



**THE TYPES OF KNOWLEDGE THAT INTERMEDIATE PHASE MATHEMATICS
TEACHERS ACQUIRE THROUGH PARTICIPATION IN JIKA IMFUNDO PROJECT:
A CASE STUDY OF SIX TEACHERS AT GRACE PRIMARY SCHOOL IN KING
CETSHWAYO DISTRICT.**

BY

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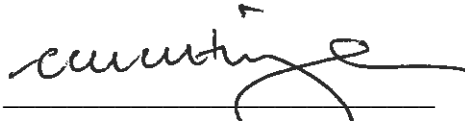
DECLARATION

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ABSTRACT

The KwaZulu-Natal Department of Education introduced a component called Jika iMfundo in partnership with NECT since 2014. The aim of this programme is to improve the quality of teaching, learning, effective management, support services, evaluation process, monitoring and improve curriculum coverage in schools under two Districts namely, King Cetshwayo and Pinetown District. This study explored the kinds of knowledge that the intermediate phase mathematics teachers acquire through participating in Jika Imfundo programme with a view of identifying the types of professional development activities they engage in.

The study was located within the interpretive paradigm. The qualitative case study was adopted. For data collection the semi-structured interviews were used together with the document analysis. Six intermediate phase mathematics teachers participating in Jika Imfundo from different schools in King Cetshwayo District were purposively selected. The study was based in one district in KwaZulu-Natal. Findings show that teachers participating in Jika Imfundo were engaged in a range of professional development activities, which includes training workshops, cluster meetings, coaching and mentoring, one-on-one meetings, subject phase meetings, class visits and reflection. These professional development activities were analysed in terms of their effectiveness. In these professional development activities, teachers acquired different kinds of mathematics knowledge that assist them in teaching mathematics effectively.

The researchers concur on the following kinds of mathematics knowledge: common content knowledge, specialized content knowledge, horizon content knowledge, knowledge of content and students, knowledge of content and teaching and knowledge of the curriculum. These types of knowledge are grouped under two domains. These are subject matter knowledge and pedagogical content knowledge. Therefore, it is imperative for the KwaZulu-Natal Department of Education to strengthen the use of Jika Imfundo as a professional development activity at a larger scale or across the province.

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LIST OF ACRONYMS

ANA	Annual National Assessment
CAPS	Curriculum and Assessment Policy Statement
CBCI	Content Based Collaborative Enquiry
CGI	Cognitively Guided Instruction
CK	Content Knowledge
CCK	Common Content Knowledge
EFA	Education for All
GPk	General pedagogical knowledge
HOD	Head of Department (school level)
HCK	Horizon Content Knowledge
JI	Jika Imfundo
IP	Intermediate Phase
KZN DoE	KwaZulu-Natal Department of Education
KCC	Knowledge of Content and Curriculum
KCS	Knowledge of Content and Students
KCT	Knowledge of Content and Teaching
LTSM	Learning and Teaching Materials
MKT	Mathematical knowledge for teaching
PCK	Pedagogical Content Knowledge
PD	Professional development
PCK	Pedagogical Content Knowledge
PILO	Programme to Improve Learning Outcome
SACMEQ	Southern and Eastern Africa Consortium for Monitoring Education
Quality	
SCK	Specialized Content Knowledge
SMK	Subject Matter Knowledge
SMT	School Management Team
TIMSS	Trends in International Mathematics and Science Study
WCED	Western Cape Education Department

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CHAPTER ONE: INTRODUCTION

1.1 Introduction

This chapter begins by describing the focus and purpose of the study. Secondly, it explains the importance of the study, followed by the description of the background information. It then presented the research questions and for the clarity, the brief explanation of each question is then offered. A review of the literature and the conceptual framework used to analyze the findings of the study are analyzed, and the research methodology. In conclusion, a brief overview of the dissertation is explained.

1.2 Focus and Purpose of the study

The purpose of the study was to explore the kinds of knowledge that intermediate phase mathematics teachers acquire through participating in Jika Imfundo (JI) project in King Cetshwayo District at KwaZulu Natal Province. This study attempted to focus on the intermediate phase mathematics teachers participating in JI project with a view of identifying the kinds of knowledge they acquire through participating in JI, also to identify the types of professional development activities they engage in through this project. The King Cetshwayo District was selected because it was one of the two Districts where Jika imfundo is being trialed.

1.3 Rationale

Most of the studies that I have read on JI project since 2014 focus more on learner achievement but not on how teachers acquire knowledge in this project. As a Masters student in the University of KwaZulu Natal I have learned that for quality education to take place, teachers must acquire adequate knowledge for teaching a particular subject. As a post level one educator, teaching in the foundation phase I am much concerned about the learners' underperformance in mathematics in the intermediate phase. The recent CDE (2011) report stated that South Africa is at the bottom of other developing countries in terms of student performance in mathematics and science. The CDE (2011) have also discovered that teachers who are teaching mathematics and science are not

teaching them properly, and these subjects are poorly managed. This report revealed that poor teaching at school causes the main cause of poor performance.

The world rankings have shown and confirmed that mathematics teaching and learning is a problem in South Africa. The international studies focusing on Numeracy and Literacy that South Africa recently participated in came with negative results. These international studies include the Progress in International Reading Literacy Study (PIRLS), Trends in International Mathematics and Science Studies (TIMSS) and the other one was conducted by Regional research study of the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ), also confirmed that South African learners are not performing well. The Annual National Assessment (ANA) results have also shown that mathematics in the intermediate phase is still a problem in South Africa. I believe that the most cause of this failure in ANA is that the examiners set the mathematics paper that was common to all South African learners irrespective of background and environment (school context). A learner from an urban area is more exposed to learning resources including libraries, media, and other learning networks while learners in rural areas do not have such resources. Hollingsworth (1999) contends that it is difficult for mathematics teachers to implement new practices in their classrooms because of unsupportive conditions in schools for example unavailability of resources.

The Department of education in South Africa have tried to overcome the problem of incompetency of the learners especially in mathematics by planning and conducting workshops to equip teachers with relevant skills for teaching, but there was little or no improvement and the problem is still persisting (Bertram, 2011). Mathematics is one of the subjects that was targeted by JI in the intermediate phase since mathematics teaching and learning is a nationwide problem.

This study was undertaken because teaching mathematics effectively is of vital importance in quality education provision. It is believed that the study results will have beneficial application as it seeks to reveal the kinds of knowledge that intermediate phase mathematics acquire through participating in JI. This study aims to close a gap of knowledge of teaching mathematics which will have an impact on learner's performance, especially in mathematics. The education programmes aimed at improving the quality of teaching mathematics as a subject especially in the

intermediate phase will benefit from this study and also the teacher education programmes. The findings will also elaborate or explain if their knowledge acquired in JI programme will have an impact on their practice or not. Those who are advocating JI will also have got adequate information if their project has an impact on teachers and learners. Through the contribution of this study, the body of knowledge concerning teacher knowledge and professional development will also benefit.

1.4. Background information

The purpose of this study was to explore the kinds of knowledge that intermediate phase mathematics acquire through participating in the JI project. Every school needs quality teachers with suitable information about the culture of teaching. Teachers are one of the most important and most powerful influences on students' engagement with mathematics as a subject (Attard, 2011). Turnuklu and Yesildere (2007, p.1) stated, "Although a number of factors may influence the effective teaching of a particular subject, teachers play an important role in success". Likewise, Attard (2011) claims, that a good teacher can achieve high and consistent levels of effective learning. Society has a common belief that a teacher who knows a particular subject can teach it very well, however, the research has contradicted that or that belief is not true (Shulman 1986,1987, Rowan and Ball, 2005& Etkina 2010). Etkina (2010, p.1), maintains that "teachers of a specific subject should possess special understandings and abilities that integrate their knowledge of the content of the subject that they are teaching as well as having knowledge of the learners who are learning the content". Teaching requires an interlinking of many aspects of specialized knowledge (Mishra &Koehler, 2006).

Since I started teaching in 2007 teaching grade one in the foundation phase, I have noticed that most of the learners have difficulties in mathematics learning. I have observed that the foundation phase learners learn mathematics in their mother tongue, which is isiZulu, and their results are very good, but in the intermediate phase, learners are struggling to master the mathematics subject content. I think the language of teaching and learning mainly cause this, which is English and the increasing number of subjects. The data gathered from TIMSS (1999) on a study done by Howie (2003) indicates that language of teaching and learning also affects the performance of learners in mathematics, learners whose proficiency in English performed very well compared to those who had poor proficiency in English. The language of teaching and learning in most rural schools and

townships of South Africa is English although it is a second language for most learners (CDE, 2004).

The school where I am currently teaching is in the deep rural area falling under quintile 1, due to its geographical demarcation. The community of this area is experiencing socio-economic conditions since they are employed in agricultural sectors whereby they are being paid low wages and some of them are unemployed. Most of the parents in this area are illiterate in such a way that they are unable to help their children with their homework and they do not want to interfere in their children's education. Learners are not exposed to mathematical practices at their homes. Researchers such as Howie (2003), De Clercq (2008) and CDE (2004, 2011) maintained that the causes of poor performance of learners in mathematics can be in-schools and out-of-school's factors. De Clercq (2008) contends that South Africa as a developing country has the following factors that contribute to poor performance of learners: poor quality of teachers, the context of schooling, socio-economic background of learners and their communities, under the resourced school and poor school leadership. The language of teaching and learning is also a factor that contributes to the poor performance of learners in mathematics (CDE, 2011).

To address the problem of mathematics and language in Kwa-Zulu Natal, the Kwa-Zulu Natal Department of Education (KZN DOE) have come up with a project called PILO (Project to Improve Learning Outcomes) under the banner called JI in Pinetown District and UThungulu District (King Cetshwayo). The JI project was launched on September 2014, by the Kwa-Zulu Natal department of education at a pilot study that includes two districts in Kwa-Zulu Natal province, reaching about 1200 schools. The purpose of this program is "to bring about improved learner performance over the next three years in the Districts in which PILO is working" (PILO, 2014-2017; p.6). It is a programme to improve learning outcomes, funded by the National Education Collaboration Trust (NECT) and Kwa-Zulu- Natal Department of Education.

The most important thing that this project tries to emphasize is the importance of collaboration that will collectively be between teachers and the department of education. Ball (1997) has also affirmed that for effective professional learning to take place it considers the interaction between individuals, communities of teachers, where teachers will discuss their problems and their teaching strategies and so on. PILO has developed and refined its theory of change and model based on an

extensive body of evidence-based experience, monitoring and evaluation of innovations, and educational research (Jika imfundo, 2015).

JI aimed to improve learning outcomes on the following subjects, English, mathematics, and isiZulu in primary schools and mathematics and physical sciences in secondary schools. To achieve their goals, they have set necessary conditions like, learners must attend school daily and put their effort, teachers must be present in the classroom, teach, and core teaching and learning materials must be made available on time. The learners must also be helped to learn to make sure that they are not hungry, worried about an issue in the community, or to be suffering from any psycho-social factor that will destruct them from learning. JI also stresses the importance of community and parental involvement in supporting disciplined education and pride. Teachers must be able to use align LTSM with the curriculum and use it appropriately. Training and coaching of School Management Teams (SMT) is both generic and content specific lead by the District and supported by user-friendly teacher toolkit tracker so that teachers will use it for reflection.

This project supplied teachers with toolkits for mathematics that includes lesson plans, assessment planner and tracker, and multilingual dictionary for mathematical terms. The lesson plans give detailed information on how to teach a Curriculum Assessment Policy Statement (CAPS) aligned mathematics every day. Each lesson plan provides the steps and guidelines that help a teacher to deliver a lesson. Lesson plans also include learner's activities that help learners in content development since it has been discovered that learners and teachers lack the content knowledge. Detailed formal written tasks and their memos are provided as one of the resources found at the end of lesson trackers plans.

The JI trackers and planners help teachers to plan the curriculum content on daily basis, align the CAPS content planning with the textbooks available, keep the record of each class on learner's performance and lastly reflect on curriculum coverage daily with colleagues and subject heads. Lastly, the PILO intervention is an intervention of the Kwa-Zulu Natal department, it is not parallel or add on assistance and therefore the KZNDoe with PILO support implements all of the individual activities so that it can be taken to scale and sustain over the long term by the Department. Looking at this programme, I have therefore developed an interest to explore the

kinds of knowledge intermediate phase mathematics teachers acquire from JI project and in what ways they acquire this knowledge. The study will take place in King Cetshwayo District in KwaZulu-Natal province. The National Teacher Education Audit of 1996 and the Mathematics and Science Audit of 1997 revealed that 50% of mathematics teachers are not properly trained to teach mathematics. The Education for All (EFA) 2000 has also confirmed that even though 85% of mathematics teachers are professionally qualified but 50% of them have not specialized in teaching mathematics. Looking at these figures it is clear to me that mathematics teachers need some sort of professional development that will help them in attaining the skills and knowledge of teaching mathematics. Bertram (2011, p.3) asserts, “professional development initiatives need to take much greater cognizance of the kinds of teacher knowledge that teachers need to acquire and the various ways in which they acquire these different types of knowledge”

1.5 Research questions

To facilitate the exploration of the types of knowledge that intermediate phase mathematics teachers acquire through participation in JI, the main research questions posed or asked in this research study was: What knowledge do intermediate phase mathematics teachers acquire through participating in JI project and how do they acquire it?

To answer the main research question two critical questions were used.

1. What types of professional development activities do intermediate phase mathematics teachers participating in Jika Imfundo project engage in?
2. What kinds of knowledge do intermediate phase mathematics teachers acquire through participating in Jika Imfundo project?

These research questions are derived from the problem statement above.

1.6 Brief Review of related literature and conceptual framework

In this study, I drew on Desimone (2009) to identify the features of effective professional development that have an impact on improving teacher knowledge. I used the concept of professional development because JI was one of the teacher development strategies initiated by the Kwa-Zulu Natal Department of Education. I also used Fennema and Franke (1992) and Hill, Rowan, and Ball (2006) to analyze the kinds of mathematical knowledge that Intermediate Phase

(IP) mathematics teachers need so that they will teach effectively. These types of knowledge are adapted from Shulman (1986) which I have also discussed in details. I will also draw on Grossman (1990) where he describes the four domains of teacher knowledge based on Shulman's teacher knowledge. This will be further discussed in chapter 2, literature review. Shulman (1986) is regarded as the first researcher to describe what teachers need to know based on teacher knowledge.

1. 7. Methodological approach

This research project adopted the qualitative research approach. Qualitative research aims to explain the social phenomenon in a natural setting (Suter 2012). Similarly, Creswell (2013) maintains that one of the characteristics of qualitative research is that it takes place in a natural environment. Qualitative research was suitable for my study because my intention was to conduct the research in the respondent's natural environment, which is the school in which IP mathematics teachers teach. Secondly, my study focused on a small group of intermediate phase mathematics teachers, and I allowed them to describe their experiences of acquiring knowledge through the JI project.

I collected data in a form of a case study, single case study through interviews and document analysis. The interviews presented an opportunity for the participant's voices to be heard. This research study adopted the interpretive paradigm or phenomenological approach. I adopted interpretive approach because it aims to understand teacher's experiences on using JI as a programme to improve learning outcomes. Creswell (2003) points out that in the interpretive paradigm an individual tries to understand the world in which they live in and subjective meanings to their experiences are obtained. I also adopted interpretive paradigm in my study as the JI project will be understood from the experiences of teachers who are teaching using the project.

The methodological design that was adopted in this study was the case study. Many researchers describe a case study in many ways. Merriman (1988) defines a case study as a bounded system. Similarly, Bromley (1990) defines a case study as a systematic inquiry aims to describe and explain the phenomenon of interest. The study took place at schools participating in Jika Imfundo; the case was the intermediate phase mathematics teachers participating in JI in this school. In this

research study, I employed exploratory case study because the study examined the contribution of the JI project in teacher knowledge at schools participating in JI.

1.8 Overview of the Dissertation

Chapter one gives an introduction, background of the study, the rationale, focus and purpose of the study, research questions, review of the related literature and conceptual framework, methodological approach used in the study, the overview of the dissertation as well as the conclusion.

Chapter two reviewed and discussed the literature for the justification of the study. I discussed the key concepts that inform my study, and I have stated what other researchers have said and done based on my study, and I have identified the gap that my study aims to fill.

In chapter three, I have placed my study into a broad research paradigm that is the interpretive paradigm. I have also outlined the methods that I used to collect data and described the population and sampling procedures. Data analysis, as well as ethical procedures, are well discussed and presented.

The fourth chapter presents the findings of my study. Data obtained from interviews and document analysis is analyzed using themes, noting patterns.

The last chapter shows how the participants answered the research questions for the study and how my study is different from other studies done before.

1.9 Conclusion

This chapter discussed the focus and purpose of the study as well as the significance of the study. It also explained the research questions and the methods used to answer the questions, and the background information about the location of the study. This chapter ends with an overview of the chapter's contents.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter is a presentation of reviewed literature related to the study. The aim of this literature review is to locate this study within other studies conducted in the field of teacher knowledge and teacher development. This study aims to explore how teacher development that takes place in Jik Mfundo program looking at professional development activities that Jika imfundo (JI) employs. This chapter will look at international, national and local literature. The purpose of the present study is to explore what types of professional development activities do intermediate phase mathematics teachers participating in JI engage in, secondly to explore the kinds of knowledge that intermediate phase mathematics teachers acquire through participating in JI. It then considers the concept of teacher learning and teacher knowledge, then I, therefore, reviewed literature on teacher knowledge and elaborate on how these different types of knowledge assist teachers to plan and conduct lessons in general especially in mathematics. I conclude this chapter with a discussion of the kinds of knowledge that is needed by mathematics teachers, especially in the intermediate phase.

2.2 Defining professional development

A wide net for what might be incorporated as professional development is cast by various literature. Little (1987) describe it as “any activity that is intended partly or primarily to prepare paid staff members for improved performance in present or future roles in the school districts” (p.491). She further maintains that professional development is seen as attending separate activities such as local and national conferences, workshops, college courses, and centers.

