



EXPLORING TEACHER LEARNING THROUGH THE USE OF
PILO TOOLKITS IN GRADE 8 AND 9 MATHEMATICS
CLASSROOMS IN THE PINETOWN DISTRICT

by

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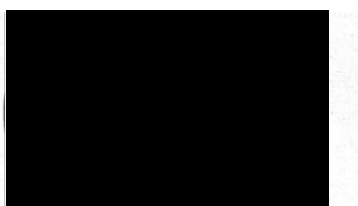
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DECLARATION

This thesis has been submitted in fulfilment of the requirements for the degree of Masters in Education in the Postgraduate Programme of the College of Humanities, University of KwaZulu-Natal, Pietermaritzburg, South Africa.

I, REVIVAL PRISCILLA NOMPUMELELO XULU, student number 203511205, declare that:

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05 December 2022

Nompumelelo Xulu

As the candidate's supervisor, I agree to the submission of this Dissertation



05 December 2022

Dr Bongiwe Zulu

DEDICATION

This thesis is dedicated to:

- My late father, Jabulani Xulu and my adorable mother Dorah Xulu, who show great support to this climb academic ladder.
- My late brothers Nkanyiso and Ndumiso also my late sister Dr Makhosazana Xulu who were there when I was starting this journey, but God did not want us to celebrate this academic achievement together. I strongly believe that you are great where you are. May your souls rest in peace.
- My adorable kids; Zotha, Luyanda, Anathi, Lwazi, Alondwe, Zenande, Ezinhle, Ongiwe, Isiphile, Elihle, Ezinhle and my grandson Junior thank you for your great support and your encouragement.

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- The principals who granted me permission to conduct interviews and document analysis for the study.
- The mathematics teachers of Pinetown district who willingly and voluntarily participated in the study.
- My colleague Thembisile Nyathi for her support and encouragement.

ABSTRACT

Curriculum coverage in mathematics has been an ongoing concern in South African schools. The KwaZulu-Natal Provincial Department of Education in partnership with National Education Collaborative Trust (NECT) initiated the Programme to Improve Learning Outcomes (PILO) aiming at developing and implementing learning improvement programmes to address curriculum coverage at district level. This case study explores teacher learning through the use of Programme to Improve Learning Outcomes toolkits in grade 8 and 9 mathematics classrooms in the Pinetown District. This study adopted Desimone's (2009) model of professional development features and Illeris's (2009) theory of learning. Five grade 8 and 9 mathematics teachers were purposively sampled to participate in this study. This case study was located within the interpretive paradigm. Data was generated using the semi-structured interviews and document analysis. Inductive approach was used to analyse the data.

The findings of this study reveal that mathematics teachers were involved in *Jika Imfundo* and PILO workshops. The findings indicate that during the workshops the mathematics teachers learn how to creating a link between mathematics textbooks, learners' workbooks and the trackers. They also learn different methods of teaching content and curriculum coverage for grade 8 and 9. While one experienced teacher was not in favour of using PILO toolkit, four teachers in this study value PILO toolkits and training because it has introduced them to better curriculum planning which had a positive impact on the teaching and learning which resulted in the change in their teaching practices in mathematics classrooms. However, teachers encountered several challenges such as lack of resources when they were using PILO toolkits. Based on the findings of this study, it is recommended that PILO programme should be reviewed and be implemented across all nine provinces in South Africa. The Department of Education should provide the resources to support teaching and learning of mathematics in schools. The PILO toolkits should be designed for all grades and subjects and the number of mathematics activities per week should be reduced in order to accommodate learners with learning difficulties and special activities for slow learners should be considered.

Key words: teacher learning, professional development, Programme to Improve Learning Outcomes (PILO), curriculum coverage, curriculum coverage

LIST OF ACRONYMS

ANA	Annual National Assessment
ATP	Annual Teaching Plan
B. Ed (Hons)	Bachelor of Education in Honours
CAPS	Curriculum and Assessment Policy Statement
CBMS	Conference Board for the Mathematics Sciences
CPTD	Continuous Professional Teacher Development
DBE	Department of Basic Education
DoE	Department of Education
FDE	Further Education and Training
GPK	General Pedagogical Knowledge
INSET	In- Service Education and Training
ISPFTED	Integrated Strategic Planning, Frameworks for Teacher Education and Development
IQMS	Integrated Quality Management System
KC	Knowledge for context
NECT	National Education Collaboration Trust
PCK	Pedagogical Content Knowledge
SMK	Subject Matter Knowledge
SP	Senior Phase
STD	Senior Teacher's Diploma

PGCE	Postgraduate Certificate in Education
PD	Professional Development
PILO	Programme to Improve Teaching Outcomes
UNESCO	United Nations Educational Scientific and Cultural Organisation

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CHAPTER ONE

OVERVIEW OF THE STUDY

1.1 Introduction

This chapter starts by illustrating the background, focus and the purpose of the study. This is followed by the presentation of the rationale, the research questions, the preliminary literature review and the conceptual frameworks of the study. The chapter also presents a brief overview of research methodology adopted in this research study. The chapter ends with the overview of chapter in the dissertation.

1.2. Background and context of the study

The Department of Education in KwaZulu-Natal created the Jika Imfundo as an intervention programme to redress the problem of curriculum coverage, which led to poor learning outcomes. The Jika Imfundo project is a developmental activity proposed by the Department of education in KwaZulu-Natal and is supported by PILO and funded by National Education Collaboration Trust with the interventions at school and district level. KwaZulu-Natal introduced the provisional program called Programme to Improve Learning Outcomes (PILO), which has been started in two districts, being Pinetown and King Cetshwayo from 2014 to 2017. The primary concern of the PILO project is in working on change at scale in education in the public sector in order to demonstrate a model of improvement that can be used across the system. The model was first piloted in King Cetshwayo and Pinetown districts in 2014 before it was rolled out across the province.

PILO was created within Jika Imfundo, sometimes teachers use PILO and Jika Imfundo interchangeable. PILO focuses on curriculum coverage in mathematics, science and languages (Christie& Manyokolo,2018). PILO was also implemented in the Northern Cape province but called “*A re Tokafatseng Seemo sa Thuto*” (Metcalf,2013). PILO was presented to district officials, teachers and school management teams with the tools and training needed to have a constructive change on the behaviours necessary to increase curriculum coverage in all classrooms so that learning outcomes improve across the system.

PILO reduces the work of teachers as they were expected to plan for curriculum coverage, prepare lessons and assessment, track curriculum coverage, and assess learners' progress to inform reporting on curriculum coverage and reflect on proof of learning shown by learners and to assess any challenges with curriculum coverage (Elmore, 2009). The DoE hopes that the PILO toolkits and training could facilitate sharing and reporting of curriculum coverage progress and challenges. Therefore, PILO project operates as a spiral process, which, at the end of the day, can improve learning outcomes.

1.3. Focus and purpose

This research explores teacher learning through the use of PILO toolkits and training in grade 8 and 9 mathematics classrooms. The study was conducted in Pinetown District. The schools which were part of this study are at KwaNdengezi location. This study identifies how Senior Phase (SP) mathematics teachers say they learn and value in using PILO toolkits and training to improve curriculum in mathematics classroom. It also aims to gain insights on the extent to which PILO toolkits training change Senior Phase mathematics teachers' practices in grade 8 and 9 classrooms regarding curriculum coverage.

1.4. Rationale

Mathematics is taken as a crucial subject which is not passed by many learners. The TIMSS Report shows that the grade 5 and 9 learners battle with mathematical concepts 9 (TIMSS Report,2015) the bad performance has negatively affected most learners who attend schools in the rural areas and townships. Based on the crisis in the teaching and learning of mathematics, South African government has established a goal to increase learner performance by making sure that about 90% of learners in grades; 3,6and 9 achieve 50% or more in mathematics, languages and science by the year 2030 (Mthiyane, Naidoo and Bertram, 2018). Department of Education (DBE) is concerned about the content coverage, lack of expertise of SMTs in monitoring and supporting teachers continue to be some of the huge challenges experienced in the education sector and teacher performance. In most cases, teachers are not able to complete the syllabus (poor coverage of learner outcomes) due to different reasons, such as teaching what they are

comfortable with, teachers skipped some sections for various reasons. Factors leading to poor coverage in the South African education system led to high failure rate of mathematics in grade 8 and 9. According to Kanjee and Sayed (2013) state that large amount of money have been spent to acquire valid and reliable information for utilization in developing learner levels of performance, with less information and support are provided to educators for how this should be attained. The lack of clear, unambiguous policy implementation guideline and teacher support, therefore create serious weaknesses in interpreting ANA effective. Mathematics is an important subject which determines the progress of the learner in the senior phase. In grade 8 and 9, if the learner fails mathematics and a language, the learner will not progress (Promotion Progression document, 2014). According to the Annual National Assessment report of 2014, one of the reasons that causes learners not to achieve in mathematics is a failure to complete the syllabus. Spaul (2011) argues that the reason teachers sometimes fail to complete their syllabi is because they have low content knowledge level in mathematics. He further argues that if the teacher struggles with teaching a geometry concept, they will tend to leave that section and teach a section she/he is familiar with. This is why some teachers do not finish the syllabus. It is for this reason that the KZN DoE introduced PILO toolkits and training. Teacher mastery of a subject is vital to syllabus coverage and it is important to note that teachers cannot teach what they do not know. The United State Conference Board for the Mathematical Science (CBMS) recommends that mathematics teachers require a detailed mastery of the mathematics in numerous grades beyond that which they supposed to teach as well as mathematics in earlier grades.

Keevey (2006) points out that there is a large percentage of South African teachers who are either unqualified or under qualified in mathematics. They have content knowledge, but they fail to deliver the content. This problem is not only an issue in South African education, but it is for worldwide. Spaul (2011) reported about the study conducted in 2009 in the North West, that schools showed low curriculum coverage with sixty percent of the lessons not taught. The reason for low coverage of the curriculum included teacher absenteeism, poor time supervision and the lack of a teaching and learning culture. These reasons can further contribute to teachers not completing their syllabus in most of the province, especially in mathematics teachers. Spaul's (2011) study also showed that teachers are lacking content knowledge. Content knowledge of teachers has been an ongoing concern in the past years, Grossman (1990) confirms that the knowledge of the subject issue. Bertram (2011) described content knowledge as a deep understanding of the basic concepts in the subject.

The current status of professional development activities is once-off workshops, Integrated Quality Management System (IQMS) and Continuous Professional Teacher Development (CTPD) initiated by the South African Council for Educators (SACE) to expose teachers an ongoing professional development activities. The Basic Department of Education hoped that the once-off workshops are not being a problem for the teachers to transfer their workshop learning to their classroom practice. The huge criticism about once-off workshops is that they only focus on a particular aspect of a new policy that tends to control professional development. One of the issues is that the workshops tends to be a one size fits all, where the official will contact teachers about how to implement the new policy and follow obligations. The teachers are expected to have more on conceptual issues like kinds of knowledge that highlight the new curriculum.

The suggestion of developing teachers at school level is through the Integrated Management System, which is still criticized. IQMS does not appraise capability very well to assist teachers to recognize their needs (Maistry, 2008). Maistry (2008) further pointed out that growth and performance appraisal is joining to make teacher growth. Mokoena (2005) affirms that during the IQMS assessment, many teachers are keen to be evaluated but not for their professional developmental objectives. Teachers go through the procedure because it is connected to salary progression and that no substantive teacher learning, and growth take place. Maistry (2008) argues that the current professional development forms in South Africa are largely unsuccessful in their effort to support the professional growth of teachers. The reason is that there is no one who does follow ups to assess classroom practice.

The Basic Department of Education intervened to solve the problem of high failure in mathematics by introducing the Nine Plus One Programme from 2015 to 2018. It meant that a teacher would teach for nine days, and the tenth day will attend the content workshop, but it also failed due to most of the teachers not attending as they were expected to write a test. Most of the teachers developed a poor self-esteem because of writing tests to check their content knowledge on mathematics. The development of appropriate professional development (PD) activities for curriculum coverage constitutes the main problem of this study.

1.5. Research questions

1. How do Senior Phase (SP) mathematics teachers learn when using PILO toolkits and training in mathematics classroom to improve curriculum coverage?
2. What do Senior Phase (SP) mathematics teachers say they learn and value in using PILO toolkits and training to improve curriculum coverage in mathematics classrooms?
3. To what extent do Senior Phase (SP) mathematics teachers say their use of PILO toolkits and training has changed their practices to improve curriculum coverage?

Based on the above research questions, these are the objectives of the study:

1. To understand how Senior Phase (SP) mathematics teachers, learn from using the PILO toolkits training in order to cover the curriculum.
2. To identify how Senior Phase (SP) mathematics teachers say they learn and value in using PILO toolkits and training to improve curriculum coverage in mathematics classroom.
3. To explore the extent to which PILO toolkits training change Senior Phase mathematics teachers' practices in grade 8 and 9 classrooms to improve curriculum coverage.

1.6. Preliminary literature review

The literature review will focus on the concepts and the conceptual frameworks of this study. The main concepts are professional teacher learning, instructional core, teacher knowledge and teacher change.

1.6.1 Professional teacher learning

Professional teacher learning can be defined as the process where apprentice teachers shift towards becoming specialists and a difference is created between teacher knowledge and teacher's personality (Kelly, 2006). For teachers to become experts, it is long journey, because there are different aspects that can influence teacher learning. Kelly (2006) further elaborates that teacher learning engages teachers involved in the procedure of knowing-in-practice so as to permit their complete contribution in classroom action. Teacher learning is the process that engages the growth of located teacher identities. Bertram (2011, p.14) defines teacher learning as "both social learning and individual learning, and which also makes clear what kind of

knowledge is learnt in the different ways”. Opfer and Pedder (2011) suggested that teacher learning does not always occur in a professional development activity, but they believed that teacher professional development is a repertoire of activities and also ways of learning. There are three systems that influence teacher learning (Opfer & Pedder (2011)). The first subsystem that influences teacher learning is the teacher professional learning activity which focuses on formal planned activities like workshops.

Kelly (2006) suggested two broad theories for understanding how teachers learn. Kelly (2006) mentioned a cognitive perspective which focuses on the idea of learning individually and it based on propositional knowledge. The main notion is that teachers will obtain knowledge in a particular context (workshop) and must transfer that learning to their classroom contexts. The second theory is social-cultural perspective, means that learning needs to take place in the same context in which it needs to be used. Learning needs to be situated because it promotes collaborative in communities of practice. The second subsystem is the individual teacher who can influence teacher learning. Bertram (2014) pointed out that there are numerous aspects that can positively influence the individual teacher being the teachers’ beliefs about the purpose of education, the role of children in a classroom, the nature of knowledge, learning and teaching that influence their practice as well as the combination of beliefs and experience. The third subsystem is school. The school includes the norms of the school as well as practices and structures which both allow and limit the possibilities of teachers’ practices and their professional learning.

1.6.2 Instructional core

The PILO project is informed by Elmore’s concept of instructional core. Elmore (2008) describes the instructional core as the connection between the teacher, the learner, and the content, but not the traits of any one of them alone. Elmore (2008) argues that professional development learning activities that only focus on one aspect of the instructional core (teacher, learner, content) have failed to produce improvement in the education system. That is why he argues that you need to change all the three aspects of the instructional core if you want improvement in learning results. Pertinent to the changes in the instructional core, the study focused on whether teachers believe the use of PILO toolkits has changed their practices and if so, how?

