks, especially those set by the Department of Education at district or provincial level. We also critically discuss their marking guidelines.	Collaborate professionally.	Brodie's characteristics of an effective PLC.
We share things like how to approach and introduce different concepts to learners in our schools. The cluster members especially those who have been teaching Maths Lit for a while take turns and share with us the different methods they use to simplify the subject matter for the learners to enable them to understand better	Collegiality.	Brodie's characteristics of an effective PLC.
We meet at the beginning of each term to discuss the work to be covered in that term. As far as I am concerned that is not sufficient. It would be much better if we meet at least three times per term	Sharing and critically debating practice regularly.	Brodie's characteristics of an effective PLC.
To me it looks like what we do here as a cluster is about	Focus on student thinking and learning.	Brodie's characteristics of an effective PLC.

all that is needed for our members to be efficient and effective in their Math. Lit teaching, because we all seem to be worried about better performance of our learners.		
Setting the common task together is also good because one end up knowing how to set the task of an acceptable standard bearing in mind that it must have balanced taxonomy levels. Even moderating and analysing learner performance is also useful because as a teacher you get an idea how your learners perform compared to other learners and seek help if there is a need.	Encouraging reflection	Brodie's characteristics of an effective PLC.

4.6 To what extent does the Mathematical Literacy cluster function as an effective professional learning community?

This subsection focuses on discussing the extent to which the Math Lit cluster functions as an effective PLC. The data was collected from both the observations of activities during cluster meetings and semi-structured interviews with participants. In analysing the characteristics of an effective PLC, I have used features outlined by Brodie (2013). Brodie (2013) outlined eight characteristics to identify an effective professional learning community as a shared vision, values, and goals; collegiality and collaborative learning; supportive conditions;

respect; sharing and critically debating practice regularly; encouraging reflection and shared trust among teachers. To analyse the data, I have used the abovementioned characteristics as a conceptual framework. These characteristics were used to analyse the extent to which the Math Lit cluster could be regarded as an effective PLC.

4.6.1 Collegiality

The element of collegiality prevailed amongst the teachers during cluster meetings. The cluster co-ordinators played an important role in ensuring the smooth running of the cluster meeting by sharing information and resources. Experienced teachers were given the opportunity to share the methods that worked well for them in their classroom practice with the fellow cluster members to develop each other. Fezile pointed out: *The cluster members, especially those who have been teaching Math Lit for a while, take turns and share with us the different methods they use to simplify the subject matter for the learners to enable them to understand better.*

On a similar note Qondie confirmed: *We share things like how to approach and introduce different concepts to learners in our schools.* Khethiwe emphasised: *We moderate learners work and analyse how the learners performed in the assessment tasks that were given to them during the previous term.*

This discussion with the participants highlighted that they worked as colleagues during cluster meetings, because the cluster co-ordinators encouraged every member to participate freely in the discussion.

4.6.2 Collaborate professionally

According to Brodie (2013), one of the characteristics of an effective professional learning community is collaboration between PLC members. Dodge and Kendal (2004) as cited by Myende (2016) asserted that the benefit of being a member of the PLC is making friends with other members of the PLC. Mphahlele (2014) viewed clusters as an innovative networking strategy for teacher learning where teachers collaborate in groups.

The data generated indicated that professional collaboration was evident among the members of the PLC. This was supported by the responses of the participants during the semi-structured interviews. Thuliswa confirmed: *Even though as new teachers we are shy to give our ideas thinking they may not be considered, the cluster co-ordinators encourages*

everyone (new or experienced) to speak their minds and we are encouraged when it is noted that our ideas are taken and considered, and we have gained confidence to express our views in a cluster which consist of experienced teachers as well.

Similarly, Fezile emphasised, "*We also discuss the quality of common tasks, especially those set by the Department of Education at district or provincial level".* In the same vein, Qondie asserted, *Even when marking and recording marks I am now careful because it could be picked up during the cluster meeting.* On a similar note Khethiwe commented, *The cluster co-ordinators play a leading role to ensure the smooth running of the discussions and co-operation among cluster members.*

This discussion of participant's responses highlights that participants exchanged ideas in a professional manner during PLC meetings. The participants also indicated that teachers need to share information and learn from one another.

4.6.3 Shared trust

Trust is one of the characteristics of an efficiently working professional learning community (Brodie, 2013). According to Stoll et al. (2011) and Steyn (2013) trust is one of the critical features of PLCs.