Other authors define professional development in the same way as authors above, for example, Kelly (2006) defines it as prepared and planned activities for teacher learning. On the other hand, Fraser, Reid, and Mckinney (2007) argued that learning can be both informal and formal, incidental or planned compulsory or voluntary. Similarly, Day (1999) defines teacher development as the “process by which teacher alone and with others review, renew and extend their commitments as change agents to the moral purposes of teaching, and by which they acquire and develop critically the knowledge skills planning and practice with children, young people and colleagues through each phase of their lives” (p.4). Likewise, Day and Sachs (2004) define

professional development as all the activities that the teacher engages in for the improvement of their work. However, Bertram (2011) contradicts this definition by explaining that a teacher can attend a workshop but that does not necessarily mean that he or she have learned to implement new practices in the classroom or the new knowledge have been acquired. Avalos (2010) contends that the way in which teachers learn, and learning how to learn and the process of transforming their knowledge into practice for student growth and student benefit is called professional development.

The definition is given by Avalos (2010) and Day and Sachs (2004) is better because it specifies teacher learning, the ways in which the teacher learns in order to acquire knowledge. Guskey (2003) and Association for Supervision and Curriculum Development (2003) agreed with Avalos (2010) on the effective professional development that it should be informed by student performance. Professional development is based on discourse, managerial and community practice (Anderson, Reder & Simon, 1996; Cobb, 1994; Lave& Wenger, 1991). Formal and informal learning that promotes teacher growth and development is part of professional development (McLaughlin& Talbert, 2003). Hilda and Borke (2004) assert that teacher learning may occur in different ways and on different aspects, including their school communities, classrooms, and professional development courses or workshops. Coaching, mentoring and reflecting on lessons are the embedded professional development models that relate to the work of teaching (Schifter & Fosnot, 1993). Professional development activities may also come in a form of teacher networks, book clubs, or groups of study (Grossman, Wineburg, &Woolworth, 2011)

From the above paragraphs, definitions of professional development it can be seen that teachers need to attend effective professional development activities that will help them to increase their knowledge and skills so that their attitude and beliefs will change, and then there will be a change in instruction for the improved student learning. It is for this reason that the study had interest in exploring the types of professional development activities that intermediate phase mathematics teachers engage in through participating in JI.

2.2.1 Characteristics of quality professional development activities

Development activities carried out in schools today does not bring change in teachers' expertise for improved student learning (Rhoton &Stile, 2002). The characteristics that contribute to effective professional development can be the differences in school communities, teachers moreover, students (Guskey, 2003). Guskey and Yoon, Desimone (2009) identified five characteristics that make up an effective professional development. These characteristics are sustained time, sustained engagement, coherent learning activity, integration in teachers work and collaboration. She suggests that for the professional development activity to be effective there should be sustained time given to professional development activity. Secondly, there should be a sustained engagement in the professional development activity. Thirdly, there should be a coherent learning activity. Fourthly, learning activity should be integrated into the teacher's daily work and their focus should be on meaningful content knowledge of the subject. Lastly, teachers from the same school or other schools should collaborate. Likewise, Villegas –Reimers (2003) suggests that professional development should be based on constructivism. It should last for a long time or it should be a long-term process.

It should take place within the school context. Teachers should work collaboratively, and lastly, it should be linked to school reform. King and Newmann (2000) pointed out that effective professional development should be teacher-driven so that it should be owned by teachers and more meaningful. It should be informed by student performance (Guskey, 2003, National Partnership for Excellence and Accountability in Teaching, no date, Association for Supervision and Curriculum Development, 2003). Lastly, there should be a self-evaluation taking place in order to guide the ongoing improvement efforts on teachers (Guskey, 2003). Kedzor (2004) argued that there are three examples of professional development activities that are regarded as incorporating the characteristics of high quality. These are mentoring; Content-Based Collaborative Inquiry (CBCI), Cognitively Guided Instruction (CGI) and lesson study (Education Policy Brief, 2004). It contends that through mentoring novice and master teachers gets an opportunity to learn from each other so that they can be able to meet the day-to-day challenges of teaching. Mentoring can take place in a form of coaching, classroom observation, a collaboration of teachers and also feedback. It (Kedzor, 2004) can also improve attitudes of teachers and experience of using the various range of strategies of instructions (Smith, 2002).

In CBCI and CGI, a collaboration of teachers occurs for the creation of deeper understandings of a particular subject and of how their student thinks. In CBCI, the facilitators are the ones who collect and analyze data, ask questions about student understandings and collaboratively creates instructional solutions. The understanding of content and pedagogy that supports student learning is built in this process (Bray, Gause-Vega, Goldman Secules, & Zech, 2000). The model of how student thinks and the ways in which they solve problems are created in the CGI, and by the way, teachers uses this model to develop instructional materials that address their learning needs. Carpenter, Fennema and Franke and Levi (2001) assert that in the CGI the teachers get an opportunity to extend the subject matter understanding and develop effective ways to teach the subject.

In the lesson study teachers work together to generate study and improve their lessons. In this process, teachers observe one another whilst teaching a particular subject, and thereafter there is a discussion of observation and data analysis and lesson revision is done (Fernandez and Chokshi, 2002 & Watanabe, 2002). Mid –Atlantic Eisenhower Regional Consortium (2002) showed that this is a model whereby collaborative self-study of teacher’s practices that supports growth and instructional improvement is achieved. From the above discussion so far, what is being implied is that to have the great impact, professional development must be aimed at implemented and evaluated so that the needs of particular teachers in particular settings will be met (Guskey, 1995). One of the purposes of my study is to explore the types of professional development activities that intermediate phase mathematics teachers participating in JI engage in, that is why I have reviewed literature based on effective professional development activities.

2.2.2 Models of professional development

Kennedy (2005) proposes nine models of professional development. These are training, award bearing, deficit, cascade, standard based, coaching or mentoring, and the community of practice, the community of practice, action research and transformative model. Each of these models is explained in the table below.

The cascade model	The cascade model involves individual teachers attending training events, and then cascading or disseminating the information to colleagues. This model is normally used in circumstances where resources are inadequate.
The action research model	In the action research model, the participants themselves are involved as researchers with a view to improving the quality of action within the research. The quality of action can be viewed as the participants understanding of the circumstances, as well as the practice within the given circumstances
The training model	This model has been the leading form of professional development for teachers. In addition to supporting a skills-based, technocratic view of teaching, it provides teachers with the opportunity to update 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.
The community of practice model	The added value of learning in communities pertains to the viewing of the existence of individual knowledge, and to the combinations of several individuals' knowledge through practice as being a powerful site for the creation of new knowledge. A clear relationship exists between communities of practice and the mutually supportive and challenging form of the coaching / mentoring model.
The deficit model	In the deficit model, professional development can be designed specifically to address an alleged deficit in teacher performance. Such development may be set within the context of performance management as a means of raising standard, or as an element of intervention to achieve greater efficiency or effectiveness.
The standards -based model	The standards- based model represents a desire to create a system of teaching, as well as teacher education that can generate and empirically validate connections between teacher effectiveness and student learning. The model also relies greatly on behaviourist perspective of learning.

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.
The award-bearing model	This model 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 mark quality assurance, but it can be equally viewed as the exercise of control by the validating organisations.
The transformative model	The transformative model of professional development involves the combination of a number of processes and aspects that are drawn from the other models outlined above. The central characteristic is the combination of practices and conditions that support a transformative agenda.

Table 1: Models of Professional Development (adapted from Kennedy, 2005, p. 236)

These models describe the dominant characteristics of particular approaches to continuous professional development they or they didn't stand alone (Kennedy, 2005). He also acknowledges that coaching and mentoring is not the same because coaching is likely to be skills-based whereas mentoring is like professional friendship. In the case of peer coaching, Loucks-Hosley and Matsumoto (1999) as cited in Kelchtermans (2016) identified the three characteristics that promote effective learning experiences for teachers. Firstly, learner-centered approach should take place on professional development activities, and the activities should incorporate and acknowledge what the teachers are able to do well and what the teachers know. The second one is learning in school through mentoring, peer coaching, team planning, and assessment. The third characteristic of professional development is learning out of the school-university partnership, and through centers for professional development.

2.2.3 Critiques of professional development

Most of the studies report only the positive effects of professional development based on the practices of teachers. Three key barriers to implementing effective professional development are described by different authors in different studies. Birman, Desimone, Garet Porter and Yoon (2001), who maintained that professional development structure and teacher's time might hinder the functioning of professional development, discuss the first barrier. Professional development structure refers to the way in which the development activity is structured in terms of time or duration. This may be a barrier because teachers may prefer one-day workshop during the school year because they hesitate to commit their time on professional development. Teachers' time can also be a barrier. The second barrier is professional development content, professional development that considers subject matter content and also practices of the classroom may come across with resistance. The environment can be supportive but some individuals may feel uncomfortable when it comes to the sharing of ideas with their supervisors and colleagues (Birman et al., 2001).

The third barrier can be a school factor; professional development that incorporates multiple characteristics of high quality can be time-consuming and challenging. The daily work of teachers allows insufficient time for individual teachers and collaborative work towards the improvement of instruction (Birman et al., 2001). Costs are another factor that can be a barrier in promoting professional development. Professional development that is high on quality can be very expensive, even twice the amount that the district spends to pay a teacher (Birman et al., 2001). In this case, it is better to rely on a core community of teachers for example clusters for the sharing of information. This study looks in particular on the nature and design of JI development activities whether effective PD determined by Desimone (2009) characterizes them.

It is therefore imperative that a professional development seeks to overcome the above-mentioned barriers for the teaching support as an ongoing inquiry.

2.3 Teacher learning

Teacher learning as explained by Kelly (2006) as a process whereby novice teachers move towards expertise through development. In their development, they acquire new knowledge and skills in different ways for their professional development. Learning can take place formally or informally, structured or unstructured, individually or collaboratively. This study looks, in particular, the design of the JI training or workshops programmes, therefore it is necessary to look at whether this

programme will allow effective teacher learning for their professional development purposes. The key discussion around the phenomenon of teacher learning regards to two main theories of teacher learning: the cognitive approach and sociocultural approach. These two theories are discussed in this study because the purpose of this current study is to explore the kinds of knowledge that intermediate phase mathematics teachers acquire through participating in JI. It is from their participation in various learning activities in different models of professional development that we can understand what types of knowledge they acquire, or they learn in order to teach mathematics effectively.

2.3.1 The cognitive approach

Putnam and Borko (2000) assert that the cognitive approach is based on the assumption that the acquisition of skills, understanding, and knowledge resides in the individual teacher's mind.

Kelly (2006), Putnam and Borko (2000) and Sfard (1998), explained that in cognitive approach or learning as acquisition, teachers acquire knowledge, skills, and understanding in one setting or context and then apply it in the context of the classroom. They also pointed out that in cognitive approach or learning as acquisition context is very important, and does not engage with teacher identities. Learning as an acquisition or cognitive approach the main focus is on knowledge of practice, for example, theories of good learning, best practice strategies. The example of the PD associated with this model is a training model. The critique for cognitive approach or acquisition is that learning is not easily transferred to a different site context and identity are important and have an influence on teachers practice,

2.3.2 Sociocultural approach to learning

In socio-cultural situated or learning as participation, teachers must acquire skills, knowledge, and understanding in the workplace through participation in the practices. In this case, learning is an individual endeavor. However, in socio-cultural situated or learning as participation, learning is understood as a collaborative endeavor, that knows in practice and it is distributed across teachers, students, and resources. In socio-cultural approach, situated or participation, it is context specific and engages with teacher identities that include how teachers understand their roles and purposes as teachers. Socio-cultural, situated or learning as participation focuses on knowledge in practice

that is the knowledge developed by teachers through experience. Alder (2007), stated that on a situate perspective, teacher learning is a process of increasing participation in teaching as a practice and the process of becoming knowledgeable in and about teaching through participation. The example of the PD activity associated with this model is the community of practice model.

The critique for socio-cultural approach, situated and participation metaphor is that schools are not sites that necessarily implement best practice, they are often conservative sites that only focus on knowledge in practice, and ignoring research-based knowledge (Kelly, 2006).

These three researchers have suggested that it is difficult to account for teacher learning using only one of these theories. Different kinds of teacher knowledge are learned in different kinds of ways. They also emphasized that teacher learning can be both individual and collaborative, and can take place through both formal and informal activities.

2. 4. Teacher knowledge

Teaching and planning any subject requires a highly complex cognitive activity, the teacher must possess and apply these from multiple domains of knowledge (Resnick 1987; Leinhardt & Greeno, 1986; Wilson, Shulman & Richer, 1988). Even (1990, p. 522) states that “defining teacher’s knowledge not by the number of courses they have taken or their success on standardized tests, but by analysing what it means to know mathematics, has some promise to contribute to the improvement of the quality of subject matter preparation for teachers and therefore the quality of teaching and learning”. Those teachers who have differentiated and integrated knowledge demonstrate greater ability than those with fragmented and limited knowledge. The purpose of this study is to explore the kinds of knowledge that mathematics teachers acquire through participating in JI, therefore I briefly explained the kinds of the teacher, as they are relevant to this study.

Shulman (1986) was the first researcher to identify the types of knowledge that are needed by the teacher for effective teaching. These types of knowledge include content knowledge, general pedagogical knowledge, Pedagogical Content Knowledge (PCK), curriculum knowledge and subject matter content knowledge. Shulman (1987) modified and came up with other types of knowledge from his earlier writing and came up with seven categories four types of this knowledge are the ones mentioned and identified earlier. These include general pedagogical knowledge,

content knowledge, curricular knowledge, and PCK. The added knowledge types include content knowledge of learners and their characteristics, knowledge of educational context, knowledge of educational ends, purposes, and values, and their philosophical and historical grounds. Grossman (1990) adapted and developed this knowledge into four domains of knowledge and considered them as the gist of teacher knowledge. This general teacher knowledge includes general pedagogical knowledge, subject matter knowledge, pedagogical content knowledge (PCK) and knowledge of context. Below I discuss Knights (2002) categories of teacher knowledge that is propositional knowledge and practical knowledge, followed by Shulman's domains of teacher knowledge, as this study focuses on the kinds of knowledge that the intermediate phase mathematics teachers acquire through participating in JI.

2.4.1 Propositional knowledge

Shulman (1986) defines propositional knowledge to be the knowledge of the basic fundamental content of a subject that is taught in class. Likewise, Knight (2002) defines propositional knowledge as the knowledge of laws and ideas or abstract knowledge of principles and knowledge of facts. Similarly, Demetriou and Wilson (as cited in Bertram, 2011, p.8) describe this knowledge as “codified knowledge” and they state that this is learned through learning formally. Kelly (2006) refers to this knowledge as knowledge-of-practice, other authors also explain this knowledge in the same way as other authors.

2.4.2 Practical knowledge

Knight (2002, p.230) explain practical knowledge as “about learning to do and higher-order knowledge”. Kelly (2006) refers to this knowledge as knowledge-in - practice. Moreover, Bertram (2011) defines practical knowledge as the knowledge that teachers acquire in the context of their teaching practice. Demetriou (as cited in Bertram, 2011, p.8) defines it as “context-specific knowledge)” and they further explain that practical knowledge is learned through informal learning when participating in social activities, it is acquired through experience.

2.4.3 Shulman's categories of knowledge

Shulman (1986) identified the first five categories of teacher knowledge. These categories are general pedagogical knowledge, content knowledge, pedagogical content knowledge, curriculum knowledge and knowledge of educational context. A year later, he added the two categories that are knowledge of learners and their characteristics and knowledge of educational ends, purposes, and values (Shulman, 1987).

General pedagogical knowledge

Grossman defines GPK as the knowledge that includes a body of general knowledge and beliefs skills for teaching, classroom management and general principles of instruction learning and learning time. Doyle (1986) contends that general pedagogical knowledge is the knowledge about education purposes and classroom management purposes. This type of knowledge helps teachers to create a positive learning atmosphere in their classrooms. It also incorporates features like learners sitting plan, class rules settings, classroom discipline and the interaction between teachers and learners. It further includes the curriculum that is offered, as well as the way in which learners learn in the classroom (Grossman, 1990). Different authors explain GPK in different ways but they all come to the same point that GPK is about classroom management.

Content knowledge

Shulman (1987) identifies this knowledge as the knowledge of the subject matter that the teacher teaches in a particular classroom. Authors like Cogill (2008), Grossman (1990) and Straker (2006) (as cited in Bertram, 2011) all agree with the definition above. Content knowledge considers the knowledge of the subject that is taught in the classroom. Shulman (1987) demonstrated that the Blooms cognitive taxonomy is used to organize the content knowledge. This Bloom's taxonomy as defined by Frehand (2010) includes six cognitive levels of complexity. They are classified into lower thinking levels and higher thinking levels. The examples of lower thinking levels include: remembering. The higher thinking levels are creating, evaluating and analyzing. Strong content knowledge is determined by teacher's ability to explain the subject in a creative way, explains difficult and abstract concepts easily, understand the concepts, theories, laws, facts, and the relationships in the subject he or she teaches. However, the teacher with little or no content knowledge will be unable to explain difficult concepts, he or will leave them out and uses only one way of a teaching strategy that he/she is comfortable with. Confidence in in-depth knowledge

in teachers is important because that will allow the teacher to prepare and plan lessons in different ways that learners will understand.

Pedagogical content knowledge (PCK)

This is the knowledge of presenting content knowledge or subject matter in a way that learners easily understand it. Shulman (1987) defines pedagogical knowledge as the combination of subject content and the presentation of content to a wide range of learners with different learning abilities. Grossman (1990) agree with Shulman (1987) that PCK takes place when a teacher teaches a particular content in a way that is accessible to learners. In the same way, Bertram (2011) outline that PCK is the way in which the teacher makes some arrangements on the content knowledge so that it will be easy for learners to understand it. The teacher can use a variety of teaching strategies that includes illustrations, demonstrations, concepts maps and presenting content in an interesting way. Therefore, this implies that the level of PCK can improve if the teacher explores different kinds of teaching strategies when teaching specific topics.

When Shulman (1986) specifies the kind of content knowledge a teacher needs, he pointed out that teachers need pedagogical content knowledge beyond subject matter knowledge because teachers need to know how to explain mathematical ideas and mathematical concepts. They also need to know the most useful and powerful analogies, give examples, demonstrations, and illustrations. Teachers should know what makes a particular mathematics topic easy or difficult for learners, and learner's mistakes and misconceptions. In this study, the PCK would enable my participants to explore different strategies when teaching specific topics.