1.6.3 Teacher knowledge

Shulman (1986) was the first researcher to explain a knowledge foundation for teachers or to respond to the inquiry. He defines teacher knowledge as the body of knowledge and information that teachers teach, and learners are expected to learn in a given subject or content area. Teacher knowledge is dynamic, rather than fixed and static. Shulman (1986) viewed models of teacher knowledge into four domains. There are: content knowledge which is the notion of the subject that needs to be taught, general pedagogical knowledge which is knowledge of different teaching strategies, classroom management strategies, and assessment strategies. The content knowledge knows about the background of the learners, is aware of the organizational culture of the school and pedagogical content knowledge, which is understood as the way in which a teacher recontextualises her substance knowledge so that it can be understood by the learner. In relation to teacher knowledge the study focused on what teachers learn from using PILO resources like toolkits.

1.6.4 Teacher change

Teacher change can happen when teachers are engaged with professional learning activities. King (2015) argues that teachers can change their practice first, followed by developing students' learning and finally teacher thoughts and ideas. Teacher learning that is occurs in the linear is criticized by most researchers, who argue that they need to make changes in the linear method rather than a common exchange between changes in values, practices, and the student with rejection as the ultimate starting position. These above changes were expected in the study that I conducted. King (2016) argued that teachers serve as the doorkeepers of change or change agency.

King (2016) assumes that teacher change can improve the student learning outcomes, because some learners are resisting change. Guskey (1986 cited in Clarke and Hollingsworth (2002)) argued that "flaws in the change and provide as an alternative model, which stated that the important change in ideas and approaches are likely to obtain place only after amend in studied learning outcomes are clear" (p.345), which means that change must be happen either with the teacher or learner first to obtain a solid outcome. Teacher change is not a once-off incident (Clarke & Hollingsworth ,2002). Clarke and Hollingsworth (2002) argued that teacher change needs to be engaged at various identifiable stages, such as recognition, refinement, re-examination, renovation, and renewal with some of the resources. Cobb, Wood and Yackel

(1990) viewed these models as linear, which need to include an on-going interplay between beliefs and practice.

The gap in the education system in South Africa is that there are only a few programmes that equip teachers to improve their learning outcomes. Most of the time the education system is doing once-off workshops (Bertram, 2011) and the current programme is the One Plus Nine programme for mathematics teachers. The One Plus Nine programme is where teachers attend the workshop for a day then for nine days will be in classroom practice. The programme attempts to equip teachers with content knowledge of which Spaul (2011) mentioned that most of the teachers are lacking in. There was a project which was similar to PILO that was conducted in Western Cape (DoE) known as the WCED' Literacy and Numeracy Intervention. It was introduced in 2009 targeting language and mathematics teachers in the province. It aimed to improve the excellence of teaching and learning, provide training and follow-up support to teachers (Meyer & Abel, 2015). Even a Gauteng intervention called the Gauteng Primary Language and Mathematics Strategy focused on three overlapping components with pre-designed daily lesson plans for teachers, great learning and teaching resources and individual instructional coaching for teachers (Meyer & Abel, 2015). Spaul (2011) argues that there is a vital need for developing a plan for meaningful teacher development. The project stated that if the curriculum coverage improves, it can lead to the improvement of learning outcomes. It uses toolkits to track curriculum coverage.

1.6.5 Conceptual and theoretical frameworks

Desimone 's (2009) was used as conceptual framework while Illeris (2009) as a theoretical framework. She looked at core features of professional development that help to improve learning outcomes. He proposed the basic model that represents interaction and relationship between the critical aspects of a teacher's professional growth, the teacher's understanding and ideas, classroom practice and learner results. Desimone (2009) describes this model as a "path model", because it shows the link between teacher knowledge, classroom practice and learner achievement. This model was essential for my study, as I was looking at the functionality of the PILO project expected to see this flow happen in the project. The path model is illustrated in Chapter 2. Illeris (2009) identifies four methods in which a person can use to learn. These methods are cumulative, assimilative, accommodative and transformative learning. My intention

of using these conceptual and theoretical frameworks is to understand how mathematics teachers, learn from using the PILO toolkits training in order to cover the curriculum.

1.7. Research methodology

This study used a qualitative research approach. McMillan and Schumacher (2006) describe qualitative research as an investigation in which the researcher gathers data in face-to face locations by working together with selected people in that location. Babbie and Mouton (2001) define qualitative research as a study of human action. Qualitative research is when the data is represented in word, pictures and analyzed thematically. Qualitative research is an activity that locates the observer in the world (Creswell, 2007). This study explores how teachers learn through the use of PILO toolkits in grade 8, 9 mathematics classrooms in the Pinetown District. Teacher learning is a continuous process and the context in which teachers learn influences their learning. To comprehend teacher learning, therefore, the location in which it happens needs to be understood as well. Through the case study research design, I was able to expose conditions that are critical to the phenomenon being investigated. The case being investigated in this study are teachers who participate in *Jika Imfundo* in the Hammarsdale circuit. Purposive sampling was used to select participants for this study. Purposive sampling was used for the selection of only those who have relevant information about the phenomenon being explored (Yin, 2011). The study required six (6) mathematics teachers. Participants in this study were qualified teachers who taught secondary school level mathematics. Throughout my communications with the participants, I was guided by Guillemin and Gillam's (2004) study that the researchers are ethically required to interact with participants in a humane, non-exploitative manner and at the same time, being mindful of their roles as researchers.

I used both interviews and document analysis. The main purpose of the interview is to access in depth insights into the participants themselves (Polkinghorne, 2005). In document analysis, I used their learners' exercise books together with trackers. In this study I used six stages of thematic analysis designed by Braun & Clarke (2007). Thematic analysis was presented through the process of coding in phases to create meaningful patterns. These phases are becoming familiar with the data, generating initial data, searching for themes, reviewing the themes, defining and naming themes and producing the report. Guba's (1981) four criteria for assessing the trustworthiness of a qualitative study were adopted. He developed the criteria of credibility, transferability, dependability, and confirmability. The study's conclusion was based on the

discussion of the findings. However, a small-scale qualitative case study's finding cannot be simplified but are limited to the contexts of the participants and schools involved.

1.8. Organisation of the dissertation

Chapter One: Overview of the study

This chapter presented the background and context of the study, focus and purpose of the study, the rationale, research questions and objectives, a brief overview of the related literature, the conceptual frameworks, the research methodology and the organization of the dissertation.

Chapter Two: Literature review

Literature related to this study is presented in this chapter. I begin the chapter by discussing the overview of Jika Imfundo, professional teacher learning, teacher knowledge and types of knowledge, and teacher change. I end the chapter by presenting the conceptual and theoretical frameworks which underpin this study.

Chapter Three: Research design and methodology

In this chapter, I first describe and justify the research paradigm, research design, research context, sampling and methodology followed in this study. The data collection methods mentioned in interviews and document analysis is then explained. Lastly, I present the sampling procedure, data analysis, ethical issues, trustworthiness issues and limitations of the study.

Chapter Four: Presentation of research data

In this chapter, I present and analyze the data of the study. The chapter discusses the participants' profiles, and data presentation according to the themes that emerged from data. The findings are based only on what the participants said during the interviews, as well as document analysis.

Chapter Five: Discussion of findings, recommendation, and conclusion

In this last chapter, I discuss and analyze the findings according to research questions. I analyze the findings using the conceptual frameworks, and other researchers' findings from the literature review section of the study. I then conclude the study, and present recommendations which come from the discussion.

1.9. Conclusion

In this chapter I presented the overview of this study; I began by explaining its aim, its background, and the context in which it was conducted and its rationale. The research question(s), an overview of related literature including the theoretical and conceptual frameworks used in the study, and the methodological approach was presented. The dissertation overview gave the reader an idea of the content of the other chapters in the dissertation. In the next chapter, I present a detailed review of literature of this study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In the earlier chapter I provided an overview of the study, by highlighting important parts such as background information as well as the rationale for the study. This chapter presents the literature review. The literature review presented in this chapter is drawn from international, regional, and local sources and it is organized conceptually. The aim of this study is to explore teacher learning through the use of PILO toolkits in grade 8, 9 mathematics classrooms in the Pinetown District. The sources referred to in this study were generally from 2000 to 2020 where the work of some main theorist and empirical studies are presented. I also used seminal sources as from 1982, like Shulman (1987) to provide relevant information for my study. The literature review can be described as an evaluative report of studies associated to one's chosen area (Boote & Berlie, 2005). The main aim of this literature review is to present a context for the study, validate the study and make sure that the topic has been done before or is not just a repetition study. On the other hand, a literature review also assists to discover gaps in the past research as well as to improve, relocate or even modify the topic.

2.2. Professional Development

Professional development is defined as “any activity that is intended partly or primarily to prepare paid staff for improved performance in present or future roles in the school districts” (Desimone, 2009, p.182). Opfer and Pedder (2011) cited in Bertram (2014) relates professional development to a particular program, activity or event which emphasises that teacher learning only occurs as a result of certain activities, workshops, or programmes. Moreover, the formal professional development activities may or may not direct to teacher learning. Professional development is the knowledge, skills and ongoing learning undertaken to develop one's ability to do duty and nurture as a professional, be excellent and stay abreast of any professional development (Davis, 2011). Guskey (2002) argues that professional development is an attempt to bring about change in the classroom practices of teachers, in their attitudes and beliefs and in the learning outcomes. Professional development is essential to develop the ability of teachers

that encounter different problems (Kwok, 2014). Professional development as the processes, activities and experiences that provide changes to expand teacher professional learning. The aim of professional development may compare along a continuum from transmission of skills at one end to transformative practice at the other end where teachers are encouraged to work mutually in a constructive manner to alter their practices to better meet the needs of the learners. Kennedy (2005) identifies nine models for continuing professional development that involves training, award-bearing, deficit, cascade, standards –based, coaching, community of practice, action research, and transformative models.

Kennedy (2005) identified a variety of characteristics for CPD models and categorised them. The models are categorised in order to explore a particular knowledge which aims to develop a specific model. He grouped models into nine categories as follows: training, award-bearing, deficit, cascade, standards-based, coaching/monitoring, community of practice, action research and transformational. Each of these models is explained in the Table1 below on the next page.

1.The cascade model	The cascade model encompasses individual teachers attending training workshops, and then cascading or disseminating the information to colleagues. This model is normally used in circumstances where resources are inadequate.
2.The action research model	In the action research model, the participants themselves are involved as researchers with a view to enlightening the quality of action within the research. The quality of action can be looked at as the participants understanding of the circumstances, as well as the practice within the given circumstances.
3.The training model	This model has been the prominent form of professional development for teachers. In addition to supporting a skills-based, technocratic view of teaching, it provides teachers with the opportunity to modernise their skills, so that they are able to demonstrate their competence. The training is generally delivered to the teacher by an expert, by means of a programme that is determined by the deliverer, and in terms of which the participants are placed in a passive role.

4.The community of practice model	The added value of learning in communities pertains to the existence of individual knowledge, and to the combinations of several individuals' knowledge through practice as being a powerful site for the conception of new knowledge. A clear relationship exists between communities of practice and the mutually supportive and challenging form of the coaching / mentoring model.
5.The deficit model	In the deficit model, professional development can be planned specifically to address an alleged deficit in teacher performance. Such development may be set within the perspective of performance management as a means of raising standards, or as a component of intervention to achieve greater efficiency or effectiveness.
6.The standard based model	The standards-based model represents a desire to make a system of teaching, as well as teacher education that can create and empirically validate connections between teacher effectiveness and student learning. The model also relies greatly on a behaviourist perspective of learning.
7.The coaching or mentoring model	The defining characteristic of this model is the importance of the one-to- one relationship, which generally occurs between two teachers, and which is designed to support professional development. Both coaching and mentoring share this characteristic, although most attempts to distinguish between the two suggest that coaching is more skills-based than is mentoring, which involves an element of counselling and professional friendship.
8.The award- bearing model	This ideal depends on or emphasizes the completion of award-bearing programmes of study that are usually, but not exclusively, validated by universities. This external validation can be viewed as a mark quality assurance, but it can be equally viewed as the exercise of control by the validating organisations.

Table 1: Models of Professional Development (Kennedy, 2005, p.248)

While Kennedy (2005) highlighted models of professional development are important such as workshops. Guskey (2009) suggests that effective professional development activities. These activities of *Workshops* are an essential tool that is used for professional development. Bertram (2011, cited in Bantwini, 2011) defines workshops being based on propositional knowledge of the curriculum document, but not disciplinary content knowledge.

Most of the time the Department of Education prefers to use workshops, because it is the best way of gathering as many people as possible. The criticism of workshops is that most education leaders consider workshops as a waste of time and money. A lot of workshops are unproductive, especially those once-off because there are no follow-ups or support. Most of the time they focus on implementation and forget about supporting the teachers in their classroom practice. Guskey (2005) argues that most workshops are poorly organized and focus on unproven ideas and approaches, as a form of professional development. *Outside expert for professional development* must be site-based and build on in-house staff members. Guskey (2005) considers that the most effective way to convey development is to have teachers in each school meet to explore common challenges and seek resolutions based on the shared experiences. *Time* of professional development showed that there is lack of sufficient time for staff members to engage in high quality professional learning. Teachers need enough time to deepen their understanding, analyse learners' work and develop new methods to instruction. Once teachers attended workshops there is a need for *Follow-up* PD experts need to emphasize follow-up activities. Teachers at all levels need just-in-time, job established support as they are battling with adaption of new instructional practices to their distinctive classroom contexts. *Activities* of professional development are most effective and work best. The structural elements of the professional development activity include the nature of the work and the context in which that works occurs. *Content* as one of PD activity is most likely to direct to enhancement of student learning. The professional development tries enhancing teachers' content knowledge and their pedagogic content knowledge (Shulman, 1986). The activities are intending to assist teachers in better understanding both what they teach and how learners obtain specific content knowledge and skills.

The suggestion of developing teachers at school level is through Integrated Management System, of which is still criticized. The Integrated Quality Management System is a national policy aimed at increasing productivity among teachers. IQMS consists of three programmes namely Development Appraisal, Performance Measurement and Whole school evaluation. The IQMS has been designed with the aim of preparing an environment for teacher development, to monitor the overall effectiveness of the institution, to evaluate the performance of the teacher, to identify specific needs of teachers for support and development, and to promote accountability. IQMS does not review capability very much to support teachers to recognize their desires (Maistry, 2008). Mokoena (2005) affirms that during the IQMS assessment many educators are keen to be

evaluated but not in their professional developmental objectives. Educators must go through the procedure of professional development connected to salary progression and that no substantive teacher learning, and growth takes place. Maistry (2008) argues that the current professional development forms in South Africa are largely unproductive in their efforts to support the professional growth of teachers. The reason is that there is no one who assesses what classroom practice are being used. The above discussion shows what really occurs in professional development in South African education. The discussion also shows that education interventions do not show any improvement, which is why the PILO was developed for professional development.