The discussions with the participants indicated that the element of trust was strong among the cluster members, for instance, checking if the marks are correctly recorded during moderation confirms that teachers are willing to develop each other during cluster meetings. Qondie pointed out:

The way it is done, teachers exchange the scripts of their respective learners with each other and moderate whether the marking and allocation of marks was done correctly according to the standard marking guidelines, and also to check if the marks were recorded correctly on the SBA mark sheets. Thuliswa alluded: *The cluster members, especially those who have been teaching Maths Lit for a while, take turns and share with us the different methods they use to simplify the subject matter for the learners to enable them to understand better.*

However, Khethiwe concurred, *It is always good when we critically analyse the assessment tasks and memoranda set by the department of education.*

The above discussion with the participants indicated that Math Lit teachers have trust that they can be developed by their fellow cluster members during cluster meetings.

4.6.4 Shared values, goals and vision

The professional learning community needs to demonstrate shared values, vision and goals (Brodie, 2013). This characteristic emphasises that the members of the PLC agree on the same values, goals and vision that guides their cluster. The emphasis on professional learning communities should be on how learners learn instead of how they are taught (Dufour, 2004). Shared values and goals will ensure that all cluster members behave in an acceptable manner which is in line with their objectives. With regard to shared common values, vision and goals, Khethiwe responded: *Yes, all the information shared in the PLC is practised commonly in classrooms and the revision material shared there is for everyone to use in his/her class with the intention of getting learners to perform well. As a cluster, we all wish to have our learners performing more or less the same way.* To further support the idea of shared values, goals and vision Thuliswa confirmed:

If as a cluster member you express any challenge regarding your teaching, subject matter or content using WhatsApp, you get positive responses from all group members with the intention to bring you on board. On a similar note, Fezile stated: *I think we all have the common goal to improve learner performance because all PLC members conduct themselves correctly and give their positive contributions towards the factors that can help to improve learner performance.*

The discussion above suggests that cluster members shared the same values, goals and vision which is improved student learning. Even though the goals and values are not formally prescribed, the way the members conduct themselves indicates that they share the same values, goals and vision.

From the discussions with the participants and observations of cluster meetings, it is evident that this Math Lit cluster reflects a few of the characteristics of an effective PLC as outlined by Brodie (2013). The following characteristics of effective PLCs were evident: collegiality, professional collaboration, shared values, goals and vision, and trust.

Phiri (2011) conducted an extensive study on clusters and his key findings were that clusters cannot be regarded as effective professional learning communities, however, he recommended that teachers need to drive their development. Villegas-Reimers (2003, as cited by Phiri, 2011) pointed out that teacher development that does not lead to improved learners'

performance is a waste of time, as teacher practices only improve and are sustainable if they produce improved learners' performance.

The findings of this study differ from the above because some transformation was noted in the cluster as the characteristics of an effective PLC as outlined by Brodie (2013) were evident.

4.7 Conclusion

In this chapter I presented, described and analysed the data guided by the two research questions as outlined in Chapter One. Data was generated through the observation of activities that took place in the two cluster meetings observed, and teachers' views as cluster participants through semi-structured interviews with four participants. The chapter began by giving the profiles of the four participants who were interviewed. The data was organised according to the two research questions and the conceptual frameworks comprising of the domains of teacher knowledge by Shulman (1987) and the characteristics of an effective PLC by Brodie (2013). The data generated elaborated on the activities that took place in the cluster meetings. However, the domains of teacher knowledge as outlined by Shulman (1987) were not all evident in the cluster meetings. Only CK, PCK, GPK, KLC and Cur.K were identified during observations and from participant's responses.

In addition, only a four characteristics of an effective PLC as outlined by Brodie (2013) were evident, namely; collegiality, professional collaboration, shared values, goals and vision, and trust. In Chapter Five I present a discussion on the findings of the data and recommendations for future research.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The previous chapter presented and analysed the data that was generated through semi-structured interviews with the four participants and the observations of two Math Lit cluster meetings. In Chapter Five, I present an overview of the study, findings, draw conclusions and suggest recommendations, and discuss the limitations of the study. The findings are discussed in line with the research questions to ensure that the findings drawn from the data address the research questions that guided this study.

5.2 Overview of the study

The purpose of this study was to explore the types of teacher knowledge teachers acquired by participating in an FET Mathematical Literacy (Math Lit) PLC in the UMgungundlovu district. The study examined the Math Lit professional learning community, exploring the extent to which the professional learning community served as a space that contributed to teacher knowledge. This study also aimed to explore the extent to which this FET Math Lit PLC was effective**.** In Chapter One, I introduced the study, its purpose and background. I outlined the types of teacher knowledge as explained by Shulman (1987) and the characteristics of an effective PLC as described by Brodie (2013).

In Chapter Two, I focused on the review of the related literature both internationally and locally, including the discussion of Shulman's (1987) conceptual framework and Brodie's (2013) characteristics of effective PLCs. The conceptual frameworks together with empirical studies in the literature review were used to analyse data.