Curriculum knowledge

Curriculum knowledge involves an awareness of the way in which topics are arranged both within the school year and over time and ways of using curriculum resources such as textbooks to organize the study for children. (Shulman, 1987, Grossman, 1990, Cogill, 2008). The teachers have been an important part around the world in the schooling system. The quality of education of the country determines the quality of teachers in a country. Deborah L Ball and Bass (2000) analyzed the actual teaching practice of mathematics in relation to the content knowledge needed in teaching mathematics. The role played by content knowledge was one of the important element in their

analysis. The finding suggests that different kinds of knowledge are needed by teachers because it is where they get an opportunity to integrate teaching practices like interpreting learners responses, understanding learners work, teaching and learning uncertainties that might occur and challenges are anticipated. Planning of and deciding about the presentation of the content is taken care of. The way in which the instruction given to learners and the materials used to modify the curriculum are well prepared. This is the important type of knowledge in the South African context because, with the change in curriculum 2003, teachers have to learn the new curriculum with the help of documents such as Curriculum and Assessment Policy Statements (CAPS), and the examination guidelines that were given to teachers.

Knowledge of educational context

Grossman (1990) and Bertram (2011), describes this knowledge as the knowledge that is related to learner's background, school culture, school setting, community and its culture from which learners come from and the location of a school. The knowledge of educational context is the knowledge of factors that have an influence in teaching. These factors can be internal or external factors outside the school. Knowledge of educational context also includes the conditions of the classrooms, the resources available in the school, the classroom sizes etc. Elbaz (as cited in Grossman, 1990) call this knowledge of the milieu of teaching. Knowledge of learner's background is important to the teacher because it helps the teacher to plan lessons accordingly. It also helps the teacher when giving examples of things that learners are familiar with. Availability or the shortage of resources in mathematics classrooms enables the teacher to choose the kinds of activities that will be done with the available resources at that time.

Knowledge of learners and their characteristics

This knowledge refers to the knowledge that the teacher has about the learners in the classroom. This includes the behavior of learners, learner's background and their disciplinary problems (Shulman, 1987). Shulman is the only researcher with this type of knowledge that I think can be the knowledge of educational context because learner's behavior is shaped or is influenced by learner's background. If the teacher understands well the conceptions, misconceptions, motives, and expectations of learners, then the teacher can choose the appropriate teaching styles that will suits students learning and that can allow learners to understand the content better(Shulman, 1987).

Knowledge of educational ends, purposes, and values

Again, Shulman (1987) is the only author with this type of or category of knowledge. Grossman (1990) defines this knowledge as the knowledge that has a component of PCK. In this knowledge, teachers have to know the values and purposes of teaching a subject at a specific grade. Most of the researchers only adapt the three types of knowledge by Shulman (1987), which are content knowledge, general pedagogical knowledge, and pedagogical content knowledge. This indicates that it is important to know and understand the subject content, secondly to know how to teach subject content in a way that learners easily understand the subject content and lastly, to be able to organize, manage the classroom in an effective way. The following paragraphs discuss mathematics knowledge needed by mathematics teachers for effective teaching of mathematics. I discussed this mathematics knowledge considering that mathematics knowledge has a great influence on what teachers teach in the mathematics classroom.

2.4.4 Mathematics knowledge for teaching

Ball, Ferrin- Mundy, Kilpatrick, Milgram, Schmid, and Schaar reach an agreement in the article, Reading for Common Ground in K-12 Mathematics that reads as follows:

“Teaching mathematics effectively depends on a solid understanding of the material. Teachers must be able to do the mathematics that they are teaching, but it is not sufficient knowledge for teaching. Effective teaching requires an understanding of the underlying meaning and justifications for the ideas to be taught, and the ability to make connections among topics (Ball, 2005.p6). These authors wrote in US context but this is relevant also to South African context.

The international research done by Van der Dandt and Niewoudt (2003), in their literature review, they proposed that they are two approaches that focus on teacher’s mathematical knowledge. This approach does not only focuses on the importance of the content of knowledge in 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 the understanding of 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 engage their learners in solving mathematical tasks, and they hardly create productive conversations with their learners.

Effective teaching can be achieved by giving learners an opportunity to explore 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 learner-centred 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 mutual devotion in teachers to work with learners, by involving them throughout mathematics activities. Teachers should know that in each individual learner's mind there is a core mathematical knowledge in which the learner or humans are born with (Henning& Kovacs, 2014).

Apple (1992) discussed mathematics teacher's work from two perspectives; these are political and economic perspective. He suggests that mathematics is seen as a subject that can create 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 transform 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). This knowledge pedagogical content knowledge links to content, students, and pedagogy to form a special kind of teacher knowledge (RAND Mathematics Study Panel, 2003).

Fennema and Franke models of mathematics teacher knowledge

Fennema and Franke (1992) used Shulman's model as a base in discussing the five components of teacher knowledge. These components of mathematics teacher knowledge are knowledge of the content of mathematics, the knowledge of the content of mathematics, knowledge of pedagogy, context-specific knowledge, and knowledge of the concepts, procedures, and problem solving and knowledge of student's cognition. The content of mathematics knowledge includes knowledge of procedures, problem-solving processes within the subject domain and the knowledge of

mathematical concepts. The knowledge of pedagogy is the type of knowledge that includes teaching procedures. Knowledge of student's cognition is the knowledge that determines how students learn and think. The context-specific knowledge includes specific communities where learners live and districts where teachers work, including cultures of the school. This discussion of the five components of mathematics knowledge needed by mathematics teachers could lay a foundation on mathematics knowledge that is discussed in the conceptual framework. This study in particular looks at the kinds of mathematics teachers acquired from JI. I used Fennema and Franke (1992) as the researcher to coin the term mathematics knowledge for teaching.

2.4.6 The state of mathematics in South Africa

In South Africa, the state of mathematics is not good. Spaul (2013) affirmed that South Africa participates in educational achievements internationally. These assessments include Southern and East African Consortium for Monitoring Educational Quality (SACMEQ), Trends in International Mathematics and Science Study (TIMMS), the National School Effectiveness Study (NSES) and Annual National Assessment (ANA).

The SACMEQ tests, SACMEQII (2000) and SACMEQIII (2007) were conducted and the results showed that grade six learners performance in numeracy and literacy in South Africa did not improve over the period of seven years. An extensive body of assessment has discovered the data points to poor performance in mathematics across all level of the schooling system in South Africa (Schollar, 2008, Esor et al., 2009). Spaul (2013) further states that these results were ranging from classroom observation to national representative assessment of mathematics such as SACMEQ, TIMSS and NSES, and ANA.

The TIMMS study clearly showed that mathematics and science in South Africa is still a major problem in grade 10 learners between the year 1995 and 2002

ANA 2011 have also indicated that a number of South African children underperformed in Literacy and numeracy in Primary schools especially grade three and grade six.

In King Cetshwayo District ANA, results have revealed that lower grade (Grade 1-3) performed considerably better in mathematics than higher grades (Grade 4-6). It further stated that 50% of schools in King Cetshwayo score below 50% in mathematics and language in higher grades.

On a study done by Taylor and Vinjevold (1999), Carnoy et al (2012) and Taylor and Taylor (2013), they all got a common finding that a large number of South African mathematics teachers lack a fundamental understanding of mathematics. Likewise, Van der Berg et al. (2011) have noted that differences in content knowledge have an impact indirect way of learner performance in South Africa. In addition, UNESCO (2006) have stressed that many researchers have claimed that teachers find it difficult to help learners with the content that they do not know or understand.

Venkat and Spaul (2015) affirmed that the international literature backed by classroom observation evidence indicates that the content of a subject needs to be presented well. They further suggest that the teacher development activity needs attention so that orientation to a problem solving is used to find unknown information. This orientation will mainly focus on how to do mathematics in ways that are helpful in teaching mathematics as a subject. Shepherd (2013) contends that teacher knowledge is predictable when bearing in mind the richest quintiles of schools in South Africa. Moreover, Venkat and Spaul (2015), conclude by explaining that the differences in Regions and quintiles of school do not necessarily mean that one size fits all PD activity in pre-service and in-service teachers will be useful. The key debate around PD is that a lot of money and time has been spending but there is no or little improvement in teachers practices (Bertram, 2011).

2.5 Conceptual framework

This study draws on two conceptual frameworks namely, Desimone (2009) characteristics of effective professional development and Hill, Rowan and Ball (2005) components of mathematical knowledge for teaching. Desimone (2009) is used to understand the types of PD activities that the intermediate phase mathematics teachers participating in JI engage in. Hill, Rowan, and Ball (2005) conceptual framework is also used in relation to the kinds of knowledge that intermediate phase mathematics acquire through participating in JI.

2.5.1 Desimone's characteristics of effective professional development

Desimone (2009) affirms that teacher professional learning takes place in areas of teaching; they may occur in professional development activities like workshops, or courses, in the teacher's classrooms or in the school communities. Her research reflects some of the characteristics of a professional development activity that is critical to increasing teacher's skills and knowledge for the improvement of teacher practice and for student achievement. According to Desimone (2005), five characteristics make up an effective professional development activity. These characteristics are the content focus, active learning, coherence, duration, and collective participation

2.5.2 Content focus:

Desimone (2009) argues that the most influential feature on teacher learning is the content focus. Skills and understandings are directly related to professional development that focuses on the subject matter content. Content- focused means that prior knowledge of students, related to content and teacher's strategies is considered for the development of new strategies. This feature enables the teacher to solve mathematical problems, to have knowledge of mathematical concepts and mathematical procedures within their classrooms.

2.5.3 Active learning:

Desimone (2009) further maintains that teachers should get an opportunity to engage themselves in active learning in professional development. She views an effective professional development activity as one that allows teachers opportunities not to just sit and listen passively to the facilitator instead they should perform tasks such as engaging in interactive feedbacks and discussions, analyzing students work, being observed and making presentations. Active learning in this study involves teachers to become engaged in meaningful discussions, planning, and practice as a part of the professional development activity.

2.5.4 Coherence:

Another feature of an effective PD activity that Desimone (2009) identifies is coherence. She defines coherence, as what teachers have learned should be similar to other professional development in school, districts, and state policies in terms of knowledge and beliefs. Experiences that are consistency with teacher's goals, assessment standards aligned and other initiatives should

be incorporated in the professional development. In this study, coherence will mean how teachers link what they have learned in different PD for example CAPS workshops and what they have learned in JI.

2.5.5 Duration:

Desimone (2009) asserts that professional development activity requires sufficient time; it can be spread over 20 hours or more of contact time. Research has shown that pedagogical and intellectual change requires long hours spent on the activity. The one-time session will not allow for substantive engagement with subject matter, it should be continuous, not episodic and can also include follow up and learning support.

2.5.6 Collective participation:

Another feature of an effective PD according to Desimone (2009) is collective participation. When teachers from the same school, grade or department collaborate, they are more likely to learn. In professional development activities that include collective participation, there are many opportunities for active learning of teachers. Desimone (2009) is a suitable framework for this study because it provides a phenomenon of an effective type of PD activity. Secondly, it helps in the analysis of research question one: What type of professional development activities do intermediate phase mathematics teachers participating in Jika Imfundo engage in?

2.5.7 Hill, Rowan and Ball's mathematics knowledge for teaching

Mathematical Knowledge for Teaching (MKT) can be defined as the mathematical knowledge that is used by teachers to carry out the work of teaching mathematics (Hill, Rowan & Ball, 2005).

Building on Shulman's work Hill, Rowan and Ball (2005) at the University of Michigan have provided a model that includes six different kinds of knowledge that mathematics teachers need.

They classified the mathematics knowledge for teaching into two categories. These categories are subject matter knowledge and pedagogical content knowledge. Under the Subject Matter Knowledge, there are three types of knowledge, namely: Common Content Knowledge (CCK), Specialized Content Knowledge (SCK) and Horizon Content Knowledge (HCK). The other three types fall under Pedagogical Content Knowledge (PCK). This mathematics knowledge for

teaching mathematics is Knowledge of Content and Students (KCS), Knowledge of Content and Teaching (KCT) and Knowledge of the Content of the Curriculum (KCC).

KCS and KCT are components of PCK that are parallel to Shulman's key components of PCK, those components are knowledge of students misconceptions and difficulties and knowledge of instructional strategies.

The remaining section of this chapter will discuss the above-mentioned kinds of mathematics knowledge building on Shulman's work.

2.5.8 Common Content Knowledge (CCK)

This knowledge refers to mathematical knowledge that educated adults share such as curriculum knowledge. These skills are used in settings other than mathematics teaching, for example, algorithm knowledge that enables the multiplication of two numbers (Ball et al, 2008). This is the knowledge that the teacher tries to develop in their students. This type of knowledge indicates the ability of a teacher to control, maintain and organize the class. This includes the discipline of the class, the class rules, the organization of learners in the classroom, their seating plan, the atmosphere in the classroom as well as the interaction between teacher and the learners (Hill, Rowan & Ball,2005).

2.5.9 Specialized Content Knowledge (SCK)

Specialized content knowledge refers to the mathematical knowledge that the teacher has beyond the curriculum. The example of this knowledge is providing explanations to learners. This knowledge also includes knowledge of mathematics and skills unique to mathematics teaching. The teachers understanding of mathematics topics, what to teach and how to teach a content falls under the process of teaching mathematics. Mishra and Koehler(2006), agreed with Shulman(1987) that teachers who have a good understanding of the subject matter, they can find various ways of representing mathematics and make it easily reached by learners. Mishra and Koehler(2006,p.1026) posit that “teachers must know and understand the mathematics that they teach, including knowledge of central facts, concepts, theories and procedures within a given topic; knowledge of explanatory frameworks that organize and connect ideas; and knowledge of the rules

of evidence and proof". It is the competency of a teacher to plan and manage explanations of topics for learners to relate the model to mathematics understanding.

2.5.10 Horizon Content Knowledge (HCK)

Hill, Rowan, and Ball (2005) hypothesize this knowledge as part of pedagogical content knowledge, and teacher's content knowledge that is necessary to teaching. They viewed horizon knowledge as the knowledge of awareness of how mathematical topics are connected across the curriculum. They contend that horizon knowledge is an awareness of how different mathematics topics are related to each other. The above-discussed mathematics knowledge is regarded as subject matter because they include knowledge of the content of the subject. In this study, teachers should be able to demonstrate the knowledge of concepts and facts in mathematics subject.

2.5.11 Knowledge of Content and Teaching (KCT)

This is the knowledge of how to teach mathematics, how to prepare for the instruction, and mastering the modes of delivering instruction and the knowledge to know how mathematics topics are related or connected (Hill, Rowan & Ball, 2005). The new curriculum recently introduced into South African schools requires learners to participate and express their mathematical ideas in mathematics lessons. This knowledge includes the knowledge of design of instructions, which led to interaction between an understanding of pedagogical issues and mathematical understanding that affects the learning of students. For the learners to be encouraged to contribute to lessons teachers must make sure that their lessons are more learner-centered. Different mathematics lessons require different teaching methods. Teacher's knowledge of the subject matter is not dependent on the correct choice of instructional strategy, but also on the teacher's knowledge of the level of learners understanding (Fennema & Franke, 1992). The success of a teacher in mathematics depends on the depth of pedagogical content knowledge of the teacher because the teacher has to plan the lesson, choose a teaching strategy, and select the content that will suit the learners before the lesson commences. The elements of good instructional strategies should engage learners actively in the lesson, motivate learners to participate during the lesson, assist learners in recognition of their prior knowledge, and create an environment that is conducive to learning and skills for problem-solving in mathematics (Ball et al., 2005).

2.5.12 Knowledge of Content and Students (KCS)

Hill et al., (2008, p.375) define KCS as “content knowledge intertwined with knowledge of how students think about, know or learn this particular content”. According to Fennema and Franke (1992,p.148) “ Knowledge of learners is generally defined as knowing about the characteristics(conceptions, pre-conceptions, misconceptions and learning difficulties) of a certain group of learners, establishing a classroom environment and planning instruction accordingly to meet the needs of these learners”. Learners come to the classroom with preconceptions in their minds about mathematics topics. As they learn, they begin to make connections with what they already know and what the teacher is presenting. Teachers may not be aware of learners experiences brought into class. Learner’s misconception is the wrong information that learners have from their prior knowledge. Teachers themselves may cause these misconceptions if they do not have sufficient subject matter knowledge. Effective teachers may be aware of common misconceptions about a particular topic. This allows them to structure their lesson in such a way that misconceptions are confronted and corrected. The elements of pedagogical content knowledge indicated by Shulman (1986) our knowledge of representations of subject matter, the understanding of student conceptions and understanding of specific learning difficulties. These elements should be used together flexible, because it is assumed that more representations that teachers have, they become better in recognizing learning difficulties. Good knowledge of possible difficulties will enable a teacher to prepare possible explanations and examples of mathematical knowledge that need to be taught.

2.5.13 Knowledge of the Content and Curriculum (KCC)

This is the knowledge about the programs and instructional materials. This knowledge requires the teacher to understand the learning abilities of learners, school plans, national syllabuses examination guidelines, and annual teaching plans. This is the knowledge of what to be taught to a particular grade of learners. Shulman (1987) and Grossman (1990) explain that curriculum knowledge is the knowledge of the curricular programs and materials or topics of a specific subject at any given level or across the grades, but Grossman (1990) classify curriculum knowledge as one of the components of PCK. Likewise, Cogill, (2008) describe this knowledge of the material to be taught to learners at a given level. Curriculum knowledge includes the selection of suitable

curriculum materials to use as well as understanding the key ideas and goals of textbooks and curricular (Shuhua, 2004). This knowledge is very important in the South African context because with the change in curriculum in 2003, teachers had to learn a new curriculum. New curriculum documents were put in place for the teachers to implement them in their classrooms.

The structure below is the illustration of the domains of mathematical knowledge of teaching that are discussed above.