In 2011, the Department of Basic Education and the Department of Higher Education and Training initiated the establishment of professional learning communities through the Integrated Strategic Planning Framework for Teacher Education and Development (ISPFTED). However, the current dominating professional development activities in South Africa are once-off workshops, Integrated Quality Management System (IQMS) and Continuous Professional Teacher Development (CTPD) initiated by South African Teacher -Development (SACE). The Department of Education hoped that the once-off workshops will not be a problem for the teachers to transfer their workshop learning to their classroom practices. The huge criticism about once-off workshops is that they only focus on a particular aspect of new policy that tends to control professional development. One of the issues is that the workshops tend to be one size fits all, where the official will conduct a workshop about how to implement the new policy and follow obligations, where teachers expect more on conceptual issues like kinds of knowledge that highlight the new curriculum. The KwaZulu-Natal Department of Education through PILO envisaged to provide professional, supportive, conversations about curriculum coverage.

2.3. Teacher Learning

Teacher learning is a complex process, which requires cognitive and emotional involvement of teachers individually and collectively, the capacity and willingness to examine where each one stands in terms of conceptions and beliefs and the inspection and enactment of appropriate alternatives for improvement or change (Avalos, 2011). Loughland and Nguyen (2015) believed that teacher learning serves as the essential matter in developing the quality of education. Teacher learning is an important for mediating factor for enhancing student outcomes; the knowledge

practice gap (King, 2015). Teacher learning assists teachers to transform new learning into classroom instruction and that can improve outcomes of the learners.

Loughland and Nguyen (2015) argued that teacher professional learning can be organized and structured in a different way or varied contexts and for several different reasons. King (2015) defines professional learning as the growth of teacher expertise leading to a change in practices to result in improved student outcomes. The effective professional learning programmes must be designed to meet at least these four conditions, which translates learning into classroom instruction, improvement of outcomes, integration into teaching, learning and evaluation. Teacher learning is a complex system rather than a single event of changing practices and may take place in a series of different places and spaces, both formal and informal, and not only as a result of formal professional development activities. However, teacher professional learning is debatable and a complex system rather than a single event of altering practices (Opfer & Pepper, 2011). This complex system includes structures with systems made up of individual teachers, interactions between teachers, school-level systems and interactions between teachers and school-level systems. This process is arguably situated and influenced by a numerous of situational factors which can support a change in practices, which is described as a change in knowledge, understanding, skills, behaviors, attitudes, values, or beliefs. Teacher professional development as an accumulation of knowledge through in-service training or courses while others argue that knowledge accumulation does not necessarily result in deep professional learning which is needed to change practices.

Teacher learning can be defined as the method by which apprentice teachers' move towards specialist and a difference is created between teacher knowing and teacher identity (Kelly, 2006). For teachers to become experts, it is long journey as there are different aspects that can influence teacher learning. When one talks about experts, one refers to an active and productive relationship with the knowledge –in and knowledge-of practice. This involves that teacher learning does not stop but is an on-going process. On the same note, Bertram (2011, p.14) defines teacher learning as “both social learning and individual learning, and which also makes clear about what kind of knowledge is learnt in the different ways”. In this above statement teachers are the agents of change in their own classroom practices. Teacher learning can either be formal or informal learning. Most of the time, teacher learning occurs in formal workshops or university courses, which emphasises a cognitive view of learning. Kelly (2006) viewed the cognitive model as one that is insufficient for understanding the complexity of teacher learning. The

cognitive approach supports a view of teacher expertise that exists in the individual's mind and provides a simplistic notion of teacher knowledge, which does not account for what is called knowledge-in-practice. Teaching learning is the process that the growth of situated teacher identities. Kelly (2006) elaborates that teacher learning engages teachers involved in the procedure of knowing-in-practice so as to permit their full contribution in classroom action. Opfer and Pedder (2011) suggest that teacher learning does not always happen in a professional development activity, but they believe that teacher professional development consists of a range of activities. Opfer and Pedder (2011) views three sub-systems that influences teacher learning that are related to my study. The first subsystem that influences teacher learning is the teacher professional learning activity. It focuses on formal activities like workshops. For my study, I will be exploring the activities of PILO project. This study therefore, intended to identify how Senior Phase (SP) mathematics teachers say they learn and value in using PILO toolkits and training to improve curriculum in mathematics classroom.

Kelly (2006) suggests two broad theories for understanding how teachers learn. Kelly (2006) mentions cognitive perspective which highlights by an idea of learning individually and it is based on propositional knowledge. The main concept is that teachers obtain knowledge in particular contexts. The second theory is socio-cultural perspective, which means learning needs to take place in the same context in which it needs to be use. Learning needs to be situated because it encourages collaborative in communities of practice. The second subsystem is individual teacher who can influence teacher learning. Bertram (2014) states that there are number of factors that can have a positive impact on the individual teacher, such as teacher's belief about the aim of education, the role of children in a classroom, the nature of knowledge, learning and teaching that influence their practice as well as the combination of beliefs and experience. The third subsystem is school. The school includes the norms of the school as well as practice and structure which both allow and limit the possibilities of teachers' practices and their professional learning. Teacher learning that occurs linearly is criticize by most researchers, who argue that they need to have a reciprocal interchange between changes in beliefs, practices, and the student with no ultimate starting place.

Professional learning is a complex process, which involves cognitive and emotional participation of teachers individually and collectively, the ability and enthusiasm to observe where each one positions in terms of conventions and beliefs and the inspection and performance of appropriate alternatives for improvement or change (Avalos, 2011). Loughland and Nguyen (2015) believe

that professional learning for teachers serves as an essential for developing the quality of education. Professional learning is an important intervening factor for enhancing learners' outcomes and the knowledge practice gap (King, 2015). Professional learning assists teachers to transform new knowledge into their classroom practices which can result in improving learners' outcomes.

The knowledge is particular and exceptional to a specific classroom or school. However, professional development may seem like knowledge-in-practice which covers implicit knowledge. Implicit knowledge involves professional activities which one cannot be fully expressed but can be formed by teachers in the context of their classroom practice. On the other hand, Kelly (2006) argues that teacher learning does not offer a clear description of knowledge-of-practice. Woods and Jeffrey (2002 cited in Kelly 2006) argues that teachers do not simply approve the identities which through their affordances give them, but all affordances make particular outcomes more likely.

The focus of this study is online with the above researchers in the sense that the study is exploring what teachers learnt and how they learnt in constructing and using PILO toolkits. This is in line with Elmore (2008) who describes instructional core as the connection between the teacher, the learner, and the content, but not the traits of any one of them alone. The statement here is that as these teachers construct and use PILO toolkits, they are mixing knowledge knowledge-of-practice together with knowledge-in practice. Kelly (2006) continually mentions that knowledge-of-practice includes content knowledge, pedagogical approaches of class management, and learner discipline which are often obtained formally through programmes or workshops. Hence, in *Jika Imfundo*, teachers will obtain different types of knowledge formally and informally. Formally through attending just-in-time workshops and informally as they will be provided with toolkits (planners and trackers)

A lot of research work has been undertaken on the phenomenon of teacher learning. In Ireland, King (2016) explored factors that affects professional learning in schools. The study included five urbans, disadvantaged primary schools in Ireland. The study was based on teachers involved in a collaborative professional development literacy initiative. The study focused on teacher professional learning as a mediating factor for improving student outcomes. The findings of this study revealed that not all teacher professional development must result in new practices and change. King (2016) found that teaching and learning is a complex and contextual process,

influenced by a range of factors such as support, initiative design and impact. The study is similar to this particular study as it based on what and how teachers learn. Therefore, the only difference is the context because King's study discovered teacher professional development to support teacher professional learning, while this study focuses on how teachers learn by using the PILO toolkits in grade 8 and 9 mathematics classrooms. The study investigates how teachers learnt through Jika iMfundo.

King (2016) used semi-structured interviews with teachers and principals in five Irish case studies. The study had on a formal programme to uplift their knowledge and skills. In King's (2016) study, it revealed that teachers learnt through a day-to-day programme, while Jika iMfundo is a programme that involved teachers to attend Just-in-Time workshops and provides the toolkits (planners and trackers). My study goes further in revealing the kinds of knowledge that they obtained through use of PILO toolkits in the classroom.

2.4. Teacher Change

Teacher professional development is described as the growth of teacher expertise directing to a change in practices to effect in progressed learner outcomes (King, 2016). Teacher change can be happened when teachers engaged with the professional learning activities. King (2015) argues that teachers can change their practice first, followed by improved student learning and lastly teacher attitudes and beliefs. Change that occurs in the linear is criticized by most researchers, who argue that change is not a linear process rather a reciprocal interplay between changes in beliefs, practices, and student with no definitive starting place. King (2016) argued that teachers serve as the gatekeepers of change or change agency.

Furthermore, one cannot assume that teacher change can influence student learning outcomes because some learners resist changing. Guskey 1986, p.345 cited in Clarke and Hollingsworth 2002) viewed that "flaws in the change and provide as an alternative model, which stated that the significant change in beliefs and attitude are likely to take place only after change in studied learning outcomes are evident", meaning change must be done by either teacher or learner first so as to obtain a solid outcome. Teacher change is not a once-off incident, but Clarke and Hollingsworth (2002) argued that teachers engage through various identifiable stages, such as recognition, refinement, re-examination, renovation, and renewal. However, some of these

researchers like Cobb et al. (1990) viewed these models as linear, which need to include an on-going interplay between beliefs and practice.

Once the teachers engaged with using PILO toolkits to improve their classroom practices the teachers were expected to have changes in their classrooms. The change in their classroom can occur by teachers who can complete their curriculum.

2.5. Teacher Knowledge

Teacher knowledge can be defined as the total knowledge that a teacher has at her or his disposal at the particular time (Verloop, van Driel & Meijer, 2001). According to Wilson and Demetriou (2007) teacher knowledge can be divided into two groups, practical knowledge, and codified academic knowledge. Practical knowledge is focuses on school-based practices and activities, while codified academic knowledge is based on the plan that learning is primarily a cognitive process of the mind.

Shulman (1989) was the original researcher to explain the knowledge foundation for teachers or to respond the inquiry. Shulman (1987, p.127) identifies seven kinds of teacher knowledge “knowledge of content, knowledge of pedagogy, knowledge of curriculum, knowledge of contexts of schooling, knowledge of learners and learning, knowledge of educational philosophies, goals and objectives”. On the other hand, Grossman (1990) reviewed these seven groups into four areas of knowledge: subject matter knowledge, pedagogical content knowledge, general pedagogical knowledge and knowledge of context. Grossman (1990) defines educators as the body of knowledge so that they instruct to learn in each subject or substance part. Teacher knowledge is dynamic, rather than fixed and static. Shulman (1986) viewed models of teacher knowledge into four domains. There is substance knowledge which is the knowledge of the topic that requires being educated, common pedagogical knowledge, which understands diverse schooling approaches, classroom management plans and assessment approaches. This research exposes the four domains illustrated by Grossman (1990). Grossman (1990) states these kinds of knowledge are vital for teachers in their teaching.

2.5.1 General pedagogical knowledge

This kind of knowledge focuses on basic skills that teachers are supposed to get by assisting with in the classroom. Grossman (1990, p.6) affirms that “general pedagogical knowledge has been the focus of most research on teaching. It includes a body of general knowledge, beliefs and

skills related to teaching principles of instruction.” One can transfer common knowledge of academic principles to teaching and learning. However, Borko and Putman (1996) argue that general pedagogical knowledge involves teaching approaches that simplify the content of a discipline. These teaching methods assist in developing a helpful learning environment. The development of regular routines for cooperation between the teacher and the learners encourages the teacher’s role as a student learning mediator with classroom management approaches. However, the teachers need to make use of teaching resources (planners and trackers) that are provided to them to promote learning outcomes, by engaging in effectiveness of teaching and learning in their classroom practices.

2.5.2 Pedagogical content knowledge

Shulman, (1987) defines pedagogical content knowledge as “blending of content and pedagogy into an understanding of how particular topics, problems or issues are organized, represented and adapted to the diverse interests and abilities of learners and then presented for instruction. PCK is viewed as a combination of general pedagogical and specific subject matter knowledge. This suggests that teachers have to acquire this type of knowledge in order for them to develop their way of teaching. Knight (2002) affirms that PCK is a simple combination of content and pedagogy in the special form of professional development. This describes that teachers must have knowledge of content and use a range of approaches to deliver their lessons. PCK covers the teacher’s appreciation of learning and the development of skills necessary to impart knowledge. PILO toolkits make teaching and learning very easy because teachers are given lessons plans so their only duty is to deliver the lesson to the learners. This defines that teachers need to understand how this type of knowledge could be applied in the classroom environment.

2.5.3 Knowledge of context

Knowledge of context can be described as requiring of a deep appreciation of the environment in which teachers accomplish their duties involving the changes, and anticipated constraints that the teaching district enforces on the teacher (Shulman, 1987). It includes the school factors that influence instructions such as culture, settings, and guidelines from the Department of Education. I personally perceive Jika Imfundo as one of the settings that assist teachers in improving learning outcomes. It came with guidelines including planners and trackers that play a major role

in the Department of Education. Community factors are also considered such as learners' family backgrounds, and specific advantages and disadvantages that form their learning. This means the teacher in the research should be well trained to deal with learners of diverse cultures and abilities. The last part of knowledge of context involves school type and size of classes, quality, and extent of beginner teacher support as well as the amounts of feedback obtained by teachers. This type of knowledge involves the whole school situation based on the aspect that the teacher requires to be aware of good performance.

2.5.4 Subject matter knowledge

Subject matter knowledge includes knowledge of the content of a subject area, such as knowledge of substantive and syntactic structures of the discipline. According to Grossman (1990) syntactic disciplines are rules of evidence, formed and confirmed in a discipline whereas, substantive disciplines are normally understood as the knowledge of concepts and principles of the disciplines that are structured to integrate its facts. The subject matter knowledge is sometimes known as content knowledge. Grossman (1990) affirms that content knowledge refers to the amount and organization of knowledge on its own which the teachers need to have in mind. This kind of knowledge does not involve how to teach but it based on the content itself. It is a very serious part of teaching where the teacher is expected to defectively deliver the content to learners, in order to impart quality education. If there is an absence of perfect grounding on content, the teacher has a low internal locus of control. PILO toolkits assist teachers' practical knowledge and propositional knowledge, which entails the knowledge of a school or classroom. The teachers require this knowledge on an on-going process in their classrooms.

2.5.5 Mathematics knowledge for teaching

Ball et al. (2005) reach a contract in the article, reading for Common Ground in K-12 mathematics that reads as follows:

Teaching mathematics effectively can be affected by a rock-hard understanding of the material. Teachers must be able to do the mathematics that they are teaching, but it is not adequate knowledge for teaching. Effective teaching requires an understanding of the underlying meaning and justifications for the ideas to be taught, and the capability to make connections among topics (Ball et al. 2005, p. 6).

These authors wrote in the US context, but this is relevant also to South Africa as well. International research done by Van der Dandt and Niewoudt (2003), proposed that there are two approaches that focus on teacher's mathematical knowledge. This approach does not only focus on the essential of the content of knowledge for mathematics teachers but also focuses on the quality of the teacher's knowledge. The first approach considered the characteristics of teacher's knowledge and assumes that mathematics content with skills is necessary for teaching but Muijs and Reynolds (2002), criticized that approach and they contend that student results cannot be associated with formal mathematics qualifications.