Chapter Three presented and described the methodology and research design that was used to generate data that assisted in answering the research questions of this study. I described qualitative research and the interpretative paradigm which this study was located in. I presented a case study design as an appropriate way to obtain new information about the phenomena examined. The sampling, data collection instruments, ethical considerations and trustworthiness were also discussed.

In Chapter Four, I presented the data which was organised into themes and was discussed. I used the types of teacher knowledge as outlined by Shulman (1987) and the characteristics of an effective PLC as outlined by Brodie (2013) to analyse data. A key finding was that during cluster meetings teachers mainly discuss content knowledge as well as assessment issues. With regards to data analysis and discussion, the following findings emerged: the Maths Lit PLC served as a space that contributed to teacher knowledge; GPK, PCK, CK, and Cur.K were the types of teacher knowledge mostly acquired by Math Lit teachers and the Math Lit cluster reflected some of the characteristics of an effective PLC.

5.3 Summary of the findings

In this section I summarise and discuss the main findings of the study and use the research questions that were posed in Chapter One to organise the presentation. Research questions that guided the study were:

1. What types of teacher knowledge do further education and training Mathematical Literacy teachers acquire by participating in a professional learning community?

2. To what extent is this professional learning community effective in contributing to Mathematical Literacy teachers' knowledge?

5.3.1 What types of teacher knowledge do FET Mathematical Literacy teachers acquire by participating in a PLC?

This section aimed at answering research question one: What types of teacher knowledge do FET Mathematical Literacy teachers acquire by participating in a PLC? Data was collected from the responses by the participants during the semi-structured interviews and observations of cluster meetings.

The responses of the participants during semi-structured interviews indicated that the participants mainly acquired GPK, PCK, CK, and Cur.K during cluster meetings. GPK and PCK were discussed the most by participants because during cluster meetings teachers mainly focussed on classroom management and teaching methods to make the subject matter understandable to all learners. KLC was not used often, and only taken into consideration when the common assessment tasks were being set. KC and KPV were the least mentioned suggesting that they were not used that much. However, Shulman (1987) pointed out that teachers need to have all these types of knowledge to teach effectively, however, he emphasised PCK because it is the combination of both the content and pedagogy.

5.3.2 To what extent is this PLC effective in contributing to Math Lit teachers' knowledge?

This section aimed to answer research question two: To what extent is this PLC effective in contributing to Math Lit teachers' knowledge? Data gathered from the participants during semi-structured interviews and the observations of cluster meetings were used to answer this question. The characteristics of an effective professional learning community outlined by Brodie (2013) were: (a) collegiality; (b) collaborating professionally; (c) shared trust; (d) shared values, goals and vision; (e) engaging in rigorous enquiry; (f) focus on student thinking and learning, (g) use of actual classroom information and (h) reflection on the part of the teacher. The data collected showed that the Math Lit cluster reflected some of the characteristics of an effective PLC. The discussion below outlines the characteristics of effective PLCs reflected in the Math Lit cluster.

Firstly, the characteristic of working together was evident amongst the teachers during cluster meetings. Teachers shared information and resources collaboratively. In addition, the experienced teachers shared with their fellow colleagues the methods that worked well for them when they are teaching.

Secondly, collaboration was encouraged during cluster meetings because the cluster members got the opportunity to work together, discuss and solve their problems as a group.

Thirdly, trust was another characteristic evident during cluster meetings. If a teacher had a problem of any kind in his/her classroom practice, he/she could trust that his/her fellow colleagues would offer a solution. However, it was noted that only the experienced teachers were trusted to share the teaching methods that worked well for them in the classroom.

Fourthly, the cluster meetings demonstrated shared values, goals and a vision for better student learning. Even though the goals were not formally prescribed, the way the cluster members conducted themselves indicated that they had the same values, goals and vision.

According to Dufour (2009), a professional learning community can be viewed as a group of teachers that are committed to work jointly in an on-going process of collective inquiry.

In conclusion, the analysis of the data shows that this Math Lit cluster reflected some characteristics of an effective PLC although not all of them as outlined by Brodie (2013). The following characteristics were observed and noted during the discussions with the participants: collegiality, professional collaboration, focusing on student thinking and learning, shared trust, and shared values, goals and a vision. However, the characteristics of sharing and critically debating their practice regularly, the use of actual classroom information and to encourage reflection on the part of teacher were not observed in the cluster meetings and did not emerge in the semi-structured interviews. Therefore, this Math Lit cluster can be regarded as an effective PLC because it reflected most of the characteristics of an effective PLC through observations and interviews with the participants.