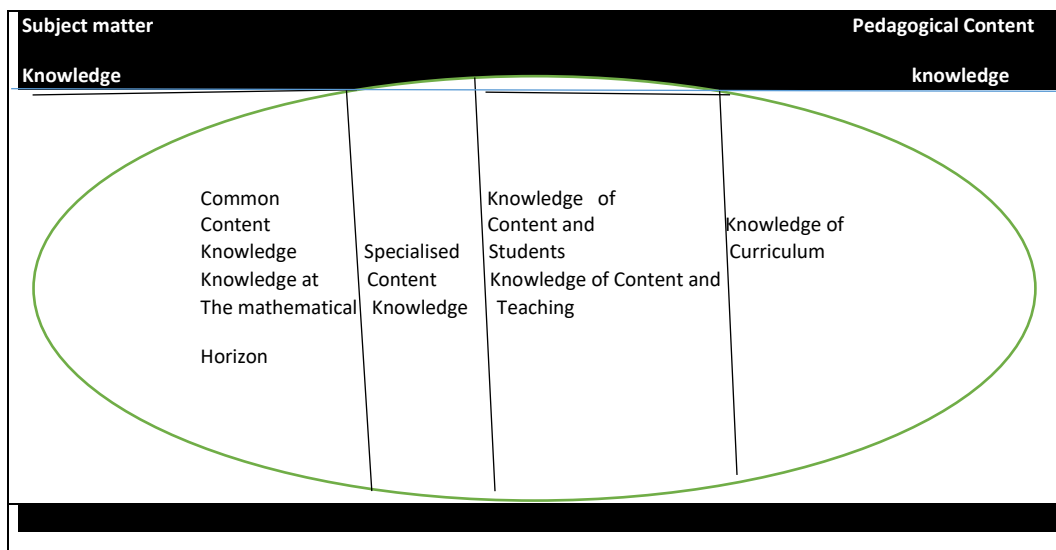


Figure 1: Domain map for the mathematical knowledge of teaching (Hill& Ball, 2009, p.70)

2.6 Conclusion

In this chapter, the notion of teacher professional development was discussed with reference to the work of other scholars in the field. The concepts of teacher learning and teacher knowledge, as well as the types of knowledge needed by teachers in order to teach effectively, were also presented. The chapter ends with a presentation of conceptual 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 3: METHODOLOGY

3.1 Introduction

The previous chapter outlines the literature review based on the on the types of knowledge that intermediate phase mathematics teachers acquire through participating in Jika imfundo. I therefore discussed what is written around teacher professional development issues internationally, nationally and locally. I also elaborated on the types of knowledge that assists teachers to teach and conduct their lessons effectively. In conclusion, I discussed the kinds of mathematical knowledge needed by mathematics teachers. This chapter presents the research paradigm it's ontological and epistemological underpinning, research approach and research design of the study. The data collection methods, sampling procedures, and data analysis is also described. An explanation of ethical issues and procedures followed in this study is then given. To conclude this chapter I describe and justify how I strengthen the trustworthiness of the study and its limitations.

3.2 Research paradigm

A paradigm is defined as a loose collection of rationally linked concepts or propositions and assumptions that guides our thinking about research (Bogdan & Bicklen, 1998). This research study is located within the interpretive paradigm or phenomenological approach since it is qualitative in nature. I adopted interpretive approach because it aims to understand teacher's experiences on using JI as a programme to improve learning outcomes. Its purpose is to explore the kinds of knowledge that the IP mathematics teachers acquire through participating in JI.

The interpretive paradigm helped me to interact with the participants in order to gain information on the types of knowledge that IP mathematics teachers acquire through participating in JI. This paradigm was appropriate for this study because of its strengths specified by Cohen and Mannion(2007) and Guba and Lincoln(1994), which outlines that in the interpretive paradigm the researcher is responsible for data collection and data analysis. Secondly, the researchers are fully engaged with participants and have a greater opportunity to get an insight into the problem that is investigated. Thirdly, the study focuses on the field, and there is a possibility of generating new knowledge that will help future researchers with valuable information for future practices.

Cresswell (2013) points out that in the interpretive paradigm individuals tries to understand the world in which they live in and subjective meanings to their experiences is obtained. Interpretive paradigm, therefore “focuses on people’s subjective experiences, on how people construct the social world by sharing meanings and how they interact with or relate to each other” (Maree 2010, p. 59). Furthermore, Taylor and Medina (2013) maintain that an interpretive paradigm is a humanistic approach aiming at understanding other people’s experiences and cultures. Moreover, Collis and Hussey (2009, p.57) pointed out that interpretivist believe that social reality is subjective and nuanced because it is shaped by the perceptions of participants, as well as the values and aims of the researcher”.

Wisker (2008) and Blumberg (2011) identify three basic principles of interpretivism. These principles are: the researcher becomes the part of what is observed. Secondly, the research is driven by interest and lastly, people construct and give meaning to the social world subjectively. Blumberg (2011)) further argue that the complexity of social phenomenon cannot be explained by simple fundamental laws. The interpretivist claim that objective observation of the social world is impossible, as it has meanings for humans only, and is constructed by intentional behavior and

actions (Livesey, 2011). The nature of reality is multiple, socially constructed and subjective (Mertrerns 2005). The subjective kind of knowledge is what I am expecting to collect from the participants because I value their experiences as individuals, secondly there is no wrong or right answer and lastly, as a researcher, I acknowledge their differences. In interpretive paradigm, knowledge is created in the interaction between researchers and the respondents and the discourse is dialogic, which means communication is transactional.

Ontological and epistemological underpinnings

Maree (2007, p.53) proposes that “the study of the nature and form of reality (that which is or can be known) is called ontology”. He further states that different philosophers define the form and nature of reality or ontology in different methodologies and approaches to research. Qualitative researchers portray reality as socially constructed, which means that no separation can be made from the researcher and the research. Therefore, the truth is not just an objective that occurs independently of the researcher. It maintains that research findings are created and not discovered. In my research study, since I adopted a qualitative methodological approach located within the interpretive paradigm, teachers will construct the reality, as they are responsible for implementing *Jika imfundo* in their classrooms.

Maree (2007) asserts that how things can be known and how physical laws can be discovered and disclosed relates to epistemology. He contends that epistemology, therefore, describes how people know the reality of things, and includes the method of knowing the nature of reality. It assumes that there is a relationship between the known and the knower. “Qualitative researchers believe that the world is made up of people with their own assumptions, intentions, attitudes, beliefs, and values and that the way of knowing reality is by exploring the experiences of others regarding a specific phenomenon-an attempt to see how others have constructed reality by asking about it” (Maree, 2007, p.55). He also argues that the way in which participants construct meaning depends on their experiences.

Qualitative researchers argue that only experienced people about a particular phenomenon that should come with knowledge and the researcher should understand the phenomenon examined through participants meaning of the phenomenon. Therefore, the researcher should allow the participant’s experiences to explain knowledge. Qualitative researchers agree that they do not

decide what is regarded as knowledge, but what participants view as knowledge during the interaction between the researcher and the participant (Maree, 2007). He explains that qualitative researchers conclude by admitting that knowledge is subjective. Burrell and Morgan (1979), and Guba and Lincoln (1989) agree with Maree (2007) about the social inquiry that subjective knowledge produces a subjective relationship between the foundations of inquiry. Maree (2007) contends that in qualitative research, results will not be generalized because of the political, cultural and economic factors; therefore, the findings of this study is not suitable for generalization to other schools who also participate in JI programme due to differences in political, economic and cultural factors of different schools.

3.3 Research approach

Burns and Grove (2003) describe qualitative research as an approach that is systematic and subjective that is used to describe life experiences and situations to give them meaning. In the same way, Parahoo (1997), affirms that qualitative research focuses on stressing the individual uniqueness and focuses on the experiences of peoples. Qualitative research examines the behaviors of people, and the behavior of setting, as this happens naturally, not influenced by a researcher (McMillan & Schumacher 2010).

This research project adopted the qualitative research approach. Qualitative research is suitable for my study because my intention is to conduct the research in the respondent's natural environment, which is the school in which they teach. Secondly, my study focuses on a small group of intermediate phase mathematics teachers participating in JI. Schwandt(cited in Polkinghorne,2005,p.138) states that “ it is the life-world as it is lived, felt, undergone, made sense of, and accomplished by human beings that is the subject of the study” of the qualitative approach. Cresswell (2013), Hatch (2002), and Marshall and Rossman (2011) describe the characteristics of qualitative research. They say it is usually conducted on a natural setting such as classrooms, schools and sports field. The researcher becomes the key instrument; they collect data for themselves through interviewing participants, examining documents and observing behavior. They do not rely on questionnaires or instruments developed by other researchers. They rely on multiple sources of data; they gather data from interviews, observations, audiovisuals, and documents. The researcher throughout the research process focuses on learning the meaning of the participant that

the participants hold about the problem. The researcher tries to develop a complex picture of the issue under study.

Qualitative research aims to explain the social phenomenon in a natural setting (Suter 2012). Similarly, Creswell (2013) concurs and agreed with Suter (2012) that one of the characteristics of qualitative research is that it takes place in a natural environment. It gives the participants a chance to share their stories and letting them or their voices heard. Polkinghorne (2005) also defines qualitative research as the type of research that clarifies and describes human lived experiences. Since this study explores the kind of knowledge that the IP mathematics teachers acquire through participating in JI, this approach suits well. He further asserts that in qualitative research information is gathered by means of spoken or written words. Interviews with participants, observations, and documents are the sources of data in qualitative research.

Specifically, this study aims to find answers from the participant's views on the following research questions:

1. What types of professional development activities do intermediate phase mathematics teachers participating in Jika Imfundo project engage in?
2. What kinds of knowledge do intermediate phase mathematics teachers acquire through participating in Jika Imfundo project?

3.4 Research design

According to Creswell (2003), there are many strategies of inquiry used in the qualitative approach; these are ethnographies, phenomenologist, narratives, grounded theory or case studies. The research design used in this study is the case study. According to Beglar, Murray, and Education (2009, p.48), a case study is an “in-depth study of a specific individual or specific context or situation”. The case being explored in the study is the intermediate phase mathematics teachers participating in Jika Imfundo project. Case studies are classified into three types (Yin & Merriam, cited in Cohen et al, 2011). These types are an exploratory case study, descriptive case study, and explanatory case study. In this study, the exploratory case study was employed because it examined the contribution of the JI project in teacher knowledge in the participant's school. Many researchers describe a case study in different ways. Merriman (1988) defines a case study as a bounded system. Similarly, Bromley (1990) defines a case study as a systematic inquiry that

aims to describe and explain the phenomenon of interest that is in this study the contribution of the JI project in teacher knowledge. On the other hand, Yin (2003) defines case study research as an empirical inquiry that aims to investigate a contemporary phenomenon. He also describes a case study as an approach that can be used to investigate an event or an incident under study.

Maree (2010) maintains that “from an interpretive perspective, the typical characteristic of case studies is that they strive 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 identifies that case studies offer an opportunity for a researcher to have multi-perspective analysis, which is the voice and the participant’s perspectives on the situation so that the deeper understanding of the dynamic of the situation will be attained. Cohen et al. (2011) suggest that in order to enable the public to have a good understanding of the idea, case studies provide examples of real people in real situations. Cohen et al. (2011) support Yin’s view that many variables can be found in one case study, meaning that data collection tools must be more than one and many sources of data are needed. In my research study, the exploratory case study is adopted because it examines the contribution of the JI project in teacher knowledge at a primary school. Yin (2003) identifies the differences in case studies; there are single and multiple case studies. In this study, a single case study was adopted because the interest was on exploring the types of knowledge that the intermediate phase mathematics teachers acquire through participating in JI and how does that knowledge influence their practice in their school as a research site. The

Strengths of a case study

Maree (2011) contends that one of the strengths of the case study is the use of more than one source and techniques of the process of gathering data, and the researcher decides on time about the evidence to gather data and the ways of analyzing data as to answer the research question. It uses various instruments of data collection such as interviews, surveys, observations and documentation review. Cohen, Manion, and Morrison (2011) contend that a large number of people can understand the results of a case study since it is written in a language that is understandable to them. The case studies contain reality and the aspects that cannot be contained in a large scale data. They offer us a deep understanding of the phenomenon under study. They help in explaining other cases. Only one researcher can conduct research without the help of other researchers. High

validity of concepts context and processes, as they link to causes and outcomes can be maintained in a case study (Denzin & Lincoln, 2013). Case studies help in the development of new research questions and new hypotheses.

Maree (2010) maintain that “from an interpretive perspective, the typical characteristic of case studies is that they strive 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 also contends that researchers use a case study in order to answer the how and why questions. Cohen et al., (2011) suggest that in order to enable the public to have a good understanding of the idea, case studies makes example of real people in real situations. Cohen et al., (2011) support the Yins idea that many variables can be found in one case study meaning that data collection tools must be more than one and many sources of data are needed.

Weaknesses of a case study

Maree (2007) identifies that “criticism of case study methodology is frequently leveled against its dependence on a single case and it is therefore claimed that case study research is incapable of providing a generalizing conclusion” (p.76). Correspondingly, Cohen, Manion, and Morrison (2011) mention that it is not easy to generalize the results of a case study, they can only be generalized in situations where the researchers see their relevance or application, cross-examination cannot be easily done, therefore they can be biased, personal and subjective. The observer, in this case, can also be biased. Case studies are also criticized for not being severe and strict (Zainal, 2007) since they employ small numbers of subjects in some cases, they are not very supportive in scientific generalization. Case studies are described as the methodology that consumes a lot of time and not easily conducted.

3.5 Research setting or context

The research site was located in Kwa-Zulu- Natal Province, King Cetshwayo District. The school is in the deep rural area falling under quintile one due to its geographical demarcation. The community of this area is experiencing socio-economic conditions since they are employed in agricultural sectors whereby they are being paid low wages. Most of the parents in this area are illiterate in such a way that they are unable to help their children with their homework and they do

not want to interfere in their children's education. Learners are not exposed to mathematical practices at their homes. Learners in this school are not performing well especially in mathematics in the intermediate phase. For the purpose of the study six teachers teaching mathematics in grade four, grade five and grade, six were selected at different schools participating in JI. Mathematics is one of the subjects that the JI project focuses on.

3.6 Sampling procedures and data sources

Maree (2007) contends that sampling is a selection of a person or group of people with the aim of getting information or uses them as sources of information for the study. McMillan and Schumacher (2014) explain that a sample is a group of subjects selected from a large population for the purpose of data collection. In this study, the sample was intentionally selected for answering the research questions. Teddlie and Yu (2007) referred to this type of sampling as purposive sampling. It occurs when subjects are carefully selected from a population to represent the topic that is being studied (McMillan & Schumacher, 2014). There are different types of purposive sampling; these are homogenous samples, heterogeneous samples, deviant samples, intensity sampling, stratified sampling, and typical case sampling. The type of purposive sample that was employed in my study is the homogenous sample. Richie and Lewis (2003) assert that a homogenous sample helps to provide an in-depth image of occurrence, and allows for in-depth examination of social activities. The homogenous sample was suitable for my study because six intermediate phase mathematics teachers teaching at different schools participating in JI project was selected based on the topic that was studied; they were selected because the JI project was implemented at their school.

These teachers were selected irrespective of their gender, age, and qualification as long as their schools participated in JI and as long as they provide me with data as much as they can. The data that was collected from them will indicate whether they learn and acquire knowledge from the JI project or not. The sample size is considered less important in qualitative research, only the depth and richness of the data that is required (Njie& Asmiran, 2014). However, Cohen et al (2000) contend that the number of participants in the study assists in a variety of perspectives on the topic being studied. Probability and non-probability are the two main categories of sampling techniques (Cohen et al., 2000). Qualitative research usually adopts non- probability sampling (Ploeg, 1999).

Cohen et al (2000), affirms that there are six types of non-probability sampling. These are the dimensional, the snowball, the convenience, and the purposive sampling.

Non- probability sampling was employed in this study. Probability sampling is based on random sampling where everyone has an equal chance of being selected. The examples of probability sampling are random sampling, stratified sampling, systematic sampling, and cluster sampling. Cohen et al., (2011) asserts that nonprobability sampling focuses on a group which does not represent the wider population. The examples of non-probability sampling are snowball sampling, purposive sampling, quota sampling, and convenient sampling.

3.5 Methods of data collection

In a case study research approach, there are six major methods of collecting data. These methods are documented analysis, observations, archival records, research diaries or journals; physical artifacts and interviews (Njie & Asimiran, 2014). Two data collection methods were used in this study; these are research interviews and document analysis. Njie and Asimiran (2014) suggest that one or more of the methods of data collections mentioned above can be used depending on the nature and relevance of the case. Data gathering in qualitative research is done for providing evidence for the experience of the phenomenon under study (Polkinghorne, 2005). According to Yin (2014), there are four principles of collecting data in a case study research. These principles include the creation of a case study database, the use of multiple sources of evidence, being cautious when using electronic data sources and the maintenance of a chain of evidence.

3.5.1 Interviews

Maree (2007, p.87) defines interview as “a two-way conversation in which an interviewer asks the participant questions to collect data and to learn about ideas, beliefs, views, opinions, and behaviors of participants”. Similarly, Connell and Khan (cited in Cohen et al.,2000,p.269) defines interview as” a two-person conversation initiated by the interviewer for the specific purposes of obtaining research relevant information, and focused by him on content specified by research questions”. Marshall and Rossman (1989) maintain that in the interview process the interviewer and the interviewee interact with an aim of collecting reliable and valid data. The interviewer clarifies the questions that are not easily answered during the interview, probes further and more deeply (Brynard, Hanekom & Brynard, 2014).

Cohen et al (2000) suggest that for research data collecting instruments, four types of interviews may be used. These are the non- directive interviews, focused interviews structured interviews and unstructured interviews. Gill, Steward, Treasure, and Chadwick (2008) call non- directive interviews as semi-structured interviews and this appears to be what Cohen et al (2000) referred to it as no- directive interviews. The semi-structured interview was used in this study. Ploeg (1999) stated that if the researcher has an idea of the research questions to ask on the phenomenon under study, then the semi-structured interview could be conducted. For the study the semi-structured interviews were conducted at primary schools about the professional development activities that IP mathematics teachers engage in, and also the types of knowledge they acquire in the JI project. Semi-structured interviews allowed me to attain in-depth information about the types of knowledge that mathematics teachers acquire through participating in JI from teachers themselves. The use of probing more deeply in interviews if their answers are not clear helped me, in order to get an in-depth understanding of the phenomenon under study. Clarity on the questions that the participants do not understand was given and the follow-up semi-structured interviews were done. The interviews were conducted after school and lasted about an hour. The interviews were video recorded, to ensure that the views of the participants were captured accurately.

Marshall and Rossman (1989) outline the strengths of interviews. They say interviews can be used to obtain a lot of information in a short period of time in a particular place. Mertens (2005) asserts that interviews allow the development of a relationship between the interviewer and the participant and they allow flexibility with the interviewee. Marshall and Rossman (1995) maintain that a limitation of interviews is that a participant may not give adequate information that the interviewer was hoping to get. In addition, people may not be willing to commit themselves to tell the whole truth (Brynard et al., 2014). The researcher may also fail to ask a question due to the language barrier problem or due to the lack of questioning skill in the researcher. Boyce and Neale (2006) contend that interviews may take a long time for the interviewer and the interviewee and they are expensive, and they can provide answers that are biased. They further suggest that the results of the interviews cannot be generalized.