The second approach was about understanding specific topics of mathematics concepts and procedures. If teachers do not understand the concepts that facilitate learning, then it is difficult for them to provide an adequate explanation of tasks to be constructed and concepts to be clarified. The National Research Council (2001) confirmed that teachers who do not have mathematical knowledge do not involve their learners in solving mathematical tasks, and thus, hardly create productive conversations with their learners.

Effective teaching can be achieved by giving learners an opportunity to discover interactive mathematics activities and connecting instructions to the context of the learners that leads and promotes the development of learners (Atweh, Becker, Grevholm & Opdenakker and Van Damme, 2006). They also contend that a learner-centered teaching style is being promoted for effective teaching of mathematics. Committee (2001) further elaborates that to teach mathematics effectively there should be an interdependence of interaction between mathematics content and a mutual devotion of teachers to work with learners, by involving them throughout mathematics activities. Teachers should know that in each individual learner's mind, there is core mathematical knowledge in which the learner or humans are born with (Henning & Kovacs, 2014).

Crespo, (2003) discussed mathematics teacher's work from two perspectives; these are political and economic perspectives. He suggests that mathematics is seen as a subject that can make a better workforce that is economically viable. Research studies proved that mathematical knowledge continues to be weak. Shulman (1987) defined pedagogical knowledge as the teacher's ability to change the content knowledge into forms which are "pedagogically powerful and yet adaptive to the variations in ability and background presented by the student" (p.15).

2.6. Overview of PILO toolkits training and Jika iMfundo

KwaZulu-Natal DoE intervened by introducing the provisional program called Programme to Improve Learning Outcomes (PILO), which was started in two districts: Pinetown and Uthungulu. The primary concern of the PILO project is in working on change at scale in education in the public sector in order to demonstrate a model of improvement that can be used across the system.

The KwaZulu-Natal DoE proposed the intervention to deal with curriculum coverage in order to improve learning outcomes. The campaign is known as Jika iMfundo. The model checks levels and lessons are learned before rollout across the province. The implementation of Jika iMfundo is carried by PILO to improve learning outcomes. This programme operated from the foundation to FET phases based on selected subjects, which is isiZulu home language, mathematics, and english additional language. It is a school-based programme. For my study, I invited mathematics teachers in the senior phase to participate.

PILO adopts the theory of change that states if curriculum coverage improves, then learning outcomes will improve. For curriculum coverage to improve, the behaviors related with curriculum coverage need to improve. It deals with the monitoring the curriculum coverage, reporting to the level where achievement can be taken, and the condition of supportive responses to solve challenges related with curriculum coverage. The project requests to be presented to district officials, teachers and school management teams with the tools and training needed to have a constructive change on the behaviors necessary to increase curriculum coverage in all classrooms so that learning outcomes improve across the system.

According to Metcalfe (2015), Jika iMfundo adopts a programmatic, rather than project-based approach, which focuses on changing teachers' behavior by using materials and tools to improve teachers' performance. The Jika iMfundo tools include trackers, planners and lesson plans that are used to build professional practices and routines required to improve teaching and learning. The materials come in the form of a toolkit and are designed to be used by teachers, school-based managers, and office-based managers to monitor and support teachers, in order to improve curriculum coverage.

The focus of this study is to explore teacher learning by using PILO toolkits. The literature presented in this chapter showed the necessity of teacher learning as an on-going process as well as the types of knowledge. The procedure of a literature review allowed me to understand the background of my research, know the specialists in the field, and recognize how other researchers have kept up with the research methodologies and procedures and therefore, situated my study into view. In general, the literature assisted me with recognizing how my research fitted into a broader context of teacher learning while providing me with the insights into what has been studied, the current state of research in professional development programmes that are in place. The next part will confer the conceptual framework of the study.

2.7. Conceptual and theoretical frameworks

The study focuses on teacher learning using PILO toolkits. The aim of this part is to discuss the conceptual frameworks of the study. Miles and Huberman, (1994, p.18) “described a conceptual framework as a visual or written product, one that explains, either graphically or in narrative form, the main things to be studied, the key factors, concepts or variables and the presumed relationships among them”. The framework helps to explain concepts and suggests relationships among the concepts in the research. This study has used Desimone’s (2009) core features of professional development conceptual framework and Illeris’s (2009) theory of learning as a theoretical framework.

2.7.1. Desimone’s (2009) core features of professional development

Desimone (2009) supported my study by looking at the core features of professional development that would improve learning outcomes. He proposed the basic model that represent interactive relationship between the critical aspects of professional growth, teacher’s understanding and ideas, classroom practice and learner results.

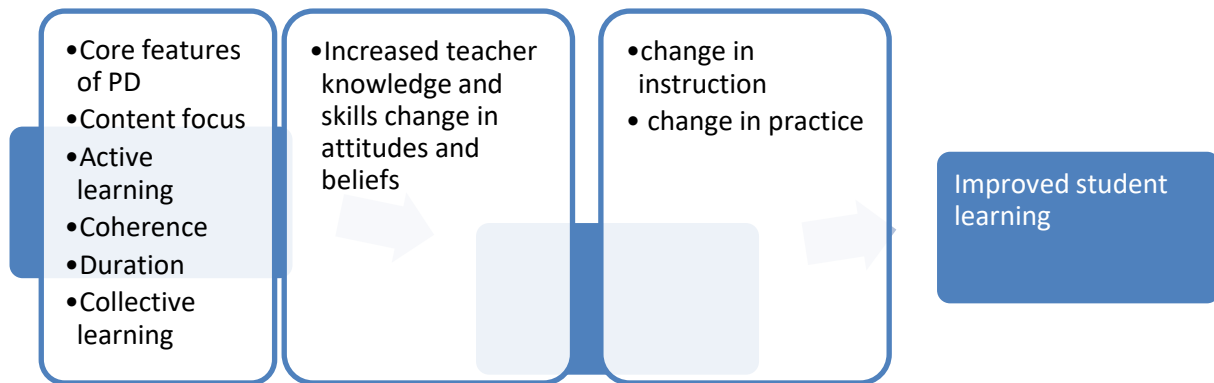


Figure 1: A path model of features of professional development Adapted from Desimone, (2009)

Desimone (2009) explains five critical components of effective professional development. These features are depicted in Figure 1. Desimone (2009) describes this model as a “path model”, because it shows the link between teacher knowledge, classroom practice and learner achievement. This model was essential for my study, as I was looking at the functionality of the PILO project, so I expected to see how this flow happened in the project. Desimone (2009) outlines the foundation elements of successful professional development. My research focused on subject issue content.

2.7.1.1 Content focus

It is an influential feature in the teacher learning. These activities focus on the subject matter content and how learners learn that content with increases in teacher knowledge and skills and also the improvements of practice.

2.7.1.2 Active learning

Teachers need to have opportunities involving active learning which relate to effective professional development. Active learning is the opposition of submissive learning, and learning is featured by paying attention to a lecture, as the Jika Imfundo initially invites teachers to attend just-in-time workshops before they use the knowledge in their classroom practice.

2.7.1.3 Coherence

These features stressed the extent to which teacher learning is constant with teachers’ knowledge and beliefs. The regularity of school, district and state transformation and policies of what is taught is a vital aspect of coherence.

2.7.1.4 Duration

The logical and pedagogical change needs professional development activities to be long enough in duration over which the activity is spread. The study does not clearly show exactly the period of time that professional development must take place, but at the end of the day it must show support and improvement.

2.7.1.5 Collective participation

This component can be realized through participation of teachers from the same school or grade. The collections set up probable interaction and discourse, which can be a powerful form of teacher learning. This feature focuses on high quality professional development as an activity that improves and increases teacher knowledge of the academic subjects they teach.

2.7.2. Illeris's (2009) theory of learning

Illeris (2009) provides four methods in which a person can use to learn (cumulative, assimilative, accommodative, and transformative). Illeris (2009) described learning as any method in living organisms that convey a capacity for change and which is not solely due to biological maturation. Learning theory includes four major aspects. The area of knowledge and understanding is the first one and brings about development of a widespread logical theory. This can be psychological, biological, or social conditions that involves any learning. The second one is the learning itself which includes processes and dimensions, different learning kinds and learning obstacles, which serve as the cornerstone of learning understanding. The third one is internal conditions (societal influences, learning context, and objective situation) that do not only control learning but are directly entailed in the learning. The last one is the application of learning including in the theory. Therefore, in this study, the learning theory enabled the researcher to explore teacher learning using PILO toolkits in grade 8 and 9 mathematics classrooms, how the learning happened and in what ways the teachers' learning changed their classroom practice. The types of learning are shown in Figure 2 below:

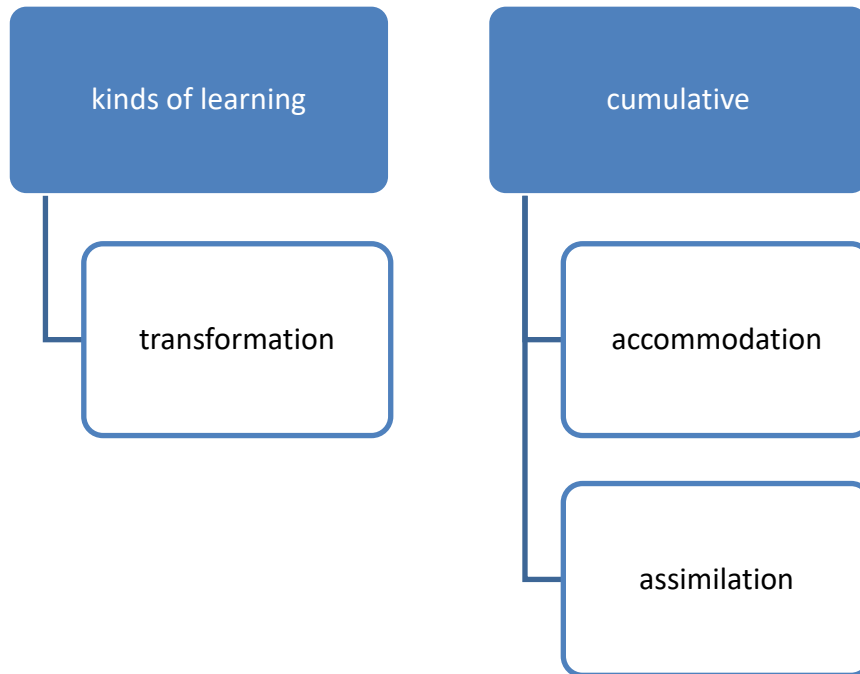


Figure 2: The basic types of learning (Illeris, 2009)

2.7.2.1 Transformative learning

Transformative learning is a process by which we transform problematic frames of reference (meaning perspectives) set of transformation and expectation to make them more inclusive, discriminating, open, reflective, and emotionally able to be altered (Illeris, 2009). This learning includes personality changes or changes in the organization of the self which are illustrated by immediate reorganizing of schemes and patterns in all of the three learning dimensions. This conveys change in one's practice. Transformative learning is tackling a development that includes core aspects such as professional activity (Mezirow & Associates, 2000). Thus, PILO provides toolkits that assist the teacher with completing their curriculum coverage, which must show a change in the classroom practice.

2.7.2.2 Assimilation

Illeris (2009) describes that assimilation learning is learning that happens by adding to earlier increased knowledge. This means PILO build up their knowledge through constantly adding to what they had earlier obtained. In addition, the PILO project brought in some kinds of knowledge which they had already gained through their own practice. In this way, assimilation happens when the new knowledge is linked to an earlier existing plan. Kutz (1999) includes that whatever is learnt is in relation to the already existing plan of knowledge. In other words, recognize knowledge robust into our beliefs and dispositions.

2.7.2.3 Accommodation

Illeris (2009) affirms that accommodative learning entails that one breaks down an existing method and converts it so that the new situation can be linked to it. This type of learning benefits people who base their learning on hands-on experience. Illeris (2009) affirms that the outcome of accommodative learning is illustrated by the fact that it can be recalled and utilized in challenging situations which are similar. Accommodation is typically experienced as having understood or embraced something which one has really internalized. Illeris (2009) internalization means a process in which a person gains knowledge initially reconciled by other people but later comes to be controlled by the person as they adjust that learning appropriately to control their practical activities. Thus, the PILO toolkits are used to improve curriculum coverage. This could form a strong basis for the learners since accumulation of knowledge occurs over a lifetime.

2.7.2. 4 Cumulative learning

Illeris (2009) affirms that cumulative learning is characterized by automation processes that are used in situations which are mentally shared in a learning situation. Thus, PILO toolkits should teach how to use them and work in line with the annual teaching plan. The new knowledge they gain could be connected to easily through the use of PILO toolkits. Cumulative learning often includes an isolated structure of something that is novel to what is already known. Therefore, it can be attributed to the learning that takes place in the early years of life where learning something new often takes place in special situations. Illeris (2009) further affirms that cumulative learning is essential in early childhood even though it can be in adolescence; therefore, the use of PILO toolkits in the classroom encourages more activities among learners with their teachers. This can formulate the tough base for the learners since accumulation of knowledge occurs over a lifetime.

2.8. Conclusion

In this chapter, the notion of teacher professional development was discussed with reference to the work of other scholars in the field. The models of teacher learning, teacher change and teacher knowledge, as well as the kinds of knowledge needed by teachers in order to teach effectively, were also presented. The chapter ended with a presentation of conceptual (Desimone, 2009) and theoretical (Illeris, 2009) frameworks on effective professional development activities

as well as mathematics teacher knowledge that was used for both the collection of data and data analysis.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.2. Introduction

The previous chapter discussed the literature review as well as the conceptual and theoretical framework of this study. This chapter outlines the methodological framework of the study. It is very vital to restate that the main objective of the study was to explore teacher learning using PILO toolkits in grade 8 and 9 mathematics classrooms in the Pinetown District. The chapter includes the research approach, research paradigm, research design and the research context. It further describes the sampling procedure adopted, followed by an in-depth justification of methods of data collection, data analysis, trustworthiness, and ethical issues.

3.2. Research approach

This study used a qualitative research design within an interpretive paradigm. According to McMillan and Schumacher (2006) “qualitative research is an inquiry in which researchers collect data in face-to-face situations by interacting with selected persons in their settings” (p.315). This means that as the Jika Imfundo teachers answered interview questions, they explained what they learnt, in what ways they learned and how the learning changed their teaching practices. Babbie and Mouton (2001) states the qualitative research is a study of human action. Qualitative research is when the data represented in words, pictures and analysed through thematic exploration. Qualitative research is a situated activity that locates the observer in the world (Creswell, 2007) while McMillan and Schumacher (2006) argue that qualitative research is a method which involves collecting contextual or verbal data. Qualitative research prompted the researcher to look deeply into the participants’ world and related phenomena and the meanings they attribute to them (Lumenberg & Irby, 2008). A more broadly defined explanation of qualitative research has been provided by (Creswell, 2008), who refer to it as “any kind of research involves the interpretations of data that is non-numeric “(Kim, 2006, p.265). Qualitative research allows for meaningful exploration of issues reflected in the reality of individuals’ perceptions, feelings, and actions (Creswell, 2007). It also facilitates the interpretations of the meanings generated through the study by contextualizing the findings rather than making over-generalisations. Qualitative research is primarily exploratory research. It is used to gain an understanding of underlying

reasons, opinions, and motivations. It provides insights into the problem or helps to develop ideas for potential qualitative research. Due to the flexibility of this research design, I was able to create modifications for the instruments during data collection. As this research explored the types of knowledge that teachers gained through using PILO toolkits, how they gained that knowledge and the way the learning shaped their teaching practice within *Jika Imfundo*.