5.4 Limitations of the study

This study involved a small number of four purposively selected teachers who were teaching Math Lit in one circuit in uMgungundlovu district. The findings of the study cannot be generalised because the participants did not represent the population of FET Math Lit teachers. However, the findings can be transferred to other similar contexts.

As a researcher I intended to select six participants for this study, unfortunately one participant fell sick and had to go on sick leave. The other participant withdrew from the study due to other commitments and this resulted in only four participants being available for interviews. The abovementioned factors might have impacted on the findings; therefore such findings cannot be generalised across the district or province (Creswell, 2003).

My position as a teacher teaching Math Lit and participating in the same cluster might have influenced the responses of the participants. However, when I began the research I introduced myself to the participants and explained to them that the findings of this study will benefit

them by improving the way the activities are conducted in the cluster. I therefore requested them to openly share their views. In addition, I guaranteed them anonymity by using pseudonyms when interacting with them. Furthermore, I explained to them my position as a researcher and that I was a university student who was also a Math Lit teacher like them. This ensured reliability of this study.

5.5 Recommendations

Based on the findings of this study, two sets of recommendations are made: recommendations based on the types of teacher knowledge acquired by cluster members and recommendations based on the characteristics of an effective PLC.

5.5.1 Recommendations based on the types of teacher knowledge acquired by cluster members

The findings of the study revealed that the interviews with the participants showed that the participants were using GPK, PCK, CK, and Cur.K the most during cluster meetings. GPK and PCK were mentioned the most because during cluster meetings as teachers were mainly focusing on classroom management and teaching methods to make subject matter understandable to all learners. KLC was not mentioned often, and only taken into consideration when the common assessment tasks are being set while KC and KPV were least mentioned. It is therefore recommended that the Math Lit teachers with the help of their subject advisor, need to have more discussions and share knowledge and practices during cluster meetings about all types of teacher knowledge. Therefore, more research should be conducted focusing on KC and KPV of Maths Lit teachers. A further recommendation is that subject advisors facilitate learning activities that focus on and develop all seven domains of teacher knowledge.

5.5.2 Recommendations based on characteristics of an effective PLC

In addition, the findings of this study revealed that the following characteristics of an effective PLC were evident during the discussions with the participants: collegiality, professional collaboration, focusing on student thinking and learning, shared trust, and shared values, goals and a vision. However, the characteristics of sharing and critically debating their practice regularly, the use of actual classroom information and to encourage reflection on the part of teacher were not mentioned or discussed by participants. This study therefore recommends that the cluster meet at least three times per term as it has been noted that they

meet once at the beginning of each term. This might help it to develop more characteristics of an effective PLC, especially the one which is sharing and critically debating their practice regularly (Brodie, 2013) this can be made possible through the subject advisor and principals allocating more time for cluster meetings to ensure their effectiveness.

5.6 Conclusion

This study aimed to explore the extent to which professional learning communities served as a space that contributed to teacher knowledge and to further explore the extent to which the PLC could be regarded as an effective PLC. The study adopted a qualitative case study design. Observations and semi-structured interviews were used to generate data.

The findings of the study showed that during cluster meetings teachers use and acquire different types of knowledge as identified by Shulman (1987), although it was evident that the types of knowledge that were referred to the most was pedagogical content knowledge and general pedagogical knowledge followed by content knowledge and curriculum knowledge. Knowledge of learners and their characteristics was also noted from observations and responses of the participants. Knowledge of context and knowledge of educational ends, purposes and values were least evident during cluster meetings. However, as stated earlier, Shulman (1987) pointed out that a teacher needed to have all these types of teacher knowledge to be efficient in his/her teaching.

Similarly, the findings revealed that four characteristics of effective PLCs were identified in in the cluster where the study was conducted namely: collegiality, professional collaboration, shared trust and shared values, goals and visions. Therefore, not all characteristics of an effective PLC were evident. However, Brodie (2013) contends that the PLC needs to have all eight characteristics before it is regarded as an effective PLC. It can therefore be concluded that the cluster where the study was conducted can, to some extent, be regarded as an effective PLC. However, recommendations were made to develop the number of characteristics of an effective PLC in this cluster.

REFERENCES

Baxter, P., & Jack, S. (2008). Qualitative Case Study Methodology: Study Design and Implementation for Novice Researchers. *The Qualitative Report, 13*(4), 544-559.

Bertram, C. (2011). What does research say about teacher learning and teacher knowledge? Implications for professional development in South Africa. *Journal of Education, 52*, 3-26.

Bless, C., Higson-Smith, C. & Kagee, A. (2006). *Fundamentals of social research methods: An African perspective*.Cape Town: Juta and Company Ltd.