3.5.2 Document analysis

The second instrument that was employed in my research study documents analysis. A document could be explained as evidence of a process (Cohen, Manion & Morrison, 2011). Document

analysis was chosen as a data collection instrument because Jensen (2000) affirms that it is a cheap method of collecting data. He explains that one of the strengths of the document analysis is that it provides crucial data on historical trends, and the researcher may have access to the data when required. One of the limitations of document analysis is that they are time-consuming, and you cannot guarantee its authenticity. To supplement the information gathered from the interview I employed document analysis. I analyzed the following documents to check whether teachers have engaged in different professional development activities and whether they have acquired different types of knowledge: JI lesson plans, lesson trackers, learner's activity books, mark sheets, and other JI documents.

Document analysis is suitable for my study because it will confirm the data given by the teachers during the interview and it will confirm that the teachers at the school implement JI. The documentary analysis includes the review of current documents in order to clarify deeper meanings, which might be shown by their style. The two types of the documentary are the primary and secondary documents. Primary documents relate to eyewitness and people create secondary documents (Mogalakwe, 2006). Bowen (2009) affirms that document analysis can save time compared to other data collection methods. An important strength of carrying out document research is that the researcher can get information that could not be easily found in other methods. 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).

3.7 Data analysis

Cohen et al(2011) state that data analysis includes “organizing, accounting for and explaining the data, making sense of data in terms of the participants' definitions' of the situation, noting patterns, themes, categories and regularities”(p.537). Data analysis in qualitative data begins in early stages and it is an ongoing process throughout the research (Bradley, Curry, and Devers (2007). To attain the understanding of data the researcher should read the data several times so that it will be easy for the researcher to identify the themes that may emerge from the data. I read the data (transcribed data) several times and came up with themes emerged from the data, thereafter I did coding and labeling. This allowed me to quickly retrieve gathered data in its themes.

Qualitative research emphasizes the inductive and deductive data analysis, going from specific to general. Inductive analysis explained by Taylor and Gibbs (2010) takes place when the researcher assigns emerging themes into codes. That is what I did with my collected data. Other authors 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, by the way, the prior coding takes place, which is deductive coding in nature. Data analysis occurs at the same time as data collection (Holloway & Wheeler, 2002). When codes are assigned into themes, emerging from data is called descriptive coding (Taylor and Gibbs, 2010). They contend that the higher level of analysis involves analytical codes based on the researcher's analytical thinking. Conceptual framework or theoretical framework needs to be considered in data collection and data analysis (Yin, 2011). My conceptual frameworks were Desimone (2009) effective professional development and Hill, Rowan and Ball (2005)(adapted Shulman's (1987)categories of teacher knowledge) I use them to conduct the data analysis. Both deductive and inductive analysis was conducted. I analyzed the themes to understand the types of knowledge that intermediate phase mathematics teachers acquire through participating in JI. To locate the new data into pre-existing data, I compared and contrasted the findings of the study with related research findings (Baxter& Jack, 2008).

3.8 Ethical issues

Ethical considerations related to the moral standards that the researcher should consider in the process of research. Gardner(2011,p.5) contends that “ ethics must be observed and individuals should be treated fairly, sensitively with dignity and within an ethic of respect and freedom from prejudice regardless of age, gender, sexuality, race, ethnicity, class nationality, cultural identity, partnership status, faith, disability, political belief or any other significant difference”. In order to gain access and be able to do research with teachers, a researcher could apply and obtain ethical clearance from the appropriate research committee in higher education institution (Cohen et al., 2011; Maree, 2007). I applied for ethical clearance certificate and I got the approval from the university in order to conduct research. Permission from the Department of Education to conduct research in schools was obtained.

Maree (2007), Curtis et al. (2014) and Cohen et al. (2011) affirm 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 purpose of my study to the participants in writing before the study. I then request their written consent to participate in a study. I also make them aware that their participation is voluntary and they can withdraw at any time if they no longer want to participate. Maree (2007) and Curtis et al. (2014) identify confidentiality as one of the issues that need to be addressed when doing research. This means that any information given by the participants is not to be disclosed or shared with other people. I make sure that the information was stored in a safe place in my supervisor's office in the university for a period of five years. I make the participants aware that the only person who has access to their information is my supervisor. McMillan and Schumacher (2014) assert that anonymity can be guaranteed by not knowing who gave the information that the researcher is inspecting. Different names or pseudonyms should be given to participants, and the place where the research study takes place should be given another name. As a researcher, I followed all the rules and procedures of conducting research that is free of harm. Creswell (2002,p.13) affirms that “ in order for a researcher to conduct research in an ethical manner, s/he must respect the rights of the participants, honor the research sites visited and report the research fully and honesty”. Therefore, the element of trust is very important when doing research.

3.9 Trustworthiness

Leyden, Moskal, and Pavelich define trustworthiness as “how we determine whether we have accurately described the settings and events, participants perspective information” (2004, p.66) Maree (2010) contends that the trustworthiness of a study could be achieved by using various methods to collect data. Guba and Lincoln (1994) standards were adopted in this study for the purpose of qualitative inquiry evaluation, in order to collect and present data. Hardy and Bryman (2004, p.273) pointed out “trustworthiness is made up of four criteria/ standards by Lincoln and Guba”. Only three main standards were used in the study these are Credibility, conformability, and trustworthiness.

3.9.1 Credibility

Credibility refers to “the extent to which the data or the findings reflect the reality and lived experiences of participants (Maree, 2007). Hardy and Bryman (2004, p.30) assert that “credibility is defined as how believable the findings area”. Maree (2007) concurs with them when he elaborates that believable and convincing findings are what is expected from the researcher. To

strengthen the research findings, the audio tapes were recorded during an interview, which gives authenticity to data, and the notes were taken during the interview process.

3.9.2 Conformability

Conformability refers to “neutrality or objectivity of data” (Pilot et al 2001, p.315). Research findings should duplicate the research problem and the participants, it should be confirmed by another study (Casey& Murphy, 2009). This means that the findings should not be the researcher’s assumptions and misconceptions. To ensure the conformability I was fully aware of my position as post level one educator and my school is participating in the JI project, to avoid biases I stick to my research questions and my research topic. According to Miles and Huberman (1984), the researcher must adopt the standard of neutrality concerning the research under study.

3.10 Limitations of the study

The aim of this study was to explore the types of knowledge that IP mathematics teachers acquire through participating in the JI project. Qualitative research suits well in this study because its aim is to study people’s experiences in their natural environment. This was a small- scale qualitative case study research, its findings would not be generalized to other context but limited to participants schools involved during research.

3.11 Conclusion

In this chapter, I present the research paradigm its ontological and epistemological underpinning, research approach and research design of the study. The data collection methods, sampling procedures and data analysis was also described. An explanation of ethical issues and procedures followed in this study was then given. In conclusion, I this described and justified how I strengthen the trustworthiness of the study and its limitations.

CHAPTER FOUR: PRESENTATION OF FINDINGS

4.1 INTRODUCTION

This chapter is a presentation of the data gathered from six teachers in King Cetshwayo district. As explained in chapter three, the purpose of this study was to explore the kinds of knowledge that the Intermediate Phase Mathematics teachers acquire through participating in Jika Imfundo. To answer my research questions I interviewed six teachers and analyzed their documents. The documents that I analyzed are trackers, lesson plans, assessment record, monitoring plan for the HOD, effective curriculum management document, class visits and one- on- one meetings plans. The data gathered was coded and categorized into themes. I used pseudonyms for the protection of the identity of the participants and to guarantee their confidentiality and anonymity. For their voices to be heard, I have used direct quotations from the interviews. The research questions guiding this study are as follows:

1. What types of professional development activities do intermediate phase mathematics teachers participating in Jika Imfundo engage in?
2. What kinds of knowledge do intermediate phase mathematics teachers say they acquire through participating in Jika Imfundo?

At the beginning of this chapter, the profiles of the participants are presented and described according to their gender, age, qualifications particularly in teaching mathematics and their teaching experience. The description of the types of activities that teachers engage in, in Jika Imfundo as well as the kinds of knowledge that these teachers acquire from Jika Imfundo is then classified. To conclude, this chapter discusses what the data revealed regarding the implementation of knowledge acquired in the school context. The data were presented according to the research questions that the study aimed to address.

4.2 Participant's profiles

Participant1: Erick

Erick is a male teacher, between 30-39 years. His highest qualification is a university Diploma in Teaching in the intermediate phase (Grades 4 – 6) obtained from a local university. One of the major subjects he did in the university was primary mathematics teaching. He has twenty-three years of teaching experience of which thirteen years of teaching mathematics at grade 4 to grade six. He is the teacher who has attended Jika Imfundo workshops for the past two years from 2017, and he attended five contact sessions. At the time of the data collection of this study, he was teaching mathematics in Grade five.

Participant 2: Jack

Jack is a male teacher between the ages of 40-49. He is the acting Head of Department (HOD) in the Intermediate and Senior Phase. He studied for a teaching diploma through one of the universities found in South Africa and then continued to Advanced Certificate in Education (ACE) in Mathematics. Jack has taught for twenty-seven years in the intermediate phase (grade 4-6). When asked why he chose to teach mathematics, he expressed that *“I chose to teach mathematics for the fact that I like to work with numbers and to solve mathematical problems”*. Jack said that after they were told to attend Jika Imfundo contact session, he was interested to attend just to see what is new in the programme that will help him to attain new knowledge for the benefit of his learners.

Participant 3: Girly

Girly is a female teacher between 30-39 age categories. She studied Bachelor of Education (B.Ed.) at University, and then proceed to enroll for a B.Ed. Honors in Education Management Law and Policy. Her teaching experience was twelve years. She teaches social sciences, life skills and mathematics. She has been teaching at the same school for twelve years. When she was invited to attend Jika Imfundo sessions, she was very excited because in her tertiary level of education she didn't do mathematics as a major, so she was worried about her teaching strategies whether she was doing the right thing or not. She believes that this programme will equip her with suitable skills and strategies for teaching mathematics.

Participant 4: Lizzy

Lizzy is a female teacher in the age category of between 30-39 years, with a teaching experience of thirteen years. Before she was trained as a teacher, she went to the university to do a Degree in Integrated Management Sciences (IMS), which had nothing to do with teaching. Lizzy then enrolled with the same university again and got Post Graduate Certificate in Education (PGCE) in Business Studies and Economics. She teaches mathematics at this school from grade four to grade seven. Lizzy attended Jika Imfundo programme from 2015, and she didn't eager to attend because she believes that these sessions will be a waste of time, she was satisfied with the knowledge she has.

Participant: Angie

Angie is a female teacher between the ages of 40-49 with a teaching experience of about twenty years. She studied for a Senior Primary Teaching Diploma (SPTD) in the University. She then studied towards B.Ed. Hons and her specialization were on inclusive education. Currently, she was teaching language (isiZulu) from grade four to grade seven and mathematics in grade four. Angie said that after they were told about Jika Imfundo programme, she was interested to attend because she hoped that this programme would assist her in receiving new knowledge and skills so that she will be able to teach her learners effectively. She expressed her feelings that she likes to work with young children especially those in grade four. She was not trained to teach mathematics at Primary school but due to a shortage of teachers, she was given mathematics in grade four and grade five.

Participant 6: Ben

Ben is a male teacher in the age category of between 20-29 years, with a teaching experience of four years. His qualifications are Bachelor of Education and B.Ed. Honors both obtained from the University. He is currently teaching mathematics in grade four and it is his second year teaching mathematics in this school at this grade without mathematics qualification. He also teaches social sciences in grade seven, and he has majored with it in his tertiary level. During our interview I asked him why he chose to teach mathematics, he said there was no one to teach it because of the shortage of teachers through Post Provisional Norm (PPN).

4.3 Presentation of Findings

In this section, I present the findings of my study according to two research questions this study seeks to answer. I analyzed the themes according to key research questions. The following paragraphs are the discussion of themes that emerged from the interview for the first research

question. “What types of professional development activities do Intermediate Phase mathematics teachers participating in Jika Imfundo engage in”

4.3.1 Professional development activities teachers engaged in

In this section, I explain the activities that participants in this study said they engaged in Jika Imfundo during interviews and document analysis. Teachers mentioned that some of these activities took place outside the school, and some inside the school. The activities that took place outside the school were training/ workshop; cluster meetings and departmental meetings. The findings revealed a number of activities that took place inside the school, namely, coaching or mentoring; one- on –one meeting; subject phase meetings and reflection. In the following paragraphs, these activities were discussed starting with activities, that teacher participated outside the school, as they are the identified themes.

Training workshops

All six teachers who participated in this study mentioned training workshops as a key activity they engaged in Jika iMfundo. They mentioned that the ward circuit managers together with the subject advisors called the workshops since Jika Imfundo was the campaign, which was aimed at improving curriculum coverage and curriculum management leading to better learner outcomes.

Subject advisors organized the workshops where one subject expert facilitated the learning process. Teachers attended these workshops at the central venue that is accessible to all schools in that ward. The workshops were called once a term and lasted for two to five days, usually starts from 08: 00 am to 14: 00 pm. The ward where this study was conducted consist of twenty-eight schools. This is what John said when asked about training workshops:

We just received circulars at the beginning of each term inviting the HOD and one subject teacher to a training. These workshops are conducted at a venue where all teachers can easily attend. We usually attend for one to five days depending on the work that we supposed to do. Two people per school was invited to attend, HOD for Mathematics or one Subject Head and the mathematics teacher preferably the teacher who was confident in the content for the phase and subject).For the whole year the teacher and the HOD have to attend four times (once per term). The participants in this study mentioned that there were some workshops that they missed due to communication breakdown because the circulars were forwarded to the Principals of the schools and they forgot

to pass them to teachers. Five out of six participants have attended more than five workshops only one participant attended only four workshops in different years. Girly have missed some training workshop, she complained:

I have missed two important workshops. We did not receive the circular on time. I think the circuit office should try other means of invitations to teachers, for example, they should use telephones, emails and other forms of communications because hard copies did not reach us on time.

In analyzing the activities teachers said they did, it is clear that the focus of the workshops differed. Most of the workshops the participants said they attended mainly dealt with the following issues: the use of tools provided by Jika Imfundo, learner problems where teachers were trained on how to deal with the different types of learners and their conceptions and misconceptions on different mathematics topics. Teachers mentioned that they were taught the content of certain sections that are identified as problematic to teachers and learners by district subject advisors after reviewing the assessment results for the previous term. They were also taught how to cover the curriculum looking at time allocation for mathematics per topic, per grade. Ben mentioned that he was given professional help in the training workshop:

We observed how to teach particular content to different types of learners. We also learn how to organize learners in the class for example in groups and individuals.

The figure below is an example of a training workshop programme. All the six participants said the training problem differs according to the activities that they did, but the example below is an example of how they are structured. This structure shows all the activities that will take place in the workshop. This training workshop was on how to use trackers, and the content knowledge that the teachers learned about was on fractions. Five out of six participants mentioned that they were having a problem in teaching fractions but after attending the training, they acquired skills on how to teach fractions effectively.

Jack mentioned that in the workshop, they understand very well what they supposed to do in the classroom but it is not easy sometimes:

The challenges that we faced in Jika Imfundo training workshop is that during facilitation it appeared to be easy to implement what we have learned, but practically it is challenging because we are teaching different learners from different backgrounds.

Secondly, there is a contradiction between Jika Imfundo and Curriculum Assessment and Policy Statements (CAPS) when it comes to assessment. The CAPS subject advisors and Jika Imfundo facilitators seem to have different opinions because when they come to school they want to see what they have taught and tools they provided which are not the same. Erick reported

I was in trouble the other day when the CAPS subject advisors visited our school. I have followed the program of assessment that Jika Imfundo provided us in the trackers. They even mentioned that I should use the program of assessment that they gave us I was confused because their assessment programs are slightly different from each other.

Programme

3 hours

Session 1: Focus of workshop and a recap of using the trackers	15 minutes
Session 2: Fractions across the grades according to CAPS	30 minutes
<ul style="list-style-type: none">• Key concepts• Prior maths knowledge needed• Use of fractions in further areas of knowledge• Diagram to show progression across the grades• Important clarification notes from CAPS	
Session 3: What you teach is not always what is learnt!	60 minutes
<ul style="list-style-type: none">• Different kinds of knowledge <i>10 minutes</i>• Case Study of a Grade 6 teacher <i>30 minutes</i>• Limited teaching can limit understanding <i>25 minutes</i>	
Session 4: Solve problems without using rules	25 minutes
Session 5: Sequence of activities	25 minutes
<ul style="list-style-type: none">• Diagnostic test• Common fractions• Decimal fractions• Percentages	
Session 6: Reflection and evaluation	20 minutes
<ul style="list-style-type: none">• Summary and reflection • PILO Evaluation of workshop	

PILO workshop for Grade 4 – Grade 7 Mathematics developed by COUNT, 2016

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Figure 2: Example of a workshop programme (Adapted from Just- in –Time Training workshop for Term one (2016)).

Teachers also said in the workshop they were taught how to use Jika Imfundo tools. They said they were given activities that trained them on tracker usage. For example, the facilitator asks them to look for the pages of the tracker that deals with the textbook they use at school. Secondly, they had to identify the tracker pages that deal with a certain week and check that they know what each column refers to or mean. Thirdly, they had to find the pages of the textbook that they need for a particular week. They must also be able to plan where they will find the pages of the Teacher Guide (TG) and Departmental Workbooks (DBE) as well. Lastly, teachers said they were also told

how to use clarification notes that gave them clear and useful tips and methodology to use with examples. However, the teachers said, they were facing challenges in executing the tasks that are set in the tracker. They said the tracker told you what to do at what time or day, not incorporating the learners' pace.

All participants mentioned that the Jika Imfundo facilitators taught them that the purpose of the tracker is to provide classroom management tools. It also provides daily tracking to plan and check teachers pace. Make links to CAPS and work schedules. Also links textbooks and DBE workbooks. It gives guidance on the resources that the teacher needs in the classroom. It provides assessment record sheets for the formal assessment required by CAPS. The review and reflection and reflection tools to support teachers in teaching are also made available in the tracker.

Angie mentioned that when they received the trackers she was confused about how to use it:

I did not understand how to use the tracker when the Principal gave us trackers after collecting them in the circuit office. My eyes were opened in the training workshop, they taught us every step we had to follow when using trackers, and it is very easy now to use it.