3.2. The research paradigm

The study is located within the interpretive paradigm. The interpretive paradigm focuses on the subjective and is interested in knowledge that is socially constructed. In the interpretive paradigm the researcher has the intention of understanding the world of human experiences. The interpretive paradigm is likely to rely upon the participants' views of the situation that is being studied (Creswell, 2008). The interpretive paradigm is concerned with understanding as it is subjective experience of individuals. The interpretive paradigm holds that to clarify human behaviour, social researchers need to understand the meanings and interpretations that people attach to phenomena in the social world. Mackenzie and Knipe (2006) describe the interpretive paradigm as the notion of understanding the world of human experience, while Creswell (2003) confirms that reality is socially constructed. The interpretive paradigm is concerned with understanding the subjective experience of individuals (Creswell, 2008). The interpretive paradigm views the impact of research on the background and experiences. In the interpretive paradigm, researchers do not to guess what people do, but rather describe how people make sense of their world and how they find meaning in their actions. Creswell (2008) pointed out that there is no one reality or truth, but rather a set of realities which are specific and not generalised. I used this paradigm because I wanted to understand the meaning these teachers find in teaching mathematics.

3.3 Research design

I used a case study design. Maree (2007) defines a case study as the fact it is bounded system, and it does not necessarily mean that one site only is studied. One of the strengths of a case study is the results are more easily understood by a wide audience as they are regularly written in everyday, non-professional language. The researchers can build in unanticipated events and uncontrolled variables. Yin (2003) describes a case study as an empirical inquiry that aims to

examine a contemporary phenomenon. He also defines a case study as an approach that can be used to investigate an event or an incident under study. Maree (2010) mentions that “from an interpretive perspective, the typical characteristic of case studies is that they struggle towards a comprehensive (holistic) understanding of how participants relate and interact with each other in a specific situation and how they make meaning of phenomenon under study” (p.75). He further classifies that case studies deal with an opportunity for a researcher to have multi-perspective analysis, which is the voice and the participant’s views in the situation so that the deeper understanding of the dynamic of the situation will be obtained. Cohen et al. (2011) suggests that in order to enable the public to have a good understanding of the phenomenon, case studies provide examples of real people in real situations. I used the case study in my study because I looked at those schools that implement the PILO project and how it is works. The case study is teachers that are teaching mathematics in the senior phase of grade 8 and 9. This study is an exploratory case study as I seemed to know how teachers use PILO toolkits to improve curriculum coverage. The exploratory case study investigates different phenomenon characterized by a lack of detailed research, especially formulated hypotheses that can be assessed or by a specific research environment that limits the choice of methodology (Maree, 2007).

3.4 Research context

The research site was in Kwa-Zulu- Natal Province, Pinetown District. The schools are in township areas falling under quintile one due to its geographical demarcation. The communities of the areas are in the middle class, and some are experiencing poor socio-economic conditions since they are employed in industrial areas as casual workers and are paid low wages. Most of the parents in this area are not well educated in such a way that they are unable to help their children with their homework and they do not want to be involved in their children’s education. Learners are not exposed to mathematical practices at their households. Most of the time learners in these schools are not performing well, especially in mathematics in the senior phase. For the purpose of the study, five teachers teaching mathematics in grade 8 and 9, were selected at different schools participating in JI. Mathematics is one of the subjects that the JI project focuses on.

3.5. Sampling

Sampling is the process of choosing people from a population of interest so that by studying the samples we may reasonably generalize the findings back to the population from which they were chosen. Creswell (2010) defines that sampling includes choosing a small part of the population under investigation, while McMillan and Schumacher (2010) clarify that sampling is a collection of respondents from whom information is produced. In simple terms, the population is a collection of people who share common features.

Choices pertaining to samples are created for the determination of reaching the rich sources of data in order to respond to the research questions. In qualitative research, it normally includes a smaller number of participants compared with quantitative research. Thus, in my study, there is small sample which allowed me to gather detailed information from teachers. PILO is the project that had several teachers who are from Pinetown and Uthungulu Districts. I decided to use purposive sampling. Cohen et al. (2008) defines purposive sampling as a strategy where the researcher makes specific choices about which people to include in the sample. The researcher targets a specific group, knowing that the group does not represent the wider population. In many cases, purposive sampling is used in order to access knowledgeable people with in-depth knowledge about a particular issue. In this study

In this study, I used purposive sampling to choose five grade 8 and 9 mathematics teachers from five different schools that were participating on PILO project at Pinetown District. Purposive sampling means that the researcher makes specific choices about which people to include in the sample (Cohen et al. 2008). It is sometimes known as judgmental sampling. Purposive sampling is “selecting information-rich cases for study in-depth” (Patton, 2002, p. 242) when one desires to understand something about those cases without wanting to simplify to all such cases. Purposive sampling serves as a booster sample, meaning it includes those who may otherwise be excluded from or under-represented in a sample. The purposive sampling chooses small groups or individuals who are likely to be knowledgeable and informative about the phenomenon of interest, selecting cases without needing or desiring to generalize to all cases. Maree (2007) explains that purposive sampling is used in special situations where the sampling is done with a specific purpose in mind. Table 1 presents the biographical information of the participants.

Name	Age Range	Gender	Qualification	Teaching Experience	Grades taught	No of years engaged in PILO
Mary	40-49	Female	STD, FDE B.Ed. Hons	27 years	9	2years
Mike	50-59	Male	Teachers' Diploma and Further Education. FED	20 years	8 -12	2 years
John	30-39	Male	BSc, PGCE	5 years	9-12	2 years
Doris	50-59	Female	B. Paed B.Ed. Hons	30 years	8-10	2years
Angel	30-39	Female	B.Ed.	13 years	8- 9	2 years

Table 2: The participants' biographical details

In my study, purposeful sampling was the best choice because I chose five mathematics teachers in the senior phase that engage with the PILO toolkits. These five teachers came from five schools at the Pinetown District. Their profiles are discussed in Chapter Four. The selection is based on pre-selected criteria that is relevant to a particular research question.

3.6. Data generation methods and process

Data generation is the process of obtaining data from participants using different techniques suitable for intended goal (Cohen, 2011; Davis ,2014). Cohen (2011), Creswell (2014), McMillan and Schmacher (2010) and Merriam (2013) supported one other in that qualitative case study can be generated through different methods. Such as interviews, field notes, observations, reflective activities, document analysis, journal notes and semi -structured

interviews. I utilized semi- structured interviews and document analysis were used as data collection instruments for this research. It is important that the participants clearly understand the research questions and expectations in order to generate meaningful and insightful data (Merriam,2013). Through document analysis I explored whether teachers really understand what is expected to them, on how to use PILO toolkits in conjunction with CAPS document by pacing their work.

3.6.1. Semi – structured interviews

In my study I used semi-structured interviews. An interview is a “two-way conversation in which the interviewer asks the participant questions to collect data and learn about the ideas, beliefs, views, opinions, and behaviors of the participant” (Maree, p.87, 2012). Brynard et al. (2014) defines interviews as a method of collecting data that allows the researcher to clarify his /her questions if the respondent is not clear on what is being asked. The interview is a flexible tool for data collection which allowing different sensory channels to be used both spoken and heard. Cohen et al. (2009) explains the interviews as an exchange of views between two or more people on a particular topic for obtaining mutual interest and knowledge. The interviewer must not limit subjective or objective views. It is in inter subjective. Interviews allow participants to discuss their interpretations of the world in which they live and express how they regard situations from their own point of view.

The interview must be scheduled rather than a naturally occurring situation and sometimes it proves difficult from an everyday conversation, therefore as a researcher, I had an obligation to get up and abide by the different rules of the game in an interview. I see the interview as the best understandable tool in terms of a theory of motivation which recognized a range of non-rational factors governed by human behavior. The interview is a social encounter not simply a site to exchange information and researchers would be well advised to keep at the forefront of their minds when conducting an interview. Cohen et al. (2007, p.351) further defines interviews as “a two-person conversation initiated by the interviewer for the specific purpose of obtaining research –relevant information”. Interviews are well known method that involves collecting data through direct verbal interaction between individuals. The good quality of the interview depends on the skills of the researcher (Maree, 2007). It is advisable to use highly skilled interviewers if the researcher does not feel competent. Poor interviewing skills, poor phrasing of questions or inadequate knowledge of the participant’s culture may cause poor data collection.

In this study, semi-structured (see Appendix E) interviews were used to obtain participants to clarify their views. Participants express themselves freely and openly in their individuals. In line with Cohen et al. (2007, p.351) semi-structured interviews allowed me to gain access through the medium of words and enabled me to seek and understanding of the participants perspectives of their experiences or situations through the repeated face -to face encounter. The interview focused on the implementation of the PILO toolkits and each interview was recorded. The study is based on senior phase teachers who are teaching Mathematics.

The strengths of the interview are that as the interviewer, I was able to explain issues that are not clear to the interviewee. I was able to pick up the behavior of the interviewee during the interview which clarified what would work for me. The interview consists of the verbal and non-verbal questions meaning a face-to-face interview is no doubt going to capture verbal and non-verbal cues, including body language. It can also point out a level of enthusiasm for the topics being discussed in the interview. The interviews are a useful way of getting large amounts of data quickly and are an effective way of obtaining data. The individual being interviewed is unable to present fake information during screening questions such as gender, age, or race. It is important to keep focus and manage the interview. The researcher can capture emotions and behaviours in face-to face interviews (Maree, 2010).

Marshall and Rossman (1995) mention that a limitation of interviews is that a participant may not give suitable information that the interviewer was wishing to obtain. Additionally, people may not be willing to tell the whole truth (Brynard et al., 2014). The researcher may also battle to ask a question due to a language barrier or the lack of questioning skill in the researcher. Boyce and Neale (2006) state that interviews may take a long time, they are expensive, and they can provide answers that are biased. They further suggest that the results of the interviews cannot be generalized.

3.6.2. Document analysis

The second instrument of collecting data in my study was document analysis. Document analysis is a form of qualitative research in which documents are interpreted by the researcher to give voice and meaning around an assessment topic (Cohen, Manion & Morrison, 2011). To enhance the information gathered from the interview. I intended to analyse the following lesson plans, trackers, learner's activity books mark sheets and other PILO documents that teachers are actively involved in the project and to see that their teaching practice change.

Document analysis is suitable for my study because I was able to compare if the data given by the teachers during the interview confirmed that information of the teachers from five schools. The documentary analysis includes the review of their trackers in order to clarify deeper meanings, which might be shown by their style. The two types of documents are the primary and secondary documents. Primary documents relate to eyewitness accounts and people make secondary documents (Mogalakwe, 2006). Bowen (2009) asserts that document analysis can save time compared to other data collection methods. A strength of conducting document analysis is that the researcher can acquire information that could not be easily found in other methods. However, documents do not give enough details as they are not made for research purposes, data written on the documents can be personal and incomplete. Documents may not also be filed properly, or they may be not completely finalized (University of Portsmouth, 2012).

Another major problem is that documents may have been written for the same purposes as the research and therefore conclusions will not usually be possible from document analysis. In my study, I used document analysis by looking at how mathematics teachers use the PILO toolkits to change their practice. I checked the documents in terms of their planning according to the Annual Teaching Plan, which assists to complete the curriculum. Document analysis was also employed to supplement the information gathered from the interview.

3.7. Data analysis

Data analysis “involves making sense of data in terms of participants’ definitions of the situation, noting patterns, themes, categories and regularities” (Cohen, Manion & Morrison 2007, p. 478). In this study, I used thematic analysis, which is applied to identify, analyze, and report patterns contained by data (Braun & Clarke, 2007). However, regularly it goes further than this and interprets different elements of the research topic. Thematic analysis is regularly used analysis approach in qualitative research. It underlines pinpointing, examining, and recording patterns contained by data. The themes are patterns across data sets that are vital to the explanation of an occurrence and are associated to a particular research question. Thematic analysis is presented through the process of coding in phases to create meaningful patterns. These phases are becoming familiar with the data, generating initial data, searching for themes, reviewing the themes, defining and naming themes and last one producing the report. Coding is the primary process for developing themes within the raw data by recognizing important moments in the data and encoding it prior to interpretations. Maree (2007) describes coding as the procedure of

reading vigilantly during the transcribed data, line by line and dividing it into consequential analytical parts. The coding method allows the researcher to rapidly gather all the transcript and other data that they have connected with some thematic idea so that the classed bits can be checked together, and different cases compared in that respect.

Inductive analysis explained by Taylor and Gibbs (2010) occurs when the researcher assigns emerging themes into codes. That is what I did with my collected data. Other writers suggest that it is possible to start coding with themes recognized as prior ideas. The way in which I organized my research interview schedule allowed me to arrange the data in such a way that participants answer the research questions. Data analysis happens at the same time as data collection (Holloway & Wheeler, 2002). When codes are assigned into themes, emerging from data is called descriptive coding (Taylor & Gibbs, 2010). They argue that a higher level of analysis involves analytical codes based on the researcher's analytical thinking. A conceptual framework or theoretical framework needs to be considered in data collection and data analysis (Yin, 2011). I analyzed the themes to understand the kinds of activities that senior phase mathematics teachers obtain through participating in PILO toolkits training.

3.8 Trustworthiness

The term trustworthiness refers to the way in which the inquirer can influence the audience that the findings in the study are worth paying attention to and that the research is of a high quality (Lincoln & Guba, 2003). In this study, I ensured that trustworthiness relates to dependability, credibility, transferability, and confirmability. Dependability refers to the degree to which the reader can be persuaded that the findings did occur (Durrheim & Wassenaar, 2002). The main standards were used in the research are validity and credibility, confirmability, and transferability.

3.8.1. Validity and credibility

Mayan (2001) describes validity as the correct appearance of a particular incident or framework as clarified by the researcher. Durrheim & Wassenaar (2002) refer to credibility as the guarantee that the researcher's ending stem from the data. "Credibility refers to the degree to which a study's findings represent the meaning of the research participants" (Lietz & Zayas, 2010, p.191) proposes that qualitative "elucidations must be reliable and exact to the explanations of the

primary participants. This is in line with Padgett (2008) who clarify that credibility could be realized by easing risk of bias and research and research reactivity. Research reactivity means the likelihood of the researcher or the study procedures to used influence the respondents, thereby impacting researchers may endeavor to make their data formulating efforts less invasive and prominent without mislead the participants. In short, by using instruments such as the voice recorder for data collection, it should not distract participants' attention or influence them to state things to amaze the researcher. To strengthen research findings, the interviews were recorded, which provides authenticity for the data and the notes were taken during the interview process.

3.8.2. Confirmability

Confirmability means that the skill of others to support or validate the study results (Lietz & Zayas, 2010). Shenton (2004) also affirms that confirmability must make sure that the study results reflect the findings of the knowledge and ideas of the participants, rather than researcher beliefs and preferences.