Bolam, R., McMahon, A., Stoll, L., Thomas, S., Wallace, M., Greenwood, A., Smith, M. (2005). Creating and sustaining effective professional learning communities. *Bristol: University of Bristol Departament of Education and Skills*.

Brodie, K. (2013). The power of professional learning communities. *Education as Change, 17*(1), 5-18.

Brodie, K. & Borko, H. (2016). *Professional learning communities in South African schools and teacher education programmes*.Cape Town: HSRC Press.

Brombacher, A. (2007). *Mathematical Literacy , A reader*. Cape Town: Bateleur Books.

Brynard, D. J., Hanekom, S. X. & Brynard, P.A. (2014). *Introduction to research*. Pretoria:

Burton, N., Brundrett, M. & Jones, M. (2008). *Doing your education research project*. Los Angeles: SAGE.

Cohen, L., Manion, L. & Morrison, K., (2007). *Research methods in education*. London and New York:Routlledge.

Cohen, L., Manion, L, & Morrison, K., (2011). *Research methods in education*. London and New York: Routledge.

Creswell, J. W. (2008). *Educational research : Planning, conducting, and evaluating quantitative and qualitative research*.(3rd ed.).New Jersey: Pearson.

Creswell, J. W. (2014). *Research design : Qualitative, quantitative, and mixed method approaches*.Los Angeles,London:SAGE Publications.

Curtis, W., Murphy, M. & Shields, S. (2014). *Research and education*:*Foundations of education studies*.London and New York :Routledge

Darling-Hammond, L., Wei, R. C., Andree, A., Richardson, N. & Orphanos, S. (2009). *Professional learning in the learning profession*: *A status report on teacher*

development in the United States and abroad. Washington, DC*:* National Staff Development Council.

Day, C. (1999). Variations in the conditions for teachers' professional learning and development: Sustaining commitment and effectiveness over a career. *Oxford review of education, 33*(4), 423-443.

De Clercq, F., & Phiri, R. (2013). The challenges of school-based teacher development initiatives in South Africa and the potential of cluster teaching. *Perspectives in Education, 31*(1), 77-86.

Department of Basic Education and Higher Education and Training.(2011).*Professional Learning Communities.* A guideline for South African Schools.Intergrated Strategic Framework for Teacher Education and Development in South Africa 2011-2025.Pretoria : Department of Education

DuFour, R. (2004). What is a" professional learning community"? *Educational Leadership, 61*(8), 6-11.

DuFour, R., & DuFour, R. (2009). *Revisiting professional learning communities at work: New Insights for Improving Schools*.Bloomington: Solution Tree Press.

Fataar, A. & Feldman, J. (2016). Dialogical habitus engagement*:* The twists and turns of teachers' pedagogical learning within a professional learning community. *Perspectives in Education, 34*(3), 98-105.

Grossman, P. L. (1990). *The Making of a teacher : Teacher knowledge and teacher education* New York and London: Teachers College Press.

Hord, S. M. (1997). Professional learning communities: Communities of continuous inquiry and improvement.Austin,TX: Southwest Development Laboratory.

Jita, L. C., & Mokhele, M. L. (2014). When teacher clusters work: Selected experiences of South African teachers with the cluster approach to professional development. *South African Journal of Education, 34*(2), 01-15.

Knight, P. (2002). A systemic approach to professional development: Learning as practice. *Teaching and Teacher Education, 18*(3), 229-241.

Krauss, S. E. (2005). *Research paradigms and meaning making*: *A Primer*. *The Qualitative Report, 10*(4), 758-770.

Lauer, P. A. (2006). *An Education Research Primer : How to Understand, Evaluate, and Use it*. San Francisco: Jossey-Bass.

Lodico, M. G., Spaulding, D. T. & Voegtle, K. H. (2010). *Methods in educational research: From theory to practice* (2nd ed.)Hoboken: John Wiley & Sons.

Mackenzie, N. & Knipe, S. (2006). Research dilemmas: Paradigms, methods and methodology. *Issues in Educational Research, 16*(2), 193-205.

Maree, K. (2010). *First steps in research*. Pretoria: Van Schaik.

McMillan, J. H. & Schumacher, S. (2010). *Research in education : Evidence-based Inquiry* (7th ed.). Boston: Pearson.

Magnusson, S. J., Borko, H., Krajcik J. S., & Layman, J. W. (1999). Developing scientific understanding: The influence of teacher knowledge and instruction on student knowledge development, unpublished manuscript

Myende, S. S. S. (2016). *An exploration of clusters as teacher learning communities for Grade 12 Geography teachers in the inland circuit.* Available from http://worldcat.org /z-wcorg/ database.