All of the participants also explained that the tracker helped them to plan and prepare lessons and to manage their time well and to cover the content of the curriculum sequentially. Lastly, it helped them to complete the formal assessment required.

The following structure is an example of a mathematics tracker that they used during training.

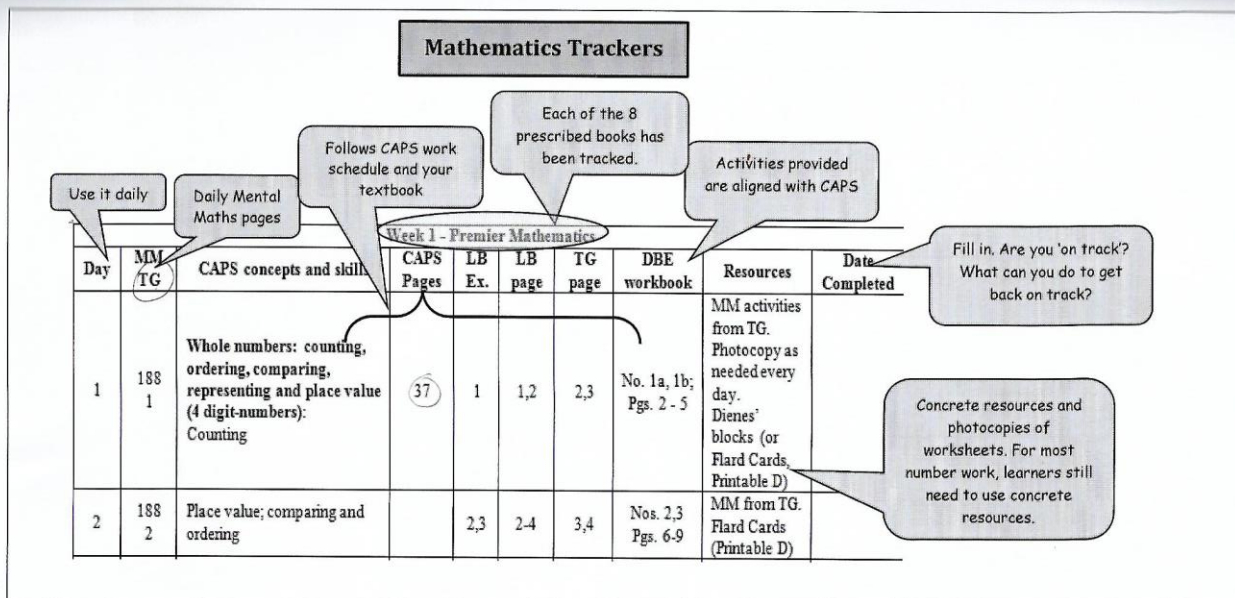


Figure 3: Mathematics tracker

Teachers also mentioned that some training workshops focus on content where they are taught a particular mathematics content that seemed to be problematic to teachers and learners. During document analysis I found that there was a training workshop that was held on 2016 Term one, the content focus of the training was on the teaching of fractions. Teachers said they were taught about the conceptual knowledge of fractions, the use of apparatus and diagrams such as fractions shapes, fraction diagrams, fraction walls fraction strips, problem-solving, rules, and calculation techniques. Regarding the content knowledge, Angie echoed her feelings when asked about what is interesting in the training workshop,

I have learned a lot from the Jika Imfundo training workshop, in fact, I learned everything. At the University, I did not do mathematics as a major subject since at high school I was doing History. I did not think of teaching mathematics, but due to the shortage of teachers, I was given a chance

to teach it. I was not confident of teaching it at first for the fact that I did not have sufficient content knowledge, but Jika Imfundo took us step by step and I was lucky to be chosen to attend Jika Imfundo training, their documents are very helpful.

Angie felt that she learned a lot from Jika Imfundo. She explained that she benefited a lot since she did not do mathematics at a Tertiary level. She said she learned from professional development activities that took place outside the school as well as those that took place inside the school. The figure below is an example of how to teach fractions in Grade 4 and Grade 5.

Session 4: Solve problems without using rules

1. The facilitator will discuss Mrs Pieterse's examples.
2. Work with a partner. Choose 4 questions from a grade and work them out together without using rules. Explain how you do them.
3. Use the textbook used in your classroom for the grade you teach. Find examples of these types of problems to solve.

Grade 4 (see CAPS page 121)

Meaning of a fraction	Examples of problems
Part of a whole where the whole is a single object	Susan eats two eighths of a chocolate bar. What fraction of the chocolate bar is left? Show your answer in a drawing.
Part of a whole where the whole is a collection of objects	Five friends share 21 chocolates equally. How many chocolates does each person get?
Relationship	Barry earns a third of what his father earns per hour. If his father earns R267 per hour, how much does Barry earn per hour?
Ratio	$\frac{2}{5}$ of a cup of milk is needed to make one batch of biscuits. How many cups of milk are needed to make 5 batches of these biscuits?
Comparator	What is the longest? $\frac{2}{5}$ of a metre or $\frac{1}{4}$ of a metre?
Unit of measurement	I need $1\frac{2}{5}$ m material to make a shirt, and I have 45 m. How much material do I still need to buy?
Number	Name two numbers between $4\frac{1}{2}$ and 5.
Fractional parts put together to make a whole (iterative – repeating)	After a game, 55 athletes get $\frac{1}{2}$ of an orange each. How many oranges are needed for the 55 athletes?

Grade 5 (see CAPS page 211)

Meaning of a fraction	Examples of problems
Part of a whole where the whole is a single object	Susan eats $\frac{1}{3}$ of a chocolate cake. Another $\frac{1}{4}$ is given away. How much cake is left over?
Part of a whole where the whole is a collection of objects	A wall has 124 panels. A painter paints $\frac{1}{3}$ of these panels. How many panels has he painted? How many panels must still be painted? Or Sue uses $\frac{2}{3}$ of an apple to make a cake. If she has 30 apples, how many cakes can she bake?
Relationship	The daughter earns a quarter of what her father earns per hour. If her father earns R267 per hour, how much does the daughter earn?
Ratio	The recipe says that for every 2 cups of sugar, $\frac{1}{4}$ cup of butter is needed. If 50 cups of sugar are used; how many cups of butter are needed?
Comparator	What is the longest? $\frac{6}{9}$ metres or $\frac{2}{3}$ metres of a strip of material?
Unit of measurement	How many $\frac{1}{3}$ of a metre is there in $5\frac{2}{3}$ metre?
Number	Give a number that is greater than $3\frac{2}{3}$, but less than $3\frac{11}{12}$
Fractional parts put together to make a whole (iterative – repeating)	35 children get cool drink. If each child gets $\frac{2}{11}$ of a bottle of cool drink, how many bottles are needed to serve all the children?

Figure 4: An example of teaching of Mathematics content learnt in the training workshop

Teachers also said they are trained on how to teach different types of learners considering their conceptions and their misconceptions in different topics. Participants mentioned that the facilitators emphasized the importance of knowing your learners as a teacher. When Girly asked about misconceptions that learners usually have she replied:

“Learners misconceptions are very problematic because that piece of wrong information that arise from learners is not easily removed. For example when learners learn with understanding, they have fewer things to remember. Children who learn with understanding know that 3×4 is the same as 4×3 . Misconceptions arise when the learner say 3×4 is the same as $3 + 4$ that is the learner’s prior experiences and learning inside and outside the classroom.

Most teachers (5 out of 6) highlighted that Jika imfundo emphasizes curriculum coverage. The facilitators unpack for them summary of year plans and teach teachers about time allocation per topic per grade so that they will be easily cover the curriculum. The following is the structure of how mathematics topics are arranged and organized so that teachers will adhere to it. When Dolly asked about curriculum coverage, she replied:

“It is not easy to cover the curriculum even though the tracker said this work must be covered on this week. The learners that we are working with are not the same; even their learning strategy is not the same. I always have the work left behind because I cannot proceed to the following work leaving learners behind. I always state that on the reflection part of the tracker but I felt to be ignored”. The following structure is the sample of Grade four summary of year plan for Mathematics. Teachers said through the summary of year plans they are able to see what they will be doing for the whole year. They said it gave them an opportunity to plan on time.

Summary of year plans

TIME ALLOCATION PER TOPIC: GRADE 4							
Term 1		Term 2		Term 3		Term 4	
Topic	Time	Topic	Time	Topic	Time	Topic	Time
Mental Mathematics		Mental Mathematics		Mental Mathematics		Mental Mathematics	
Whole Numbers:		Whole Numbers:		Capacity/volume		Whole Numbers:	
Number sentences		Whole numbers: addition and subtraction		Common fractions	5 hours	Whole numbers: addition and subtraction	
Whole numbers: addition and subtraction		Common fractions	6 hours	Whole Numbers:		Mass	
Numeric patterns		Length		Whole numbers: addition and subtraction		Properties of 3-D objects	
Whole numbers: multiplication and division		Whole numbers: multiplication		Viewing objects		Common fractions	5 hours
Time		Properties of 3-D objects		Properties of 2-D shapes		Whole numbers: division	
Data handling		Geometric patterns		Data handling		Perimeter, area & shape	
Properties of 2-D shapes		Symmetry		Numeric patterns		Position and movement	
Whole numbers: multiplication and division		Whole numbers: addition and subtraction		Whole numbers: addition and subtraction		Transformations	
		Whole numbers: division		Whole numbers: multiplication		Geometric patterns	
				Number sentences		Whole numbers: addition and subtraction	
				Transformations		Probability	
Revision		Revision		Revision		Revision	
		Assessment				Assessment	

TIME ALLOCATION PER TOPIC: GRADE 5							
Term 1		Term 2		Term 3		Term 4	
Topic	Time	Topic	Time	Topic	Time	Topic	Time
Mental Mathematics		Mental Mathematics		Mental Mathematics		Mental Mathematics	
Whole Numbers:		Whole Numbers:		Common fractions	5 hours	Whole Numbers:	
Number sentences		Whole numbers: addition and subtraction		Mass		Whole numbers: addition and subtraction	
Whole numbers: addition and subtraction		Common fractions	5 hours	Whole Numbers:		Properties of 3-D objects	
Numeric patterns		Length**		Whole numbers: addition and subtraction		Common fractions	5 hours
Whole numbers: multiplication and division		Whole numbers: multiplication		Viewing objects		Whole numbers: division	
Time**		Properties of 3-D objects		Properties of 2-D shapes		Area, perimeter & shape	
Data handling		Geometric patterns		Transformations		Position and movement	
Properties of 2-D shapes		Symmetry		Temperature		Transformations	
Capacity/volume		Whole numbers: division		Data handling		Geometric patterns	
		Whole numbers: division		Numeric patterns		Number sentences	
				Whole numbers: division		Probability**	
Revision		Revision		Revision		Revision	
		Assessment				Assessment	

PILD workshop for Grade 4 – Grade 7 Mathematics developed by COUNT, 2016

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Figure 5: An example of a summary of year plans

From the above evidence of documents and participants responses it can be said that teachers do attend training workshops that develop them professionally especially in Mathematics teaching,

however, there are gaps that need to be closed or filled for the fact that only two people attended the workshop.

Cluster meetings

A cluster meeting is another professional development activity that the participants of this study said they engage in Jika Imfundo. Cluster meetings in South African context are described as a process whereby a group of teachers in a ward who teaches the same subject in the same grades or phase comes together to help one another or ask someone, for example, a subject advisor to help them with a particular issue regarding teaching and learning that subject. The participants of this study said their clusters are organized according to neighboring schools. Four out of six participants in my study attend in the same cluster of twenty to twenty-five teachers (8 schools). They said the cluster co-coordinator organizes the meetings, and if there is a need, he/ she invite the subject advisor. These meetings are organized after attending Jika Imfundo training. All teachers teaching mathematics are allowed to attend, unlike training workshop where only one HOD and one teacher were allowed to attend.

These teachers said they meet twice a term, firstly after attending Jika Imfundo training workshop, and then they come to their clusters and reviewed what they did in the training and helping those who did not attend. Secondly, they meet before examination commences where they review previous term results in mathematics, and then they set common examination papers for the ward. They also share their experiences in mathematics teaching and discussion about the problems they encounter in their school concerning mathematics teaching and learning. When Angie asked about what you do in cluster meetings, she responded:

We discuss the challenges we experience in particular content and pedagogy, for example, I was having a problem in fractions teaching then I asked teachers to help me in a cluster, I was new in mathematics teaching but the teaches welcomed me with warm hands. In clusters, we also revise previous term results and find the solutions before we set new question papers.

Some teachers do not saw the importance of cluster meetings. This was made clear when Ben explained that:

In the cluster where I attended teachers did not take cluster meetings seriously. They make clusters their places of entertainment just to take them out of their schools. The HODs do not even do

follow up on the work done on the clusters. Nothing is important taking place in my cluster that is why I left them. I saw cluster meetings as a waste of time.

Jack has a different opinion about cluster meetings. He said:

As I am an acting HOD, I am always busy. I do not have time to attend cluster meetings. The knowledge I gained from attending Jika Imfundo is enough for me. I asked the teachers to give me question papers after they have set them in a cluster meeting so that my learners will write what other learners write in the ward. Sometimes the cluster coordinator did not organize the cluster meeting because few teachers attend.

Four out of six teachers noted the importance of collaborative work that takes place in the clusters. They said learning does not merely depend on the individual teacher, rather a social issue where knowledge was disseminated amongst other teachers in a cluster. In the above data is eminent that in the cluster meetings teachers share their experiences and challenges and come up with solutions to their problems.

On the other hand, the participants complained about the cluster meetings time. They said these meetings are conducted after school hours; they sacrificed their own time for the benefit of their learners. They suggested that these meetings should be incorporated within contact time.

Class visits

The majority of the participants mentioned the following as the purposes of the class visits according to Jika Imfundo as a programme to improve learning outcomes. They said the purpose of the class visits is to monitor and supervise the teachers' work. Secondly, find out whether the curriculum is properly implemented. Thirdly is to see that the Jika Imfundo tools, for example, the tracker and lesson plans are used effectively. Thirdly, to find out which barriers are hindering the culture of teaching and learning during the contact time as well to see if the teacher accommodates all learners. Lizzy mentioned that during a class visit the HOD checks the following:

To find out whether the teacher monitors the learners' work by marking and giving feedback to learners, support the learners and also interacts with them. Find out whether the learning and teaching materials are adequate in the classroom and to monitor classroom management. Lastly, give support and to track curriculum coverage for the benefit of the learners. The teachers said it

is the duty of the HOD to execute the above-mentioned duties together with the peer. However, some teachers complained about class visits, they suggested that the period should be extended for monitoring and support in the classroom. They showed that one-day visit does not satisfy them; they stated the need for more classroom-based support.

Jack as an acting HOD, supplied me with the information and the tool that was used during the class visits, tool 2.



TOOL 2: GUIDELINE - HoD'S SUPERVISION CONVERSATION WITH THE TEACHER
DISTRIBUTED AS PART OF THE SMT TRAINING AND COACHING PROGRAMME

REMEMBER:

- The over-riding goal is to leave the teacher feeling *encouraged and enabled* to improve
- This is a professional management conversation based on the evidence of the teachers' documents
 - Lesson Plans
 - Trackers
 - Learners' work (workbooks and exercise books)
 - Assessments completed

KEY PRACTICE (BEHAVIOUR)	WHAT'S WORKING	WHAT NEEDS WORK
1. PLANNING & TRACKING		
Use of Tracker to plan		
Use of Tracker to track completion of topics		
Use of tracker to reflect on what works and what can be improved		
Has homework completion been monitored		
2. LESSON PREPARATION		
Evidence of clear planning for each lesson		
Evidence of the use of resources provided		

3. ASSESSMENT		
Planning for assessments as required by CAPS		
Completion of assessments as per plan		
Reflection on the range of learner performance		
4. CLASS VISITS		

Figure 6: The structure of the supervision tool: 2

As I analyzed this tool, I found out that this tool helps the HOD to look for the evidence of the use of a tracker to plan, to complete topics, and to reflect on works and on what to be improved. Secondly, to find evidence of lesson preparation including the use of resources provided. Thirdly, it helps the HOD to look for the evidence of assessment and completion of tasks as per plan. This confirmed what teachers told me when they said the HODs used different tools to monitor their work.

Jack explained that as an HOD he designed the class visit plan for the whole term. In this plan, there are the names of teachers and their dates of visits. He said the following documents served as evidence of teachers' documents during class visits: Lesson plans, Trackers, Learners work, workbooks and exercises and assessment documents. I also analyzed the documents that Jack said they serve as evidence of class visits, however, I found out only four participants were doing their work properly.

Some of my participants have expressed their initial uneasiness about class visits, as expressed by Erick:

I hated it when my HOD started to conduct class visits, but because I am a hard worker I managed to stay on top with my work, I feel encouraged and enable to improve after the class visit.

This was a view expressed by four of my participants. This discomfort was not just expressed by teachers, even the HOD that I interviewed, Jack, said he was worried about conducting class visits. He explained that:

I was is afraid that teachers might think that I am policing their work and I have never been trained as a curriculum manager, so I didn't feel confident in supervising the work of others, particularly because I am working with the teachers that I know.

On one of my participants, I found out that the reflection part of the trackers is not completely done. She did not reflect if there is a reflection it does not answer the questions asked, the HOD has not signed the tracker, and there are no dates. When I asked Lizzy why her work is not monitored she said:

I did not have an HOD, my HOD retired last year February. The HODs that are on surplus refused to come to this school since this school is in a deep rural area. We are doing as we pleased because even the Jika Imfundo facilitators do not usually do follow up on schools to monitor the progress and the implementation of Jika Imfundo.

With regard to the above quote, the Department of Education has the responsibility to ensure that sufficient HODs are appointed for the effective school functionality.

Ben said something different regarding class visits:

I know that I am not the HODs favorite teacher. Every time when my HOD visited me, she complained about everything. I have tried to impress her the other day I asked my colleague to help me prepare for the class visit. My colleague is an experienced senior teacher he always got good comments when visited by the HOD. Even though I tried to do that but she gave me negative results. From there I hated class visits because my HOD did not understand the purpose of the class visit. She did not support me to be an experienced teacher.

Overall with the respect to the above extracts from interviews and document analysis on the aspect of class visits the majority of participants talked about the class visits as a form of professional development activity that encouraged enable them to improve professionally. However, Jack as an HOD stated that teachers do not want to comply with class visit feedback; they tend to become angry when the HOD communicated with them about their areas of improvement or development.