3.8.3. Transferability

Transferability really refers to the degree to which findings can be appropriate or helpful to theory, practice, and future research (Lietz & Zayas, 2010). Devers (1999) also argue that findings can complete transferability if the perspective is the same. The main role of the researcher is to discover main aspects of the context from which the results come out and the degree to which they may be applicable to other contexts. Thick descriptions in the data presentation and discussion of findings assisted the reader to the context of the study and the processes included so that they could decide whether or not to transfer the results to their own context. Thick description refers to the depth or the thickness of the description that a researcher needs to report (Bertram & Christiansen, 2010).

3.9. Ethical issues

Cohen et al. (2007, p.58) explain "ethics as a matter of principled sensitivity to the rights of others and that, while truth is good, respect for human dignity is better". In this study, the rights of the individuals were maintained. Permission from the Department of Education (Appendix B) and university ethical clearance (Appendix A) were granted by the UKZN Higher Degrees Research and Ethics Committee. I also asked for principals' permission (Appendix C) to do research in their schools. In my study, I used the informed consent that each participant signed.

Maree (2007), Curtis et al. (2014) and Cohen et al. (2011) state that a researcher needs to obtain informed consent from participants in order to participate in the research study. I ensured this by explaining the research aim of my study to the participants in writing before the study. I then requested their written consent to participate in the study. I also made them aware that their participation is voluntary, and they could withdraw at any time.

3.10. Limitations

The aim of this study was to explore teacher learning through the use of PILO toolkits in grade 8 and 9 mathematics classroom in the Pinetown District. Qualitative research suits this study because its purpose is to study people's experiences in their learning environment. This was a small- scale qualitative case study design; its findings would not be generalized to other contexts but limited to participants' schools included in the research.

3.11. Conclusion

In this chapter, the methodology of the study was discussed. The chapter provided justification for adopting a qualitative research approach, and an interpretive paradigm which framed and guided the study, the research design, sampling, data collection and analysis were explained. The features of increasing trustworthiness in the study, ethical issues as well as the limitation of study were discussed. The next chapter presents the data which was generated through semi- structured interviews and document analysis.

CHAPTER FOUR

PRESENTATION OF RESEARCH DATA

4.1. Introduction

This chapter is a presentation of the data gathered from five teachers in Pinetown District. As explained in Chapter Three, the purpose of this study was to explore teacher learning using PILO toolkits in grade 8 and 9 mathematics in the Pinetown District. To answer my research questions, I interviewed five teachers and analysed their PILO trackers and lesson plans. I started the chapter with the profiles of the participants. I then presented themes that emerged from data. The data collected was coded and categorized into five themes.

4.2. Participant's profiles

I used pseudonyms for the protection of the identity of the participants and to guarantee their confidentiality and anonymity

4.2.1. Mary

Mary is a female teacher, between 40-49 years. Her highest qualification is STD, then she has a Further Education in Diploma (FDE) and she has a B.Ed. (HONS) from Unisa. She has been teaching mathematics for 27 years to grade 7's and 8's. She is a teacher who has attended Jika Imfundo workshops for the past one year and she attended five contact sessions. She is a senior teacher, and used to be a departmental head before she resigned and came back as a post level one teacher. At the time of the data collection of this study, she was teaching mathematics to grade 9's.

4.2.2. Mike

Mike is a male teacher between 50-59 years. He is a departmental head of Science of senior and FET phases. He has a teachers' diploma and further education. Mike has taught for twenty years in the senior and FET phases. Mike said that after Jika Imfundo contact sessions, he was not interested because he sees that new programme is a huge burden of paperwork. He stated that the new programme will help him gain new knowledge that will assist him in curriculum coverage of mathematics.

4.2.3. John

John is a male teacher between 30-39 years. He studied a Bachelor of Science, majoring in Computer Application Technology. Later he decided to do a PGCE at UKZN (Edgewood campus) majoring in mathematics and computer application technology. He started teaching in 2003 as an unqualified teacher, but he became qualified in 2012 as a post level one teacher. When he received a circular that invited him to attend a Jika Imfundo workshop for the first time, he was excited because he was hoping to learn more teaching strategies which will assist in improving results and able to complete his syllabus on time.

4.2.4. Doris`

Doris is a female teacher in the category of between 50-59 years, with more than 30 years' experience. She has experienced different curriculums and all the changes that occurred in education. She started as unqualified teacher then she went to the University of Zululand, then she obtained a B. Paed which majored in mathematics and physical Sciences. She did not complete her degree due to financial problems. She went back to teaching and saved money to complete her studies. She furthered her studies at the University of Natal, where she obtained a B. Ed degree. She further has a BEd. (Hons) degree from the University of KwaZulu-Natal. Her position is a departmental head, but she was appointed from another school. She did a cross transfer with another teacher due to problems in her school. Doris has attended Jika Imfundo workshops since 2015 but she did not eager to attend because she believed that those workshops would be a waste of time and she was satisfied with the knowledge she has.

4.5. Angel

Angel is a female teacher between 30-39 years with teaching experience of about 13 years. She studied a Bachelor of Education at the University of KwaZulu- Natal. Currently she is teaching mathematics and physical Sciences in FET band/phase. Angel said that they were told about Jika Imfundo workshops and she was interested to attend because she believed that this programme would help her in gaining new knowledge and skills so that her learners will pass and are able to finish the syllabus on time. She is well trained to teach mathematics in senior phase, but she finds it very difficult to teach her learners because they perform badly in mathematics.

4.3. Thematic analysis

There are five theme that emerged from the data. I have used direct quotations from their interviews and document analysis data to support my findings. The themes are presented as follows; teachers' descriptions of Jika Imfundo and PILO toolkits learning activities, learn how to creating a link between mathematics textbooks, learners' workbooks and the trackers, learn different methods of teaching content and curriculum coverage for grade 8 and 9, teachers value the PILO toolkits differently and challenges encountered when using PILO toolkits.

4.3.1. Teachers' descriptions of Jika Imfundo and PILO toolkit learning activities

In this section I describe the activities that participants in this study said they involved in Jika Imfundo and PILO during interviews and document analysis. During the interview sessions the participants were using the terms: Jika Imfundo and PILO interchangeable. Teachers listed that some of the learning activities that happened outside the school and some that occurred in the school. These common activities that happened outside the school are training workshops and cluster meetings.

All five teachers who participated in this study pointed out that training workshops are the main key activity they engaged in at Jika Imfundo. They stated that the ward circuit managers together with the subject advisors called the workshops since Jika Imfundo was the introduced campaign aimed at improving curriculum management which lead to good learner outcomes. These include formal data from interviews which suggests that trackers and planners produce a lot of activities. These activities are informal and formal workshops, for example Mike explains in this way:

The workshops were conducted in the form of formal and informal learning. For formal learning, the facilitator does presentations in the form of PowerPoint. Teachers were given the activities to do in their groups, which is the informal learning because teachers helped one another in teaching the concepts and how to use different methodology.

The four participants also mentioned that some training workshops focus on content where they are taught a particular mathematics content that appeared to be problematic to teaches and learners. Mary echoed her mixed emotions when asked about what was interesting in the training workshop.

I have learned a lot from the Jika Imfundo training workshop, even though I majored with mathematics but teaching approach on how to teach fractions and complete on given pace was difficult to me. I was not confident of teaching it at first for the fact that I did not have sufficient content knowledge, with PILO workshop took us step by step and I was fortunate to be chosen to attend PILO workshop and they provide with useful documents.

Four out five teachers highlighted that PILO project assisted them during the PILO workshops. The facilitators unpack for them a summary of annual teaching plans and show time allocation per topic so that it will be easy to cover the curriculum. The following Figure 3 derived from the PILO Mathematics tracker shows the structure of how mathematics topics are arranged and organized so that teachers will adhere to it.

PREMIER MATHEMATICS Week 5							
Day	CAPS concepts and skills	CAPS pp.	LB ex.	LB pp.	TG pp.	DBE workbook	Sasol Inzalo
21	Exponents: Comparing and representing numbers in exponential form; Calculations using the laws of exponents	124–125	1 2	33–35	15–16		No. 1–2 (pp. 71–73) No. 1–4 (p. 74)
22	Calculations using the laws of exponents (use DBE workbook or Sasol Inzalo book)	124–125				No. 22–23 (pp. 56–59)	No. 1–8 (pp. 74–77)
23	Calculations using numbers in exponential form: Using the laws of exponents (use DBE workbook or Sasol Inzalo book)	124–125				No. 24–25 (pp. 60–63)	No. 1–7 (pp. 77–79)
24	Representing numbers in scientific notation	125–126	3	35–37	17	No. 21 (pp. 54–55)	No. 1–4 (pp. 82–83) No. 1–2 (p. 84)
25	Solving equations using numbers in exponential form	124–125	4	37–38	18		No. 1–2 (pp. 80–81)

Figure 3: The structure of how mathematics topics are arranged and organized

Teacher were expected to use the table to relate ATP and trackers. When Angel was asked about curriculum coverage using the organization shown in the above Table 1 she answered:

It is not easy to cover the curriculum though the toolkits said this work covered on this week. The learners that we are teaching are not the same: even their learning strategy is not the same. The learning environment is affected by socio- cultural issues. I always have work behind because I cannot move on to the following work while other learners are behind, I ended up doing extra classes to cover my work.

All five teachers commented about Jika Imfundo taught them how to draw their lesson plans in groups and presentations. Angel reported that:

The facilitator grouped them randomly and gave them the topic. In our groups we were supposed to design own lesson plans and one delegate will present a lesson plan in class. As we design the lesson plan, we were asked to show exactly the teaching methodology and as well as the activities that are suitable for the lesson.

All the five teachers stated that they wrote the pre-test (Figure 4 on the next page) before the workshops started. Mary explained:

Before the training workshops began the facilitator provide us with the pre-assessment tests just to check our level of understanding for the particular concept.

Time: 60 minutes
Total: 50 marks

INSTRUCTIONS TO LEARNERS:


1. Answer all the questions.
2. Show all your workings.
3. No calculators.

QUESTION 1:

- 1.1 Arrange the following numbers from smallest to largest:
318 752; 319 052; 318 952; 309 999 (1)
- 1.2 Complete the number sentence to make the statement true, by filling in $<$, $>$ or $=$:
22 101 22 110 (1)
- 1.3 Give three multiples of 20. (1)
- 1.4 Write 360 and 450 each as a product of prime factors and then find the HCF and the LCM of 360 and 450. (4)
- 1.5 Bongani claims that 1 is not a prime number. Is he correct? (1)

[8]

QUESTION 2:

- 2.1 The ratio of boys to girls at an athletics practice is 4:3.
There are 49 athletes in total at the practice.
How many boys were at the practice?  (2)
- 2.2 The usual price of a heater is R300. There is a 30% discount on all items. How much does the heater cost after the discount? (2)
- 2.3 Thandi deposits R850 into a bank. The bank will pay a simple interest rate of 8% per year. How much money will Thandi get when she withdraws all her money after five years? (2)

[6]

Figure 4: Example of the pre-and post-test

4.3.2. Learn how to create a link between mathematics textbooks, learners 'workbooks and the trackers.

The participants reported using trackers as a link between Mathematics textbooks and learners' work and the trackers. Mary stated that trackers are useful documents to be used by all teachers, because it reduced the paperwork for teachers:

In PILO projects taught us how to organize work, by using annual teaching plan, the trackers make breakdown of work to be done every week. I learn how to order adherence on the content very carefully and we must make sure lesson is not skipped. If I missed one lesson it is my duty to make catch up programme. The trackers enabled us to follow the syllabus logically and sequentially.

PREMIER MATHEMATICS Week 8							
Day	CAPS concepts and skills	CAPS pp.	LB ex.	LB pp.	TG pp.	DBE workbook	Sasol Inzalo
36	Solve geometric problems involving unknown sides and angles in triangles and quadrilaterals cont.; Revise geometry of 2-D shapes	97	4 (No. 5-10) 2	101-102 117-118	71	No. 60a-60b (pp. 136-139)	Worksheet (p. 210) No. 1-4 (p. 229) Worksheet (p. 230)
37	The Theorem of Pythagoras: Develop the Theorem of Pythagoras	105	1 <i>extended version</i>	142-143	95	No. 77-78 (pp. 32-35)	No. 1-6 (pp. 41-45)
38	Use the Theorem of Pythagoras to determine whether a triangle is a right-angled triangle	105	2	143-144	95-96		No. 1-4 (pp. 51-52)
39	Use the Theorem of Pythagoras to calculate the missing length in a right-angled triangle; Use the Theorem of Pythagoras to solve problems in different contexts	105	3	144-146	96-97	No. 79 (pp. 36-37)	No. 1-4 (pp. 46-48) No. 1-5 (pp. 48-49)
40	Revise the Theorem of Pythagoras (use <i>Sasol Inzalo Mathematics book</i> or <i>DBE workbook 2</i>)	105				No. 80-81* (pp. 38-41)	No. 1-5 (pp. 50-51)
Note: The Theorem of Pythagoras is found in <i>Sasol Inzalo Mathematics Book 2</i> or <i>DBE Workbook 2</i> . (It is taught in Term 3 according to the CAPS.)							

PREMIER MATHEMATICS Week 9: Catch-up and revision (examination preparation) – plan your week							
Day	CAPS concepts and skills	CAPS pp.	LB ex.	LB pp.	TG pp.	DBE workbook	Sasol Inzalo
41	<i>The Theorem of Pythagoras</i>	105	1	142		<i>No. 77-78 pp. 32-35</i>	<i>No. 1-6 pp. 41-45</i>
42							
43							
44							
45							

Figure 5: Illustration of the catch-up programme if teachers missed the day

Contrary to Mary, John was unhappy about the use of trackers to check curriculum coverage. He commented:

The trackers give instructions on what should be covered in each lesson and how. It guides teachers on pacing, changes them if they are falling behind and on what needs to be improved. The tracker has too many activities to do in a single day which becomes a problem to struggling learners who happen to be a majority in this context. The different topics in a day make it impossible to do in one day and one-hour lesson. The pace of learning by learners is a challenge. Learners struggle to conceptualise some of the topics which, which creates a backlog of other topics as the teacher tries to ensure that previous topics are covered.

Mike elaborated about using trackers.

All I can say about trackers are optional, nobody forces you to use it. PILO toolkits are not coming with extra work, it is just work that we are supposed to do daily, but others assume that it is extra work because if you lazy to work, you see it additional burden. The trackers make a clear breakdown of your lesson and the activities that you need to do with your learners. It works hand in hand with annual teaching plan because in my case I don't have to start looking at annual teaching plan, but I am just go to tracker and look for the topic that I am supposed to teach. For example, this term what need to be covered than I just focus on without referring on annual teaching plan?

All five participants confirm that trackers are designed in such a way that the trackers are in line with ATP. Mary, she mentioned that:

John reported about the teaching strategy that he has learnt:

I show how to work out on five sums on the board afterwards I give them three examples of sums to be done so that learners will be occupied with work. As the learners busy with their classwork, I walk around and assist those ones who are battling with classwork. examples

All participants of this study agreed that in PILO project they learn how to link mathematics topics and for the aim of the curriculum coverage. Mary pointed out that the work set out for everyday was associated with the topics and subtopics given in the CAPS policy and the specified time allocation to each topic. Angel explained:

The PILO toolkits organizes the CAPS requirements with the content set out in the approved learners' books and teachers guide. The toolkits gave a link to the DBE workbooks relevant to the content prescribed each day.