Ritchie, J., Lewis, J., McNaughton Nicholls, C., & Ormston, R. (2014). *Qualitative research practice : A guide for social science students and researchers*.Carlifonia:Sage Publications.

Rule, P., & John, V. (2011). *Your guide to case study research*. Pretoria: Van Schaik

Scott, D., & Morrison, M. (2005). *Key ideas in educational research* London: A&C Black.

Shulman, L. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*(1), 1-23.

Shulman, L. S., & Shulman, J. H. (2004). How and what teachers learn: A shifting perspective. *Journal of Curriculum Studies, 36*(2), 257-271.

Steyn, G. M. (2013). Building professional learning communities to enhance continuing professional development in South African schools. *The Anthropologist, 15*(3), 277-289.

Vescio, V., Ross, D., & Adams, A. (2008). A review of research on the impact of professional learning communities on teaching practice and student learning. *Teaching and Teacher Education, 24*(1), 80-91.

Weindling, D. (2005). *Teachers as collaborative professionals. A survey of the views of ATL members*. Retrieved from organisational learning to professional learning communities.New York:Teachers College Press.

Windschitl, M. (1997). Student epistemological beliefs and conceptual change activities: How do pair members affect each other? *Journal of Science Education and Technology, 6*(1), 37-47.

Yin, R. K. (2003). *Case study research : Design and methods*. Thousand Oaks, California.: Sage Publications.

Zulu, B. (2017). *Teacher learning: A case study of two teacher learning communities in KwaZulu-Natal.* (Doctor of Philosophy in the school of education), Urniversity of Kwazulu-Natal, Pietermaritzburg.

APPENDIX 1: GATEKEEPER'S PERMISSION

education

Department:
Education
PROVINCE OF KWAZULU-NATAL

Enquiries: Phindile Duma | Tel: 033 392 1063 | Ref.:2/4/8/1422

Mr JG Mshengu
6 Wallace Road
Manor
Pietermaritzburg
3201

Dear Mr Mshengu

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: "EXPLORING AN FET MATHEMATICAL LITERACY PROFESSIONAL LEARNING COMMUNITY (PLC) IN UMGUNGUNDLOVU DISTRICT AS A SPACE THAT CONTRIBUTES TO TEACHER KNOWLEDGE", 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 11 January 2018 to 30 June 2020.
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 Phindile Duma 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.

UMgungundlovu District

Dr. EV Nzama
Head of Department: Education
Date: 15 January 2018

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

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APPENDIX 2: ETHICAL CLEARANCE

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

17 January 2018

Mr Joseph Godfrey Mshengu 214581934
School of Education
Pietermaritzburg Campus

Dear Mr Mshengu

Protocol reference number: HSS/2274/017M
Project Title: Exploring an FET Mathematical Literacy Professional Learning Community (PLC) in Umgungundlovu District as a space that contributes to Teacher Knowledge

Full Approval – Expedited Application

In response to your application received 28 November 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.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....

Dr Shamila Naidoo (Deputy Chair)
Humanities & Social Sciences Research Ethics Committee

/pm

cc Supervisor: Dr Jacqueline Naidoo
cc. Academic Leader Research: Dr SB Khoza
CC.School Administrator: Ms Tyzer Khumalo

APPENDIX 3: INFORMED CONSENT LETTER

UKZN HUMANITIES AND SOCIAL SCINCES RESEARCH ETHICS COMMITTEE (HSSREC)

School of Education

College of Humanities

University of Kwa-Zulu Natal

Dear Participant

INFORMED CONSENT LETTER

I am Joseph G. Mshengu, 214581934, a student pursuing Master in Education with the University of Kwa-Zulu-Natal, Pietermaritzburg in Human and Social Sciences.

I am interested in conducting a study based on "clusters as a space that contributes to teacher knowledge Imbali Circuit in UMgungundlovu District". The study aimed at understanding the nature of activities and functioning of teacher clusters in the above-mentioned circuit. The participants of this study were identified in Imbali cluster. These were taken into consideration; participants need to be a teacher teaching FET Mathematical Literacy and Mathematical Literacy Subject Advisor under UMgungundlovu District, Imbali circuit within Imbali cluster. The identified participants will be required to engage on the interviews and observation during the cluster meetings and outside if need be. This will take place in year 2018 between January and September.

The data will be collected on the semi structured interviews and observations, using data audio recordings and in writing. It will be transcribed by the interviewer and kept securely for a period of five year, under the supervision of the University of Kwa-Zulu Natal. Being a participant on this study is voluntary and the participant can withdraw at any stage, for any reason. Confidentiality is guaranteed as your inputs will not be attributed to you in person. Participation to the study is purely for academic purposes only, and there are no financial benefits.