Coaching/mentoring

Regarding coaching /mentoring as a professional development activity teachers responded that the HOD served as coaches and mentors within their school. The participants of this study said coaching and mentoring usually takes place after Jika imfundo training workshop. Teachers said

the purpose of coaching / mentoring was to see if what was learned from the training workshop was implemented in the classroom. Most of the participants also noted that coaching/ mentoring is also done if there is a new teacher appointed to teach at a particular school, it is the duty of the HOD to support that newly appointed teacher. Girly reported that:

When I arrived at this school to teach mathematics my HOD mentored and coached me. She arranged for me the special training workshop where she showed me the tools that are used in Jika Imfundo because I was from another District where Jika Imfundo was not conducted. During the first two weeks it was difficult for me I was mixing up the tools, but through my HODs support on the third week, it was as if I have started a long time ago.

Teachers mentioned that even though Jika Imfundo encourage the HODs to do coaching / mentoring especially for the novice teachers but the HODs saw the need of doing it even on senior educators for the fact that a teacher can have many years in teaching but can lack content and pedagogy knowledge. Five out of six participants claimed that their HOD coaches and mentors them especially if there was something learned in the workshop and want to make it sure that they implement it successfully. Although the participants showed an understanding of what coaching and mentoring is, but they were not aware that this is another form of PD activity. Erick expressed his negativity with regarding coaching and mentoring:

The HOD does coaching and mentoring and I see it as a waste of time because in the workshop we learn everything and strategies for teaching it.

Although Erick has a negative opinion due to coaching and mentoring the four participants viewed coaching and mentoring as an activity that is helpful to them because they got an opportunity to learn from the HOD. Ben mentioned the challenges faced by HODs when he pointed out that:

My HOD hardly provides support to the teachers due to unavailability of time and duty load problems, I only attend workshops and that is where I got knowledge of mathematics teaching.

Jack as an acting HOD similarly responded like Ben that of course, they face different challenges when it comes to professional development of teachers. He explained that he faced challenges and blockages when executing his job. He mentioned that one of the purposes of Jika imfundos is to make HODs feel heard and acknowledged, but that is not easy. He said he found it difficult to give negative feedback to teachers, and some of his colleagues destruct the process through which he was placed or appointed.

From these three participants views it is not made clear if the coaching and mentoring as a professional development activity serve as a vehicle to be used by HOD to ensure curriculum coverage and by teachers to update and deepen their knowledge and sharpen their skills in order to improve their practice.

One -on- one meeting

Another activity that the participating teachers said they engage in, as part of Jika Imfundo is one on- one meeting. The focus of Jika Imfundo was curriculum coverage. The one-on-one- meetings like most Jika Imfundo activities are aimed at tracking curriculum coverage, not just helping teachers master mathematics. All teachers explained that these meetings take place between a teacher and an HOD. The HOD after class visits where a teacher rate himself or herself against the documents reviewed then the HOD arrange a one on one meeting with that teacher. The aim of that meeting is to help that teacher to master the curriculum coverage as well as the work of teaching mathematics in particular.

Lizzy mentioned that:

The meetings are formally organized, and minutes of the meeting serves as evidence that the HOD with a particular teacher on this date was at the meeting and the meeting was about what. The supervision conversation with the teacher form needs to be furnished by the HOD and the teacher. The following structure is an example of the one- on- one conversation.

out their problems with the knowledgeable person. This is what Girly said when asked on one on one meetings.

I used to hate one on one meeting with my HOD, I took it as a curiosity, but now I have seen that I got adequate support from my HOD. I was so keen to change and use what my HOD suggest I should do.

Jack as an acting HOD participant claims that one-on-one meetings were used as a curriculum supervision instrument where the HOD supports the teachers. He explained that on one-on-one meetings the records that they went through them is the evidence of written schedules for the meetings, minutes or notes for the meeting, and lastly, the minutes or notes should state the agreed actions with responsibility and timeframes. He explained that their success as HODs depends on how they influenced and support others so that they can achieve their collective goals. He said even though there are some common blockages to effective supervision but teachers themselves share their experiences of the effectiveness of one-on-one.

In summary, the study found out that their participation in one on one meeting is helpful to both the teacher and the HOD because it is where they reach consensus on the different aspects like planning, tracking and curriculum coverage.

Subject phase meetings

The other form of professional development activities that teachers said they engage was subject phase meeting. The subject heads conducted the subject phase meeting planned for the year. All of the six participants mentioned that they hold subject meetings after Jika Imfundo training workshops. The reason for scheduling these meetings was to inform other teachers about what they learned in Jika Imfundo. The Jika Imfundo officials invited two people to attend the training that is the HOD and one subject teacher. Through the subject phase meetings, the teacher and the HOD who attended the training got an opportunity to disseminate the information back to his or her colleagues who were not attending the training.

All teachers in this study were having similar views on subject meetings that these meetings are underpinned by training workshop because the teachers who have attended the training also trained other teachers. However, Angie explained that there are some implications taking place when a teacher cascade the information:

I did not hate cascade as a way of transferring information but it might happen that the information can be lost along the way; by the way, teachers got insufficient information. Secondly, in her school there is no time allocated for professional development activities, subject meetings are held after contact hours. It is the responsibility of the HOD and the teachers to make sure that cascading takes place on their own time. Jack as an acting HOD expressed his feelings when he explains that:

To be an HOD is not an easy job when I invite teachers for giving them feedback they really showed that that thing is annoying them. The problem is that subject phase meetings are held after contact time, so they complained about their time. They wished to have these meetings during school hours of which are impossible, but I tried to make them see that this feedback will help them. I did not promote cascading of information, but due to limited resources, it happens. I am sure that if each individual teacher can be given an opportunity to attend we will do better.

Different problems were reported concerning subject phase meetings. Girly as the teacher who attended the workshop find it difficult to report or cascade back the information to other teachers. This is what she said when asked about subject phase meetings:

My HOD gave me time to cascade information to teachers. The colleagues were less interested because I conducted the meeting after school others did not have transport and they were in a rush of time.

Looking at these two responses it is evident that two schools out of six have a problem of time allocation for professional development.

It appears though that the majority of the respondents benefitted from subject phase meetings because all four of them were of the opinion that in these meetings they gained a lot of information. They did not feel the gap that they have not attended Jika Imfundo training workshop. Those teachers who attended trained them using the participatory manuals that were used during training. Teachers said they took us systematically as the facilitators did. Dolly is one of the four participants raised interesting opinion in her response. She explained that:

In our school year plan, we have allocated time for professional development activities including subject phase meetings. In these meetings, it is where we review the previous term results for mathematics. Secondly, we look at the year plan for the subject and its assessment programme. We also share the information gathered from Jika Imfundo training workshops. I really like subject

phase meetings because we got an opportunity to share our problems, especially on curriculum coverage.

Four out of six participants got similar views that subject/ departmental meetings served as spaces to debate, diversity of thoughts and opinions where they raise their critical issues. Teachers think the aim of the subject phase meeting is to achieve a shared goal and a common purpose in mathematics teaching and learning especially curriculum coverage for the benefit of learners. Teachers noted that in these meeting the HOD is responsible for the subject learning area, and phase that they are appointed for, coordination and evaluation of assessment and homework in their departments. They also provide support and guidance on subject content, teaching techniques and methods, support inexperienced teachers and lastly to control and monitor the educator and learners work. To summarize, the study on subject phase meeting it is evident that most of the teachers value the importance of subject phase meetings.

Reflection

One of the activities that the teachers said they engaged in, as part of professional development activity in Jika Imfundo was a reflection. All six teachers explained that they received documents from Jika Imfundo before training. They said the tracker is the document that contains the work that needs to be done for that particular term, it is arranged in weeks, and below the week ending there is a space where a teacher reflects on the work done. This part reads as follows, "What went well? What did not go well? What did the learners find difficult or easy to understand? What will you do to support? Did you complete all the work set for the week? If not, how will you get back on track? The second space has the following questions, what will you change next time why? Concerning the reflection part, the participants explained how it helped them in mathematics teaching and curriculum coverage. Ben explained that:

I reflect on the work done for that week, reflection part makes it simple for me know where I left off if there was something interrupting me and also help me to know where I need to pay more effort or give extra support to my learners. Erick also mentioned that he does reflection on a weekly basis, but initially, he did not understand the importance of reflection. He now realized how important it is to reflect because it helps him to see if the work set for the week is effectively done.

I do reflection on a weekly basis but first I did not see its importance, but now I know that if I finish my work on time...everything will be perfect and that will save time for revision. Dolly also concur with Jack she mentioned that:

I reflect on the lessons done each week, reflection helps me to see if I am on the right track in terms of curriculum coverage or not and if not how am I going to cover that work.

Jack say something different pertaining reflection as an acting HOD. He said:

At first mathematics teachers that I am working within the Intermediate Phase, they tend to do lesson plans that are incomplete and mistakenly repeat the activities that need to be done. To correct those mistakes it was time-consuming, but through Jika Imfundo documents, my work is as easy as ABC. Now I know what to look for at what week, what were teachers and learners problems in that week. If the teacher did not complete her work, he/she writes down what she or he is going to do to recover that work.

From the participant's responses, it emerged that all participating teachers do reflection as the part of their professional development activity. However, when I was analyzing their documents I found out that what they said was not what they do. Two out of six participants did not do reflection at all. When I asked them, they said they did not have an HOD so no one was looking at their work especially their trackers. They also said they have short staffed the Principal have his own class to teach, he is overloaded.

The other two participants to reflect on their trackers, but they have written scanty work. They are not answering the questions asked. The other one participant correctly do reflection and the dates were filled for each week, up to the last day of the term. Jack as an acting HOD also his work is perfect. Every week has its own reflection with a volume and valid evidence of learners work. He said he submitted his work every Friday to his Principal for monitoring and evaluation.

From the above quotes, it was clear that these participating teachers have attended Jika Imfundo workshop and other forms of professional development activities inside and outside their school. However, some of these teachers lack supervision and support from their HODs.

4.3.2 Kinds of knowledge acquired

The participants of this study said they acquired different kinds of knowledge. They said they acquired the following types of knowledge: Content knowledge, strategies for mathematics teaching, linking mathematics topics, curriculum and curriculum materials, and knowing different levels of learners. The following paragraphs explained the above-mentioned types of knowledge.

Content knowledge

The participants of this study said the Jika Imfundo facilitators together with District subject advisors key areas of mathematics learning and teaching that present difficulties for both teachers and learners. Thereafter, they chose topics that they will deal with in the training workshop.

Four out of six teachers mentioned that they have never trained to teach mathematics in their tertiary level, but through Jika imfundo training, they are now able to teach well. Girly echoed:

We learn how to teach a particular lesson/content to learners. We get knowledge about subject content and subject matter. The tracker encourages us to reflect on what is effective in the lessons and where to strengthen content coverage.

The trackers that they used consist of detailed CAPS concepts and skills that need to be taught for a day, week and term. They said the tracker also strengthen the content coverage. They said the facilitators taught them to think carefully about the content that they will teach their learners, and also be aware of the prior knowledge that the learners should have learned in the previous grade.

Ben describe his learning experience on Jika Imfundo:

I was not prepared to teach mathematics in such a way that even in High school I chose History over mathematics. Fortunately, at primary school, I was doing it. When Jika Imfundo was conducted on my District, I told myself that it would be like other professional development activities that I have attended before. I was happy when the facilitators take us through mathematics CAPS content and showing us the clarification column or notes that will guide us while we prepare for teaching. We learn every content and concepts of mathematics. We learn a lot about subject content and matter. They provide us with tools that have enough content that we need as mathematics teachers

Erick also have a similar opinion with Ben, He said:

When I got lost I just use the clarification notes, they are very useful. I used notes as reference for further examples and to enrich ideas on my explanations. They make me prepared for the questions that may arise from learners. On the tracker, the time for lesson content and concept development is allocated, fifteen minutes where I actively involved my learners and go through examples with them. As a mathematics teacher, I think teachers should possess knowledge of the subject and problem-solving skills. Subject matter knowledge is important as well as the subject presentation for the benefit of my learners.

Most of the participants mentioned that they learned about mathematics content that helped them on a day- to –day teaching of mathematics. The role played by HODs in content development is also evident that teachers use knowledge acquired in *Jika Imfundo*. During document analysis, I found that all participants have adequate content knowledge for mathematics teaching.

This was confirmed by their learners' work when I was doing document analysis. Learners were given the same sums to complete; however, they used different procedures to complete their sums. This clearly indicates that a teacher used different teaching strategies and learners have chosen what they think suits them but all of them came up with correct answers.

Strategies for mathematics teaching

The participants in this study explained that they also learned different strategies for teaching mathematics. The lesson plans provided teachers with the strategies of teaching mathematics in different grades. Most of the participants said they used different strategies to present the lessons in a way that enables their learners to access the topic easily. All participants were of the opinion that they used different teaching strategies so that their learners will understand the content or subject matter very easily. This was confirmed by Girly when she said: *As a teacher, you must use a variety of teaching strategies that are very important. Different textbooks have different teaching strategies so I make use of all the textbooks so that I will have more teaching strategies to accommodate my learners.*

She mentioned those learners in Grade four and Grade five struggles to adjust because of the larger amount of content work that is why it is important for a teacher to have to choose teaching strategies that are appropriate for a learner. The learner's activities should be planned before for the promotion of learners understanding. The other participants also gave examples of their

teaching strategies. When Jack was asked what type of teaching strategy he used most, he responded: *When I teach mathematics, I act as a facilitator, not a teacher. I do not tell learners what to do at each step but I let learners work on their own. I only monitor the learners checking if they are doing right and support them where necessary answering their questions and directs them to the right direction.*

Similarly, Dolly shared: *the learners must do most of the work, as a teacher just comes to assist them when they need help. I believe that I should not tell learners everything; they should be able to solve mathematical problems on their own.* Dolly believed that the teacher must only see to it whether the learners are following the appropriate steps that you taught them during a content presentation.

Ben came up with his own teaching strategy he said: *I demonstrate and go through examples so that learners will know what to do.* In this strategy, he said he go through the procedure and examples until all learners understand the content. He explained that after learners are sure of what they have to do, then he goes around the classroom when learners are doing work on their own.

An alternative teaching strategy was mentioned by Erick, which was drilling method. He said *Jika Imfundo* facilitators emphasized this type of teaching strategy because they believe that if it is done properly; learners will be able to acquire the certain content. He said: *I do drilling method when we do the sums that are problematic to learners. Sometimes it depends on the learners and the types of activities they are doing; usually, I go over one or two classwork activities orally with the whole class before allowing the learners to work independently.* Lizzy explained the steps that the facilitators taught them on lesson presentation. She said:

A tracker gives me detailed information on the steps to follow in the lesson presentation, time allocation for each lesson and the organization of learners when they work. These include the following steps: Mental mathematics (5-10 minutes), Homework review/ reflection (10 minutes), Lesson content- concept development (15 minutes), Classwork activity (20 minutes) and allocate homework (5 minutes) followed by a reflection.

From the above quotes, it is evident that participating teachers used a variety of teaching strategies when teaching mathematics. Teachers said for different teaching strategies they are assisted by lesson presentation notes found in the lesson plan provided by *Jika Imfundo*. Fewer teachers mentioned that the learners that the taught experienced language barrier. They said it was not easy

to teach learners who have difficulty in understanding English as a medium of instruction. They explained that they do code switching for other learners to understand the mathematics concepts; however, they believe that it will affect learner's progress in the future.

Linking mathematics topics

The participants of this study said that in Jika Imfundo they learn how to link mathematics topics for the purpose of curriculum coverage. They mentioned that the work set out for each day was linked directly to the topics and subtopics given in the CAPS, and the specified amount of time was allocated to each topic. Girly explained:

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

Jack confirmed that they used topics links identified and prescribed by Jika Imfundo. As a mathematics teacher: *I know which textbooks to choose amongst the eight textbooks prescribed by Jika Imfundo. Some textbooks are rich in content, some reach in teaching strategies and some have linked the topics that cover the ideas for teaching the same content in different ways. Actually, trackers saved preparation time.*

He mentioned that in the tracker the CAPS concepts and skills are arranged systematically, to make it easier for the teacher to complete the work set for each week. All the participants maintained that the Jika Imfundo tools helped them, especially in curriculum coverage.

Curricular and curriculum materials

The participants mentioned that in Jika Imfundo they learned that teachers consistently plan, track and report on their teaching using the curriculum tracking tools. They said the HODs used a tool to track teacher's curriculum coverage. They mentioned that the main aim of Jika Imfundo was curriculum coverage. Teachers said they are given tools especially trackers to track curriculum. The trackers consisted of a sequenced programme of activities to be followed to avoid the skipping of work. These activities are CAPS aligned and teachers can refer to curriculum document directly if they wish so. Jack mentioned that:

The tracker makes it clear to me which resources I will need each day in order to deliver the lesson. Some of the printable resources are included in the learner's books and teachers guides

that I can use with the learners. Some materials found at the back of the tracker are either suggestions or actual activities for remediation and extension.

Other participants mentioned that through Jika Imfundo now they know which materials to use when teaching mathematics. Ben pointed out that: *When I am doing planning, I used the following documents, teachers guide, learners' book, tracker and the CAPS document.* Girly has a similar opinion with Ben, she said she also prepared her curriculum materials before teaching. *I make sure that I have the necessary materials before I go to class. This helps me to manage time so that I will finish the work in allocated time.*

Teachers also said they learned about assessment strategies. They said they used lesson tracker for assessment purposes. The tracker provides teachers with the information regarding guidelines for assessment activities, assessment plan that gives an overview of the planned assessment to be done on the term and a marking memorandum. They mentioned that there are suggested mark record sheet for the recording of learner's marks. This was pointed out by Dolly: *JI toolkits gives guidelines on formal assessment for each term. Select materials that are CAPS aligned, covers the curriculum enjoyable and usable to learners.*

During document analysis, the records showed that teachers used the assessment programmes and assessment tasks successfully. Teachers have recorded learner's marks in the record sheets and the HOD approved and signed the record sheets. It is evident that pre-moderation and post moderation of task was done during the assessment.

All the participants in the sample pointed out that planning in advance for mathematics teaching is a key, it gave them time to gather the materials or resources that they will need to ensure successful mathematics teaching. During document analysis, it was evident that four out of six teachers make use of materials prescribed by Jika Imfundo facilitators even though some other teachers said they have very few textbooks in their schools because of allocation of school funding. The complaint that they are unable to expose their learners to different textbooks that have different ideas on mathematics teaching and learning because of limited resources.