Doris confirmed that they used topic links categorized and prescribed by PILO. As a mathematics teacher:

I know which textbooks to select amongst the eight textbooks prescribed by PILO. Most prescribed textbooks are rich in content, most reach in teaching strategies and some have linked the topics that cover the ideas for teaching the same content in different ways. Toolkits saved preparation time.

4.3.3 Learn different methods of teaching and curriculum coverage for grade 8 and 9.

Four participants in the study reported that the focus of PILO tool kit training was more than just curriculum coverage as it also focused on teaching mathematics. Most of the participants said they used different methods to deliver the lessons in a way that assists their learners to access the topics easily. Most participants were of the view that they use different teaching methodologies so that their learners will understand the mathematics content easily. Doris confirmed this when she said:

As a teacher, you must use different methodologies in delivering the content and it vital. Different textbooks have different teaching strategies so I make use of all the textbooks have different teaching strategies so I will have more teaching strategies to accommodate my learners.

Angel pointed out that Grade 8 and 9 learners' struggle to change because of the larger amount of content work, which is why it is essential for a teacher to have to choose teaching strategies that are suitable for a learner. The activities of the learners must be planned before for promotion of learners understanding. One participant gave an example of the teaching methodology. When Angel was asked which type of teaching strategy he used most, he responded:

When I teach mathematics I act as facilitator, not a teacher. I do not tell learners if they are doing right and support them where necessary answering their questions and directs them to the right directions. Focus on without referring on annual teaching plan?

In the same way Mary shared that the learners must do the work, as a teacher just comes to assist to them when they need assistance.

I strongly believe that I should not tell learners everything: they must be able to solve mathematical problems on their own. The teacher must only see to it that the learners are following the suitable steps that you taught them during a content presentation.

The four participants who were in favour of PILO toolkits training mentioned that there is proper curriculum planning in PILO projects, and curriculum planning which goes hand and hand with time allocation. Time on the task is also essential in curriculum delivery and management. Allocated time available for teaching and learning needs to be planned for and used effectively. Allocated time always wants teachers and learners to be punctual for the task of teaching and learning. The PILO initiative assisted teachers with curriculum planning and coverage, which involves time allocation. Most teachers agreed that the PILO programme has introduced better curriculum planning which had a positive impact on teaching and learning. Doris noted that as a result of participating in the PILO programme her behaviour in allocating time in her planning has changed.

I learnt to organize my work. To teach according to what the department of education is expected to do. I now learnt to not to skip the difficult concepts and I now know myself. I learnt to use PILO toolkits in collaboration with annual teaching plan. PILO toolkits provide with clear instructions, uniformity and ready-made lesson planning, which reduce paperwork.

All the participants of this study mentioned that with PILO they learned that teachers constantly plan, track and report on their teaching using the curriculum tracking tools. The teachers said that PILO toolkits make it easier for the departmental heads to track teachers' curriculum coverage which was the aim of PILO. The participants stated that they are given tools especially trackers to track the curriculum. The toolkits consisted of the structured programme of activities to be followed to avoid the skipping of work. These activities are aligned with CAPS and teachers can refer to the curriculum document directly if they need to.

Four participants state that they used the detailed CAPS concepts and skills that need to be taught for each day. They mentioned that the toolkits also reinforce the content coverage. The teachers said the facilitators taught them to think critically about the content that they will teach their

learners and also be aware of practicing prior knowledge before you introduce a new lesson. John explains his learning experience on PILO.

I was well prepared to teach mathematics in such a way that even in high school I chose mathematics over Physical Sciences. Apparently, I have done it at the primary school. When I attended PILO, I told myself that PILO was just one of the professional development activities that is conducted by District in order to assist teachers for curriculum coverage. I was glad when the PILO facilitator takes us through mathematics CAPS content and showing us the clarification column that will guide us while we prepare for teaching. We learn every content and concepts of mathematics. We learn a lot about subject matter and content. They provide us with tools that have enough content that we want as mathematics educators.

While four teachers agreed that the PILO programme really assisted them in completing curriculum coverage Mike disagreed:

PILO programme really assisted teachers in curriculum coverage. He mentioned that they must come up with innovative strategies because there are bringing a lot of documents that need to be filled. In my view, they do not assist in terms of ensuring that there is drastic improve on results, because there is more monitoring rather than assisting in the classroom practice.

4.3.4. Teachers value PILO toolkits differently

Four participants reported that PILO toolkits were valuable in their teaching practices. Mary affirmed that:

I value that divide the work according of weeks. It will tell exactly what to cover for each week and specify the number of hours to teach each topic. I also value prescribed to be used and which pages are you going to find learners activities.

Four out of five participants agreed that through the PILO training they know exactly what to teach each day, because PILO toolkits guide teachers on how to organise and summarise the work for each week that teachers are expected to cover: Doris mentioned that:

As a result of participating in the PILO programme her behaviour in allocating time in her planning has changed.

Furthermore, the teachers expressed appreciation of the fact that they now understood the importance of being organized and of using teaching and support material to facilitate the understanding of the content by learners. John confirms:

The facilitators teach them how to organize the work, by showing us the breakdown of work to be done every week., where it must match with the annual teaching plan and programme of assessment designed by DBE. I also learnt how to sequence adherence on the content very carefully and not to skip any lesson.

However, Mike who is a DH for Mathematics and Sciences reported that PILO was not useful and helpful. Mike stated that it was not compulsory to use it. Mike puts it in this manner:

Jika Imfundo it assisting teachers that are lazy. If you are not lazy teacher, seriously Jika Imfundo tools are not really assisting at all. Tracker is only to monitor that end there and make some kind of conscious as a teacher that you are on the right track with your learners. In my view instead of spending more money on trackers they can use to develop, for example, smart board for mathematics, which can ensure that the teaching is more effective since I am making an example.

In the toolkits the CAPS concepts and skills are arranged systematically, to make it easier for the teacher to finish the work set per week. Four of five participants stated that the PILO toolkits assisted them to complete curriculum coverage. Angel pointed out that:

Through attending PILO project, I know exactly what to teach each day, because PILO toolkits organized and summarise the work for each week that teachers are supposed to cover.

4.3.5. Challenges encountered when using PILO toolkits.

All the five participants were concerned about different aspects. John defines the challenges he encountered:

The problems that I faced was that many of my learners do not cover the curriculum at the prescribed time. The frustration I have is the lack of resources in my school, such as the availability of learning materials and classroom size. Some learners are failing to get help on their homework at home due to their parents are illiteracy.

Mary confirms her challenge by saying:

The challenge I encounter was that PILO toolkits want the teachers to be fast on teaching the syllabus, while the slow learners are behind.

Mike also has something different from the above participants: *PILO toolkits came with more paperwork such as two reflections for lesson plan and trackers.*

Angel commented about the learner's attitude which presents a challenge in using PILO toolkits:

The huge problem I encountered was larger number of learners in the class, where you find that half of the class is not concentrating. The learners are coming in poor background families where others are child headed families and cause huge absenteeism. The repeaters showed no interest towards the subject as a whole.

These extracts suggest that most of the teachers are battling with time management as they deal with different learners. If they fail to manage time, it makes it hard to cover the curriculum on time. It clearly appears that teachers have battled with time management and had not necessarily understood the importance of following the school timetable to ensure curriculum coverage.

4.4. Conclusion

This chapter first presents the profiles of the participants. Secondly, it discusses the five themes that emerged from the data and used direct quotations from the interviews and document analysis acquired by participating in JI. Some of my participants' PILO toolkits were not accessible because they never used it. I only manage to get less information based on document analysis, as results documents were not accessible. To conclude, the chapter described the challenges the teachers encountered when using the PILO toolkits.

CHAPTER 5

DISCUSSION OF FINDINGS, RECOMMENDATIONS AND CONCLUSIONS

5.1. Introduction

The aim of this study was to explore teacher learning through the use of PILO toolkits in grade 8 and 9 mathematics classrooms in the Pinetown District. In Chapter Four research findings were presented according to themes that emerged from the data. This chapter discusses the findings in response to the three questions of this study. The key research questions of this study are:

1. How do Senior Phase (SP) mathematics teachers learn when using PILO toolkits and training in mathematics classroom to improve curriculum coverage?
2. What do Senior Phase (SP) mathematics teachers say they learn and value in using PILO toolkits and training to improve curriculum coverage in mathematics classrooms?
3. To what extent do Senior Phase (SP) mathematics teachers say their use of PILO toolkits and training has changed their practices to improve curriculum coverage?

I used Desimone 's (2009) features of effective professional development activities, Illeris's (2009) theory of learning and the literature to re-examine the findings in relation to each research question. This is followed by the discussion of limitation and the recommendations of the study. Finally, I end the chapter with conclusion.

5.2. Summary of Findings

5.1.1. How do Senior Phase (SP) mathematics teachers learn when using PILO toolkits and training in mathematics classroom to improve curriculum coverage?

The findings suggest that the mathematics teachers were involved in Jika Imfundo and PILO learning activities that were taking place outside their school and some occurred within the schools. During the workshop the teachers were engage in individual and group activities. The individual activities include pre- test that teachers wrote and the group presentations of the prepared lesson. The findings also indicated that the PILO facilitators taught teachers basic mathematics content, how to teach a planned lesson, sequencing and choosing content in the lessons. In line with Desimone (2009), these activities seem to suggest that *active learning* was

taking place in PILO workshops. The emphasis during the workshops was on how to cover curriculum coverage within the notion time given by the Department of Education. The participants highlighted that attending the JI workshops also assisted them in dealing with CAPS. In other words, the programme brought a practical approach to the implementation of CAPS. It unpacks CAPS, and it also eases the burden of CAPS by cutting down CAPS into pieces. Jika Imfundo breaks down CAPS and makes it easier for teaching and learning. This situation seems to relate to accommodative learning (Illeris 2009) which demands that one should break down an existing method and converts it so that the new situation can be linked to it.

Opposing contextual knowledge which is based on the understanding of unique learners' and the school context (Grossman, 1990), teachers felt that facilitator encouraged the pacing but forget that they are teaching different learners. The participants highlighted that the pace of PILO curriculum was too fast. The PILO curriculum is good for intelligent learners. According Bertram, Mthiyane Naidoo (2021, p.7) to there is a need for the strategy to be used with supporting curriculum coverage to provide teaching at the level at which the learner is actually operating. Teachers also indicated that they have learnt how teach difficult topics such fractions. Teachers explained that during the workshop they learned step by step, how to do fractions. This learning is in line with accommodative learning occurring when one breaks down an existing method and converts it that the new situation (Illeris, 2009). It also came out from the findings that using PILO tool kits enabled the four mathematics teachers to teach all the mathematics topics with most of the participants mentioning that before they attended the workshop they used to teach only their favourite topics. These findings confirm the findings of the study conducted by Maphalala, Khumalo, Buthelezi, Mabusela, Gamede, Sibiya and Nzima (2016-2019) that teachers used to start with any topic they want and are comfortable with, denying that there is a need to follow the planned curriculum.

5.1.2. 2. What do Senior Phase (SP) mathematics teachers say they learn and value in using PILO toolkits and training to improve curriculum coverage in mathematics classrooms?

The findings show that the PILO toolkits trainings created opportunities for teachers to assist one another in teaching the concepts and how to use different methodologies to organize their work, by using the annual teaching plan (APT) and how to make sure that teachers do not skip the topics. It seems as that teachers gain teaching concepts by using different methodology, this is in line with assimilation illustrated by Illeris (2009) , where is learning that occurs by adding

to the existing knowledge. Teachers learnt how to organize exactly what to teach, and time allocation for the lessons while the trackers planned the work for the teachers. Pillay (2020) argues that the trackers guide educators to page numbers to get relevant activities to be done by the learners. Mthiyane, Naidoo and Bertram (2016-2019) pointed out that the JI planner and trackers makes it clear that teachers need to follow the prescribed sequencing and pacing.

The findings indicate that the four participants reported that PILO toolkits were useful because they helped teachers to develop the lesson plans, activities to be done by the learners, and assessment tasks that could be used to assess the level of learners' understanding. In line with De Clercq, Shalem and Nkambule, (2016-2019), the findings indicate that trackers were used and enabled teachers to improve the sequencing and pacing the curriculum activities specified by CAPS. Whereas the doing of lessons activities and assessments is not something new so I just relate to cumulative learning as it consists of an isolated structure of something that is already known (Illeris,2009) Sequencing and pacing of curriculum activities relate to knowledge of structures of discipline affirms that without this knowledge, teachers may misrepresent both the content and nature of the discipline itself (Grossman, 1990). In the findings from the study, trackers created the ability for the teachers to complete the syllabus on time because the teachers teach according to prescribed syllabus.

Mathematics teachers who valued PILO toolkits reported they been battling with time management and had not understood the importance of following the annual teaching plans to ensure curriculum coverage. These teachers mentioned that their curriculum coverage in mathematics had improved as a result of better planning. They reported as a results of training workshops they benefited with supportive materials and ready-made lesson plans which tell them what to teach and what to cover in the curriculum. They stated that JI assisted them to manage the curriculum coverage better, through the use of PILO toolkits. The findings suggest that using of PILO toolkits made planning easier for the teachers. For example, one of the teachers stated that before using PILO toolkits "I used to start the day with whatever I feel like teaching, but I now understand its importance and I'm always prepared for everything I need to teach on a given date". The tracker gave the instructions on what should be covered in each lesson and how. It makes teachers be aware if they are falling behind on what needs to be improved.

Though the findings stipulate that the teachers were feeling burdened with administrative work, they also stated that they were able to work smarter and more efficiently. Furthermore, the

teachers acknowledged scheduled formative assessment tasks were provided with tools to enhance learning. Maphalala, Khumalo, Buthelezi, Mabusela, Gumede Sibiyana and Nzima (2019) acknowledged the use of trackers because they came up with the assessment tasks. Trackers assisted teachers to set papers of a good standard as evidenced in the learners' assessments books. Teachers now used the trackers to cover their work. They can see if they are behind, especially if they were absent from school and are able to cover the work to be on track.

Teachers confirm that the content in each toolkit has been carefully sequenced and it is therefore essential that no lessons are skipped. If the teachers missed a mathematics lesson for some reason or worked at a slower pace it was a result of not understanding. The teachers should show the catch-up programme. Bertram, Mthiyane and Naidoo (2021) affirm that many teachers recommend toolkits as useful because it assists them to cover the scope without skipping any topics. The teachers also pointed out that toolkits assisted them to know which topics to teach and whether they were on path with the curriculum coverage or not. However, one mathematics teacher did not value the use of PILO toolkits.

5.1.3. To what extent do Senior Phase (SP) mathematics teachers say their use of PILO toolkits and training has changed their practices to improve curriculum coverage?