My contact details: Email; humblejg@webmail.co.za Cell: 0832448458. My supervisor Dr: J. Naidoo: email; NaidooJ@ukzn.ac.za, Cell 0832313378. Ethics committee: UKZN Humanities and Social Sciences Research Ethics Administrator: P. Mohun HSSREC Research Office, Tel: 031 260 4557 E-mail: mohunp@ukzn.ac.za Email: HSSREC@ukzn.ac.za.

DECLARATION

I …… (Full names of participant)

Hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

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

I hereby provide consent to|:

	YES	NO
Take part on observing of the activities of the cluster.		
Audio recording of semi-structured interviews.		

Thank you for your contribution to this research.

Regards

Mshengu J.G.

SIGNATURE OF PARTICIPANT DATE

…….. ……

APPENDIX 4: OBSERVATION SCHEDULE

OBSERVATION SCHEDULE

Cluster Name: ----------

Observation Date: ----------

Topic for discussion: ----------

Number of teachers present: ---------- (refer to attached attendance register)

Prompts and Comments
Types of professional development activities
Types of knowledge Shulman (1987) 1. Content knowledge.
2. General pedagogical knowledge (GPK).
3. Pedagogical content knowledge (PCK).
4. Curriculum knowledge (Cur.K).
5. Knowledge of context (KC).
6. Knowledge of learners and their characteristics (KLC).
7. Knowledge of educational ends purposes and values (KPV).
Characteristics of PLCs Brodie (2013)
1. Collaboration.
2. Collegiality.
3. Shared trust.
4. Shared values, goals and vision.
5. Encouraging reflection.
6. Focus on student thinking and learning.

7. Active participation.
8. Respect.

Summary on the overall activities of the day:

APPENDIX 5: INTERVIEW SCHEDULE

INTERVIEW SCHEDULE

BIOGRAPHICAL AND EDUCATONAL DATA

1. What are your qualifications?

2. How many years of experience do you have as a teacher?

3. For how many years have you been teaching Mathematical Literacy? At what grades?

4. What is your present position in this PLC/cluster?(Mark with X)

PRINCIPAL	
SUB.ADVISOR	
HOD	
CLUSTER CO-ORDINATOR	
TEACHER	

5. Who initiated the formation of this PLC/cluster/? And why?

6. Who are the members of this PLC/cluster? How did they become members of the PLC/cluster?

7. How many teachers attend this PLC/cluster?

8. Describe the range of teaching experience of teachers in this PLC/cluster.

WHAT IS THE NATURE OF LEARNING ACTIVITIES IN AN FET MATH LIT PLC?

9. Tell me more about the learning activities that take place in PLC/cluster meetings. How are these learning activities facilitated? Explain.
10. What activities/topics do these PLC/cluster meetings mainly focus on? Are these activities/topics relevant? Explain.
11. Would you recommend any changes to these learning activities/topics? Elaborate.
12. Describe some of the activities that you engage in at PLC/cluster meetings? Give examples
13. Which of these activities do you find most useful? Elaborate and give examples
14. Which of these activities do you find least useful? Elaborate and give examples.
15. What do you learn from the PLC/cluster activities? Describe new content knowledge, knowledge of assessment, knowledge of the curriculum or any other knowledge that you learn
16. Is there any improvement in your classroom practice because of participating in this PLC? Explain or give examples

TO WHAT EXTENT DO CLUSTERS FOR FET MATH. LIT TEACHERS FUNCTION AS EFFECTIVE PLC?

17. How often do you meet as a PLC/cluster? In your opinion is this sufficient? Explain.
18. Who leads the professional learning community and how was he/she chosen?
19. What do you understand by the term teacher knowledge?
20. What knowledge do you acquire from the PLC? Give examples.
21. To what extent is there co-operation among PLC members? Elaborate.
22. Do all members of the PLC/cluster have a common goal of improved learner performance? Elaborate.
23. How does the PLC /cluster promote a shared vision and goals?

APPENDIX 6: CONFIRMATION OF EDITING

Proofwrite Solutions

WRITE • EDIT • RESEARCH • DESIGN

28th of January 2019

To whom it may concern

ADDITIONAL EDITING OF DISSERTATION (Chapters 4 & 5) FOR MR JOSEPH GODREY MSHENGU

I have a master's degree in Social Science, Research Psychology and TEFL qualification from UKZN. I also have an undergraduate and honour's degree Bachelor of Arts in Health Sciences and Social Services from UNISA.

I have 15 years of teaching experience and have been editing academic theses for students from UKZN, UNISA, the University of Fort Hare, and DUT for the past seven years. I have further done editing, transcribing and other research work for private individuals and businesses.

I hereby confirm that I have edited Joseph Godfrey Mshengu's dissertation titled "Exploring an FET Mathematical Literacy professional learning community as a space that contributes to teacher knowledge" for submission of his master's dissertation in education at UKZN. Corrections were made in respect of grammar, tenses, spelling and language usage using track changes in MS Word 2010. Once corrections have been attended to, the dissertation should be correct.

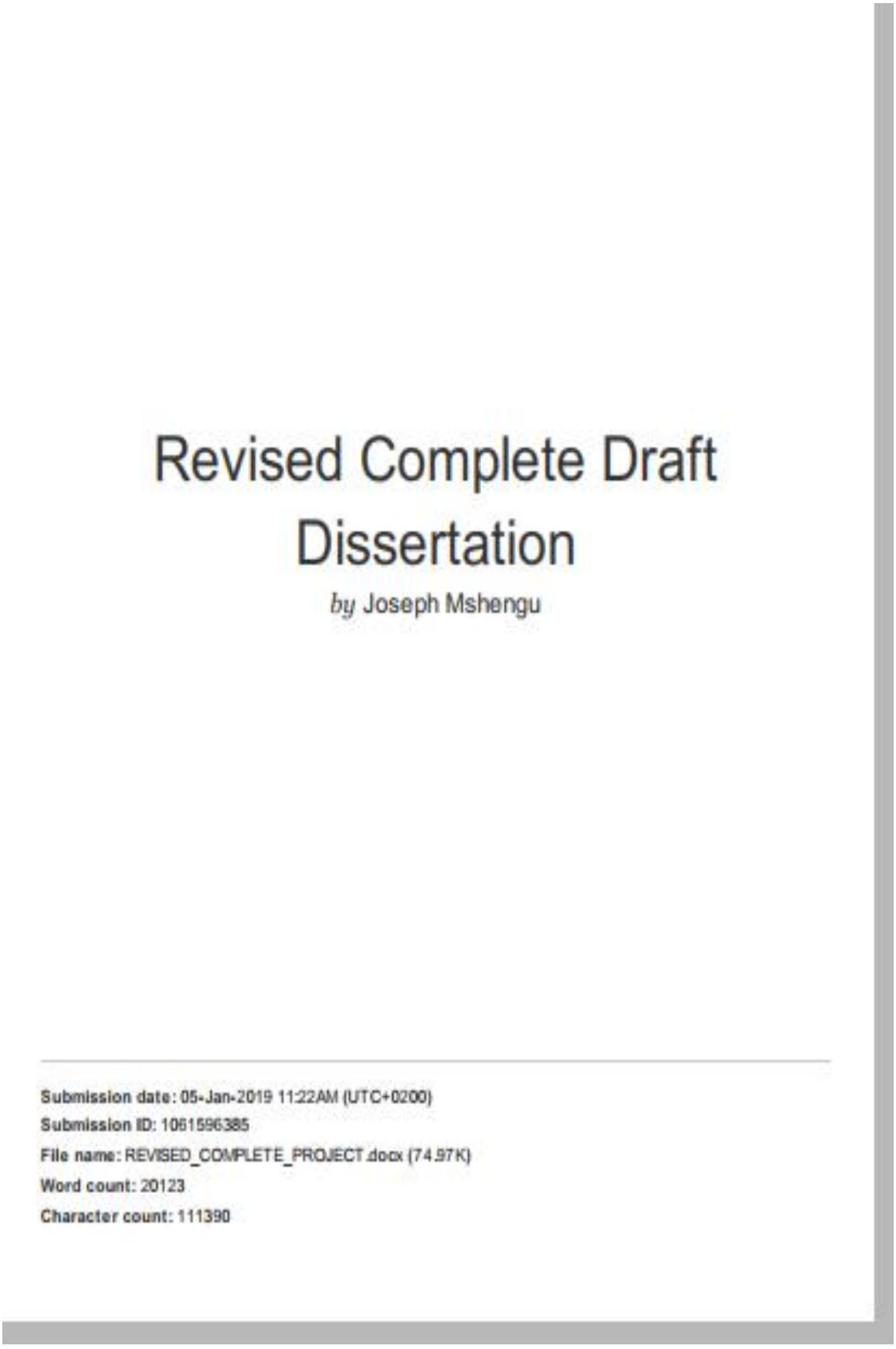
PLEASE NOTE: Should the student add content to their dissertation after my editing and suggested corrections, I cannot guarantee their work is correct in respect of grammar, tenses, spelling and language usage.

Yours sincerely

Shuttleworth

Terry Shuttleworth (TEFL, UKZN, MSocSc, Res Psych, UKZN).

APPENDIX 7: TURNITIN CERTIFICATE



Revised Complete Draft Dissertation

by Joseph Mshengu

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