The findings indicate that the teachers noted that there was no proper curriculum planning before they use the PILO toolkits for curriculum coverage. From the findings, there is evidence which suggests that the four teachers value the PILO toolkits greatly. These four teachers reported that they are guided by the time on the task as it is very essential for curriculum delivery and a management environment. They stick to the allocated time for teaching and learning. They recognized that by attending the *Jika Imfundo* programme, the behaviour of teachers had changed in that they were conscious of being ready and prepared for lessons. The teachers affirm that they now know exactly what they are supposed to teach and asserted their preparedness and readiness to clarify instructions, which saved them time on planning and made them focus more on the time for each task. It seems as if learning through PILO toolkits for curriculum coverage positively influenced their teaching practices, as results there was transformative learning that is illustrated by Illeris (2009)

However, the findings indicate that teachers had challenges with PILO toolkits training. They felt that it is designed for high achievers and not for learners who struggle to keep to the pace of the activities. Bertram, Mthiyane and Naidoo (2021) confirm that many teachers who came from

no fee schools' state that pacing is big challenge. The teachers try by all means to cover the curriculum, but they find it hard because they deal with learners with various learning barriers. They say it's bad to move on to another topic while learners have not understood the content. The teachers stated that the tracker has too many activities to do in a one day which becomes a challenge for the majority of learners who happen to be majority in this context. The different topics in a day make it impossible to do in one day and one period (one hour). There is no time to recap on the following day because the learners are left behind.

The pace of learning for the learners is a challenge. Learners battle to conceptualize some of the topics, which creates a backlog of other topics as the teacher tries to ensure that previous topics are covered. Teachers who apply PILO methods in their teaching practice need to adapt to each new situation. Teachers elaborated about reorganizing the sequencing of the CAPS topics. The issue of the fast pace of the trackers, classwork and homework made it difficult to admit that they do not have enough time to check and mark learners' work as there too many learners in one class. Teachers are unable to keep up with the pace of the tracker as they are required to teach the topic once and move on the next topic. Some learners learnt easily if they drill the lesson.

The findings seem to show that learners could be left behind with the content covered in the class and sometimes battled with different topics in the curriculum. From the findings, it is clear that teachers battled with content coverage. Teachers need to do reflections on a weekly basis which showed the positive benefits of providing a chance to think of what worked well, what did not work well, as well as share ideas about what to improve. Teachers stated that reflections assisted in identifying learners who have grasped the concept and those who need more time or more help. It assisted the teachers to plan for a catch up programme and devise strategies to enhance the learning environment. The findings show that there is too much work and too much marking. They are expected to use both exercise books and workbooks and to mark both of them. PILO toolkits focus on speed rather than quality because the trackers lead and not the learner. One teacher felt that there is no need for reflection. He said "I don't even understand why teachers should do reflection after each and every lesson".

Another challenge with PILO that came from the teachers is the lack of parental involvement in their learners' education. It made it understandable that the relationship parents and learners have is poor where the type of curriculum that is in place requires active parental involvement as they

are expected to help learners with their homework. So, if learners are not assisted at home, it becomes a problem for the teachers as they have to start from the previous day's work, which is supposed to be already completed with the help of parents at home. The other point raised is that of parents who are illiterate cannot help their children. The big challenge mentioned by teachers is that other learners are child headed families and others live with their uneducated grandparents who cannot read and write, and they are unable to assist them. The teachers also indicated that they need to develop the skills on how to deal with parents of slow learners because they did not want to be told that their learners are under performing.

5.3. Limitations of the study

The research study included a small sample that was purposively selected. Five mathematics teachers from different schools who participated in the PILO programme were selected. This study was done in a small sample from one district in a province. Therefore, we cannot generalize the results across the whole country or province. However, the purpose of qualitative research is not to generalise, but to develop a complex picture of the issue under study (Creswell, 2013). As a senior and FET teacher, in the Commerce Department, I had never participated in a PILO programme, so I was not affected by the project. However, at the beginning of this study, I described that as a teacher and a researcher, I need to ensure the reliability of the study. Most of the time the participants spoke in English which made it easier for me not to translate their transcripts. The biggest challenge I encounter was accessibility of documents which make my discussion have some limitations.

5.4. Recommendations

Using Desimone (2009) made me to realize that PILO is a professional development activity as it reflected some features of an effective professional development coherent learning in particular. I therefore recommend that PILO programme be reviewed and be implemented and conducted across all nine provinces of South Africa. The teachers need resources to improve curriculum coverage for mathematics, the Department of Education should provide the resources to support teaching and learning of mathematics. I also suggest that PILO toolkits should be designed for all grades because it is not only mathematics and other difficult subjects that need planners and trackers and, it is not only certain subjects that have a curriculum coverage problem. I recommend that PILO planners should reduce a number of mathematics activities per week because teachers are also dealing with learners with learning difficulties. PILO project should

have also assisted teachers on how to deal with learners' difficulties and the slow learners should have special activities. The future research could investigate these teachers in their classroom to confirm if their teaching practices and curriculum coverage have changed.

5.4. Conclusion

This study has explored teacher learning through the use of PILO toolkits in grade 8 and 9 mathematics classrooms in the Pinetown District. The findings indicated that teachers learnt in workshops and cluster meetings. They learnt how to create a great link between Mathematics textbooks, learners' workbooks, and the trackers. The teachers also emphasized that by attending in PILO training, they gained pedagogical and content knowledge. Teachers stressed that by participating in PILO training they now teach exactly what they are supposed to teach in the sense that they do not skip any topic. The teachers appreciated the PILO project because it reduced the paperwork and gave enough time to teach, as it came with planned lessons, assessment tasks and clear direction of what to teach and activity to be done. Teachers raised concern about PILO, that it promotes active learning only for intelligent learners, but it does consider slow learners. Trackers are fast paced but overall, teaching practices drastically changed.

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ICES

Appendix 1: Permission Letter from Department Basic Education



education

Department:
Education
PROVINCE OF KWAZULU-NATAL

Enquiries: Phindile Duma

Tel: 033 392 1041

Ref.:2/4/8/1148

Miss RPN Xulu
PO Box 205
Kranskop
3268

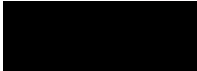
Dear Miss Xulu

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: "EXPLORING TEACHER LEARNING THROUGH THE USE OF PILO TOOLKITS IN GRADE 8, 9 MATHEMATICS CLASSROOMS IN THE PINETOWN DISTRICT", 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 27 January 2017 to 07 June 2019.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Connie Kehologile at the contact numbers below
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report/dissertation/thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education.

Pinetown District


Dr. EV Nzama
Head of Department: Education
Date: 01 February 2017

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

KWAZULU-NATAL DEPARTMENT OF EDUCATION
Postal Address: Private Bag X9137 • Pietermaritzburg • 3200 • Republic of South Africa
Physical Address: 247 Burger Street • Arson Lembede Building • Pietermaritzburg • 3201
Tel.: +27 33 392 1004/41 • Fax.: +27 033 392 1203 • Email: Kehologile.Connie@kzndoe.gov.za/Phindile.Duma@kzndoe.gov.za • Web:www.kzndoe.gov.za
Facebook: KZNDOE...Twitter: @DBE_KZN...Instagram: kzn_education...Youtube:kzndoe

Appendix 2: Ethical Clearance Letter from University of KwaZulu-Natal



28 November 2022

Revival Priscilla Nompumelelo Xulu 203511205 School of Education

Edgewood Campus Dear RPN Xulu

Protocol Reference Number: HSS/0078/017M

Project title: Exploring teacher learning through the use of PILO toolkits in Grade 8 and 9 Mathematics classrooms in the Pinetown District

Approval Notification – Amendment Application

This letter serves to notify you that your application and request for an amendment received on 25 November 2022 has now been approved as follows:

- Change in Supervisor: Previous Supervisor: Dr Nonhlanhla Mthiyane

New Supervisor: Dr Bongwiwe Zulu

Any alterations to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form; Title of the Project, Location of the Study must be reviewed and approved through an 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.

Best wishes for the successful completion of your research protocol. Yours faithfully

.....

Professor Dipane Hlalele (Chair)

/dd



Humanities & Social Sciences Research Ethics Committee

UKZN Research Ethics Office Westville Campus, Govan Mbeki Building Postal Address: Private Bag X54001, Durban 4000

Tel: +27 31 260 8350 / 4557 / 3587

Founding Campuses: ■ Edgewood ■ Howard College ■ Medical School ■ Pietermaritzburg ■ Westville

INSPIRING GREATNESS

Website: <http://research.ukzn.ac.za/Research-Ethics/>

Appendix 3: Letter of informed consent to the participants

P.O. Box 205

Kranskop

3268

LETTER OF INFORMED CONSENT TO THE PARTICIPANT

The title of the study: Exploring teacher learning through the use of PILO toolkits in grade 8,9 mathematics classroom in the Pinetown District.

Dear Colleagues

My name is Revival Priscilla Nompumelelo Xulu. I am a student at the University of KwaZulu- Natal, and currently registered for a Master's Degree in Teacher Professional Development. One of the requirements in completing the degree is to conduct a study. I am requesting the permission to conduct a study with you. I would appreciate the opportunity of conducting an individual interview. The interview will produce data on mathematics teachers explore teacher learning through the use of PILO toolkits.

The school was purposively selected because some of the teachers in school have an experience in implementation of Jika Imfundo. So, they are perceived to have an in-depth knowledge that would assist in conducting the study.

Please note that:

- The interview will take approximately one hour it will be audio- recorded and noted in writing.
- The interview will be conducted after school hours at your convenience.
- Your confidentiality is guaranteed as your inputs will not be attributed to you in person, but reported only as population member opinion. Participants will be given pseudonyms, as result it will not be linked to your name.
- The information that will be collected will be pure for research and the audio- recording will be safely stored in a secure storage for the purposes of security and destroyed after 5 years
- Your involvement is purely for academic purposes only, and there are no financial benefits involved.
- You have a choice to participate, not participate and you are at liberty to withdraw from the study at any stage. You will not be penalized for taking such action.
- Please be advised that permission for the interview will also be sought from the principal.
- If you are willing to be interviewed, please indicate (by ticking as applicable) whether or not you are willing to allow the interview to be recorded by the following equipment:

	Willing	Not willing
Audio equipment		
Photographic equipment		
Video equipment		

Should you need further information regarding the matter, you may contact me, my Supervisor and the Research Office of the University.

Thank you.

Yours in education
Miss R.P.N. Xulu

CONTACT DETAILS

Researcher: R.P.N. Xulu

rpnxulu@yahoo.com

0825105573

Research and Higher Degrees Office School of Education

University of KwaZulu –Natal

HSSREC Research Office –Ethics

Tel: 031-260 4557

Fax: 031 -2604609

Appendix 4: Letter to the principals

P.O. Box 205

Kranskop

3268

The Principal

Dear Sir/ Madam

LETTER SEEKING PERMISSION TO CONDUCT A STUDY

The title of the study: Exploring teacher learning through the use of PILO toolkits in Grade 8, 9 mathematics classrooms in the Pinetown District.

My name is Revival Priscilla Nompumelelo Xulu. I am a student at the University of KwaZulu- Natal and currently registered for a M.Ed. Degree in Teacher Development Studies. One of the obligations in finishing the degree is to conduct a research. I am appealing permission to conduct a research from at your school.

I ask for permission to interview the mathematics teachers in senior phase on what do teachers learn and value in using the PILO toolkits to improve curriculum coverage in mathematics classrooms. The teachers will be interviewed individually. The interview will take approximately 60 minutes, depending on their preference and it will be audio-recorded and noted in writing. I will also do document analysis on how teachers use of PILO toolkits in improving the curriculum coverage. The information that will be collected will be purely for research and audio-recording will be safely stored for security purposes and be destroyed after 5 years. Their involvement would be purely for academic purposes only, and there are no financial benefits involved.

Thank you

Yours in education

Ms. R.P.N. Xulu

Should you need further information regarding the matter, you may contact me, my Supervisor and the Research Office of the University.

Contact Details

Researcher: R.P.N. Xulu

rpnxulu@yahoo.com

HSSREC Research Office

Tel: 031 260 4557

Appendix 5: Turnitin report

The screenshot shows a Turnitin report in a browser window. The document title is "CHAPTER ONE - OVERVIEW OF THE STUDY". The report shows a total similarity score of 8%. The matches are as follows:

Match Number	Source	Similarity Percentage
1	Aileen Kennedy. "Model... Publication"	1%
2	Fiona King. "Teacher pr... Publication"	1%
3	Robbert Smit, Kurt Hes... Publication	<1%
4	Bertram, Carol, Nonhla... Publication	<1%
5	Margaret Mohr. "Mathe... Publication"	<1%
6	Fatma Kübra Çelen, Sül... Publication	<1%

The document content visible includes:

CHAPTER ONE - OVERVIEW OF THE STUDY

1.1 Introduction

This chapter starts by illustrating the background, focus and the purpose of the study. This is followed by the presentation of the rationale, the research questions, the preliminary literature review and the conceptual frameworks of the study. The chapter also presents a brief overview of research methodology adopted in this research study. The chapter ends with the overview of chapter in the dissertation.

1.2. Background and context of the study

The Department of Education in KwaZulu-Natal created the Jika Imfundo as an intervention

Page: 1 of 63 | Word Count: 21955 | Text-Only Report | High Resolution: On

Appendix 6: Editor's letter



17th November 2022

To whom it may concern

EDITING OF DISSERTATION FOR NOMPUMELELO XULU

I have a master's degree in Social Science, Research Psychology and a 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 eight years. I have

further undertaken editing, transcribing and other research work for private individuals and businesses.

I hereby confirm that I have edited Nompumelelo Xulu's dissertation titled **"To explore teacher learning through the use of PILO toolkits in grade 8,9 mathematics classrooms in the Pinetown District"** for submission of her master's dissertation in education at the University of KwaZulu-Natal. Corrections were made in respect of grammar, tenses, spelling and language usage using track changes in MS Word 2019. Once corrections have been attended to, the dissertation should be correct.

Yours sincerely

A solid black rectangular box used to redact the signature of the editor.

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

DISCLAIMER

Should the student not attend to the changes suggested by the editor and make additions to the dissertation after editing has been completed, the editor cannot guarantee the language, grammar and tenses are correct at the time of publication.

Appendix 7 Interview schedule

Title: Exploring teacher learning through the use of PILO toolkits in grade 8 and 9 mathematics classrooms in the Pinetown District

Thank you so much for being available for an interview and thank you for signing the consent form, so you are aware that this project is part of my studies at UKZN. Everything that you say will kept confidential. This interview should take about 45-60 minutes.

Section 1: Biographical questions

- Can you tell me more about yourself?
- What grade are you teaching and how long have you been teaching mathematics in these grades?
- What are your teaching qualifications?

Section 2: What do teachers learn and value in using the PILO toolkits to improve curriculum coverage in Mathematics classroom?

- How do you feel now, after attending the PILO project?
- In which ways has the PILO project affected your confidence as a mathematics teacher?
- What do you think is the most essential thing you have learned in PILO project?
- What did you learn from the PILO project?

Tell us more about it?

Which one of these do you think is most important?

Why do you say so?

How would you use PILO toolkits to improve your curriculum coverage?

Section 3: How do teachers experience learning from using PILO toolkits in Mathematics classroom to improve curriculum coverage?

1. What do you think about what was taught in terms of content?
2. How would you perhaps improve the teaching?

- How do you think the use of toolkits to improve curriculum coverage has impact on learner outcomes?

Section 4: How has the use of PILO toolkits changed teachers' practices to improve curriculum coverage in Mathematics classroom?

- How do the uses of toolkits improve learner outcomes?
- What challenges do you encounter when you use PILO toolkits in your classroom practices?
- What support do you obtain through attending the PILO project?

Thank you.