Catering for different levels of learners

The teachers participating in this study said knowing the learner's competence was central to how the teacher will structure the lessons. They mentioned that this allows the teacher to cater to different intellectual levels of learners. Teachers said that in Jika Imfundo they learned that it is

important to assign learners carefully in groups because there are learners with mixed abilities who can assist each other in each group. Teachers also said Jika Imfundo also emphasized the importance of identifying learners who need extra support and extend those who need enrichment. Jack confirmed this when he said:

In the tracker as well as learners books there are activities provided for those learners who need enrichment. As a teacher, you must try to identify those learners who need support or extension by paying attention to how they cope in the classroom.

Teachers said they structure their learners in such a way that the learners who finished their work first do not get bored and those who need assistance was accommodated not to get lost. Dolly mentioned this:

I learned skills to explain mathematics concepts at a level of a learner that I am teaching, to give clear explanations to learners where they did not understand. I learned how to accommodate the learners in a subject and to encourage them to love mathematics. I gave them to give an opportunity to come up with solutions and create an atmosphere that is conducive to learning.

The information above revealed the evidence that participants do cater for different learners levels as they were able to accommodate all types of learners and they were appropriate to teach different ages. However, some teachers complained about learners activities. They said there are too many exercises or activities that need to be done at an allocated time. The Jika Imfundo facilitators did not take into consideration the pace of learners since they teach different learners. They also mentioned that in the tracker there is no day for repetition of the work if the learners did not understand. From Monday up to Friday, there are activities set for each day, teachers are worried about when they will do a recap. They said the only thing they did was to work on weekends just to cover the work left behind because they are chasing a tracker behind. The following paragraphs explained some of the challenges faced by teachers and HODs in Jika Imfundo programme.

Firstly, teachers said there was a contradiction in Jika Imfundo and CAPS. CAPS facilitators and Jika Imfundo facilitators when it comes to documentation they ask for different documents from participants. Teachers were provided with different documents from these programmes. CAPS have its own marks record sheets that specified different assessment tasks, and Jika Imfundo has its own. Teachers said the CAPS and Jika Imfundo facilitators were confusing them because they want teachers to use their documents, and teachers ended up having two marks record sheets. Ben

expressed his confusion *“I thought Jika Imfundo is another new curriculum like NCS and CAPS. The facilitators were also confusing us...but at the end I realized that it is not a new curriculum but it is a programme to improve learning outcomes, it is just a programme to rectify CAPS”*.

Secondly, it was the issue of Jika Imfundo teaching pace. All participants revealed that they were having a problem in covering the work given for each day or week. They failed to teach all the activities prescribed for each day. They mentioned that they teach different learners with different learning strategies. The activities given by Jika Imfundo does not support slow learners, because there are many activities that need to be done on a short period. There was not enough time to support the learners with learning problems. Jack revealed that he was left behind with his work.

My grade four learners are far behind with their work, they did not catch up easily because of the language of teaching and the load of work, especially the number of activities. They are behind because I am trying to push those learners who are very slow. I am even using weekends to cover the work.

Girly explained her feelings concerning the pace of Jika Imfundo; *the focus of Jika Imfundo is not on quality but on speed to teachers and learners. The tracker is the leader, not the child...that is why we have learners who are unable to do mathematics. Some learners could not master the content of a subject. We struggled to cover the curriculum because of slow learners that I have to support.*

Dolly mentioned that there are too many activities per day, especially in mathematics in a limited time. She explained that there is mental mathematics, homework review, lesson content presentation or concept development, classwork activity and lastly the allocation of homework. *We try to squeeze the activities but it is not easy... Learners are expected to write on their exercise books and workbooks, that increases the work of marking.* Angie was having the same opinion, like Dolly, she said that there was too much work for both teachers and learners: *"We are expected to use both the workbook and exercise book for teachers, that calls for too much marking and there was a duplication of activities.*

Lizzy mentioned that even though there are too many activities but in the end, they are able to cover the curriculum. *I tried even the afternoon classes. In Jika Imfundo, it is easy because you clearly know where you left off and where to start again through the tracker.* From the participants' views, it was evident that teachers were having the problem of curriculum coverage on time, but

all of them stated that they ended up covering all the work required of them. They clearly stated that the tracker helped them a lot in curriculum coverage.

The participants also mentioned that they have a difficulty concerning reflection. They said the tracker sometimes is not in line with the school calendar. It happened that the tracker indicates five days a week even though maybe there were holidays in that week. That resulted in a backlog for both teachers and learners. The problem here was that the activities in a tracker are arranged in such a way that you cannot skip some activities. By the way, it is the duty of the teacher to arrange how he /she should cover that work before continuing to the next.

Another challenge mentioned by participants was the lack of resources in rural schools. They mentioned that the shortage of resources like workbooks needed a teacher to do photocopies and that was coupled by lack of electricity sometimes. When there are thunderstorms the schools in the rural area faced the problem of electricity, then no printing and photocopying that can be done on that day. Participants mentioned that in 2018 schools were given Universal Serial Bus (USB) in order to print their own trackers, lesson plans and learners activities. That process created a huge problem because some other USBs were not downloaded the work. Schools needed to borrow it from other schools. Other schools were also having the problem with their printing and photocopying machines, they were not in a good condition. These problems caused delays in teaching and learning. The curriculum coverage was affected especially in Term one. Teachers were working under pressure to cover the curriculum.

The last problem mentioned by participants was the lack of parental involvement in schools. They explained that the current curriculum required active parental involvement since they are expected to help their children with their homework. Each day in mathematics there was homework given to learners. Jack explained his feelings when asked about parent involvement, he said “*In the parents meetings we always told the parents about their importance in the education of their children, but very few parents interfered or assist their children*” If the learners are not taken care of by their parents in terms of helping them to write their homework, that leads to poor performance. Most of the learners' parents in the area where the study was located as I have stated in chapter one are illiterate. They are unable to help their children. The participants indicated that they needed ways or skills to deal with this issue.

From the above participant's views, it emerged that there are some problems and challenges with the program. The participants are able to overcome some challenges and some they are not.

4.3.3 Conclusion

This chapter first presents the profiles of the participants. Secondly, it described the types of activities that the teachers participating in Jika Imfundo engage in. This was followed by a discussion of the kinds of knowledge they acquire through participating in JI. To conclude, this chapter presents the main findings of the study according to the research questions.

From the findings discussed, it was observed that teachers participating in Jika Imfundo attend different professional development activities and acquire different types of knowledge for the benefit of their personal growth and for the benefit of their learners. From the semi-structured interviews, it was noticed that teachers acquire different kinds of knowledge from Jika Imfundo. The semi-structured interviews also revealed that teachers engage in the PD conducted outside their school and inside their school. From this PD it is where they acquire different types of knowledge.

Similarly, findings from the document analysis, data present that participants engage themselves in all types of PD; they acquire different types of knowledge from this PD. Throughout the findings of this study was presented and discussed through the literature reviewed. In the next chapter, these findings were discussed using conceptual frameworks adopted, and reviewed literature was done. At this point, I am of the opinion that the main findings of the study addressed the two research questions.

CHAPTER FIVE: DISCUSSION, RECOMMENDATIONS AND CONCLUSION

5.1 INTRODUCTION

The purpose of this study was to explore the kinds of knowledge that the intermediate phase mathematics teachers acquire through participating in Jika Imfundo programme. In chapter four, the research findings were presented, discussed and analyzed. The research data was generated through semi-structured interviews and document analysis with six teachers participating in Jika Imfundo.

This chapter started by presenting the discussions of the data obtained from the semi-structured interviews and document analysis. The research findings in chapter four were organized according to research questions. In this chapter the two conceptual frameworks are used to make sense of the data, namely, Desimone (2009) features of effective professional development activities and Hill, Rowan and Ball(2005) mathematical knowledge for teaching as discussed in chapter two-literature review. Two types of mathematics knowledge for teaching emerged from the data and are discussed under two domains on which they belong. These two domains are subject matter knowledge and pedagogical content knowledge. This chapter concludes by making recommendations and the conclusions based on the research findings.

5.2. Summary of findings

The findings in chapter four showed that the participation of teachers in a range of professional development activities changed their professional practice. The following paragraphs summarise the main findings of the study. The following aspects are discussed: the characteristics of professional development activities that the IP mathematics teachers engage in JI and kinds of mathematics knowledge they acquire through participating in JI.

In this section, I used the conceptual framework of Desimone (2009) to bring about an understanding of the characteristics or features of effective professional development activities. I apply this theory to summarize the types of professional development activities teachers participating in Jika Imfundo said they engage in at King Cetshwayo District.

5.2.1 Types of professional development activities teachers participating in Jika Imfundo engage in

This section started by responding to research question one: What types of professional development activities do intermediate phase mathematics teachers participating in Jika Imfundo engage in? Data was generated from the participant's responses during the semi-structured interviews as well as document analysis.

From the participants' responses during semi-structured interviews, it was evident that all six participants were engaged in professional development activities that took place inside and outside of their schools. These activities could contribute to a teacher's personal growth including emotional and social growth. According to Desimone (2009), the professional development activity is more likely to be effective if it improves teacher knowledge and allows for teacher learning and development to take place.

She mentioned that there are five features or characteristics of effective professional development. She suggests that for professional development to be effective firstly there should be sustained time given to professional development activity. Secondly, there should be a sustained engagement in the professional development activity. Thirdly, there should be a coherent learning activity. Fourthly, learning activity should be integrated into the teacher's daily work and their focus should be on meaningful content knowledge of the subject. Lastly, teachers from the same school or other schools should collaborate. The paragraphs hereunder discuss the features of effective professional development activities by Desimone (2009). These features are discussed and described related to Jika Imfundo professional development activities.

5.2.2 Activities that took place over a long period of time

Desimone (2009) asserts that the professional development activity that has a longer duration could have coherence, content focus, and more opportunities for active learning compared to those with a short period of time. Desimone (2009) explained that the professional development activities that lead to teacher learning should be conducted over a sufficient time of about 30 hours, and that time must be well organized. Research has shown that pedagogical and intellectual change requires long hours spent on the activity (Guskey & Yoon, 2009). A one-time session will not allow for substantive engagement with subject matter, it should be continuous, not episodic and can also include follow up and learning support. She further stated that these activities should focus on the enhancement of the teachers' content knowledge and their pedagogic content knowledge. The participants in this study mentioned that they were engaged in different professional development activities. They said the training workshop lasted from the year 2015 and continued to 2018 and then spread to other Districts across KwaZulu-Natal. The training workshop took about 2 to five days at the beginning of 2015. From 2016 up, 2018 the training only took one day starting from eight in the morning and 14; 00 and follow up a programme for monitoring and support done by HODs and subject advisors in schools. The teachers expressed that they were engaged in different types of high-quality activities that strengthen their deeper understanding and knowledge. The findings showed that the on Jika Imfundo programmes, follow-up sessions were done on the implementation as additional training. However, two participants suggested that once-off follow up session is not enough, stating that they need more time on coaching and mentoring. The data collected seems to suggest that Jika Imfundo did meet to a certain extent, this requirement because the participants explained that at the beginning of each term they attend training workshops as well as cluster meeting. They are also monitored developed and supported at a school level by their

HODs. The problems that the participants encountered are the unavailability of HODs in other school and the HODs workload that hinders them from doing their job effectively. The critique of the workshop model, which is prevalent in South Africa, is that most of the professional development activities have no sustainable time given to them. One- day workshop does not lead to sustainable engagement.

5.2.3 Activities that focus on content

Desimone (2009) argued that the most influential feature of teacher learning is the content focus. Skills and understandings are directly related to professional development that focuses on the subject matter content. She argues that Content- focused means that prior knowledge of students, related to content and teacher's strategies is considered for the development of new strategies. This feature enabled the teacher to solve mathematical problems, to have knowledge of mathematical concepts and mathematical procedures within their classrooms. She stated that the content focus of a teacher is a very important feature, as evidence in the past showed a connection between activities that focus on subject matter content and an increase in teacher knowledge and skills, an improvement in practice, and an improvement in student achievement. The participants of this study acknowledged that all of the professional development activities they have attended focuses on content knowledge. They revealed that Jika Imfundo was aimed at remedying the condition of education, to standardize the approach and to promote uniformity in curriculum implementation and support in the province. Villegas-Reimers (2003) suggested that professional development activity should focus on meaningful content knowledge of the subject. The data collected in this study seem to reveal that Jika Imfundo does focus on content knowledge because other participants mentioned that they were having problems in teaching some mathematical concepts, but through Jika Imfundo they acquired that content knowledge.

5.2.4 Activities that promote active learning and collective participation

Desimone (2009) further maintains that teachers should get an opportunity to engage themselves in active learning in professional development. She views an effective professional development activity as one that allows teachers opportunities not to just sit and listen passively to the facilitator instead, they should perform tasks. She affirms that active learning takes place where inexperienced teachers observe expert teachers, or where inexperienced teachers are being

observed, where there are interactive feedback and discussion, and reviewing student work is more effective than passive learning, which is characterized by listening to a lecture. In Jika Imfundo, active learning is emphasized and expressed through engaging teachers and HODs in interactive feedbacks and discussions, analyzing students work, being observed and making presentations in training workshops, cluster meetings, and departmental meetings. Active learning in this study involves teachers to become engaged in meaningful discussions, planning, tracking, reflecting, monitoring, evaluating and implementing Jika Imfundo programme as a part of the professional development activity. King and Newmann (2000) concur with Desimone (2009) on active learning. They pointed out that for the professional development activity to be effective learning activity should be integrated into teacher's daily work. The participants in this study mentioned that what they learn in Jika Imfundo is what they do daily in their classrooms.

Desimone (2009) also mentioned collective participation as an element that makes professional development activity to be effective. When teachers from the same school, grade or department collaborate, they are more likely to learn. In professional development activities that include collective participation, there are many opportunities for active learning of teachers (Guskey, 2003).

In this study, the professional development activities that intermediate phase mathematics teachers engage in have the characteristics of collective participation. The teachers, HODs and subject advisors were working collectively for the benefit of teachers as well as learners. In this study teacher from the same school worked together to share ideas on mathematics teaching and learning in subject phase meetings. Teachers from different schools in a ward collaborate for the purpose of teaching and learning of mathematics. The findings of this study concerning the types of professional development activities that teachers engage in, in Jika Imfundo it emerged that Jika Imfundo is an effective professional development activity. All the five characteristics of effective professional development identified by Desimone (2009) were present in this programme.

5.2.5. Activities that promote coherence

Another feature of an effective PD activity that Desimone (2009) identified is coherence. She defines coherence, as what teachers have learned should be similar to other professional development in school, districts, and state policies in terms of knowledge and beliefs. Experiences

that are consistency with teacher's goals, assessment standards aligned and other initiatives should be incorporated in the professional development. In this study, coherence will mean how teachers link what they have learned in different PD for example CAPS workshops and what they have learned in Jika Imfundo. She maintained that there must be coherence, where there should be a consistency of teacher learning and teachers' knowledge and belief. There must be a consistency of school, district and state reforms and policies with what is taught in professional development. Looking at the participants' responses, it emerged that teacher through Jika Imfundo they were engaged in professional development activities that were coherent. They indicated that they were attending training workshops, thereafter the HOD monitored the implementation of what they have learned also the District officials did the follow-up and support programmes with the schools. Guskey and Yoon (2009) concur with Desimone (2009) that for professional development activities to be effective there must be follow-up activities after the main professional development activity.

5.2.6 Kinds of knowledge teachers acquired through participating in Jika Imfundo

This section responded to research question two: What kinds of knowledge do intermediate phase mathematics teachers acquire through participating in Jika Imfundo. This part of the chapter discussed the findings on the kinds of knowledge that the Intermediate Phase mathematics teachers acquire through participating in Jika Imfundo. The conceptual framework of Hill, Rowan and Ball (2005) was adopted to identify the kinds of mathematics teacher knowledge. This theory was used to summarize the kinds of mathematics that teachers participating in Jika Imfundo said they acquire.

Hill et al (2005) defined Mathematical Knowledge for Teaching (MKT) as the mathematical knowledge that is used by teachers to carry out the work of teaching mathematics. Building on Shulman's work Hill, Rowan and Ball (2005) at the University of Michigan have provided a model that includes six different kinds of knowledge that mathematics teachers need.

They classified the mathematics knowledge for teaching into two categories or domains. These categories are subject matter knowledge and pedagogical content knowledge. Within the Subject Matter Knowledge (SMK), there are three types of knowledge, namely: Common Content Knowledge (CCK), Specialized Content Knowledge (SCK) and Horizon Content Knowledge

(HCK). The other three types fall within the Pedagogical Content Knowledge (PCK). This mathematics knowledge for teaching mathematics is Knowledge of Content and Students (KCS), Knowledge of Content and Teaching (KCT) and Knowledge of the Content of the Curriculum (KCC).

KCS and KCT are components of PCK that are parallel to Shulman's key components of PCK, those components are knowledge of students misconceptions and difficulties and knowledge of instructional strategies. The findings relating to the kinds of knowledge are discussed under two major types or domains of knowledge in which the six types of mathematics falls under. The first domain is Subject Matter Knowledge and the second domain is Pedagogical Content Knowledge.

5.2.7 Subject Matter Knowledge

Hill, Rowan and Ball (2005) defined subject matter knowledge as the knowledge of understanding principles, facts, and concepts and their organization. It includes the discipline knowledge and the ways of establishing the truth. They posit that the subject matter knowledge is the knowledge about the actual subject that needs to be taught by a teacher and learned by students. It is very important for the teacher to have a solid subject matter so that he/she will be able to help his /her students. The teacher's duty is to help the learner to acquire subject matter, but the teacher can do that if he/she has a meaningful understanding of subject matter. Subject matter knowledge is only one component of the knowledge of a well-prepared teacher - nevertheless - an important one (Ball, 2005). A powerful content-specific pedagogical preparation based on meaningful and comprehensive subject-matter knowledge would enable teachers to teach in the spirit envisioned in the Professional Standards for Teaching Mathematics (NCTM, 1991).

The participants of this study mentioned that in Jika Imfundo they learn a lot about a subject matter. However, better subject-matter preparation does not mean changing the number of courses prospective teachers must take. Most of the participants in this study were not trained to teach mathematics in their tertiary levels of education, but they mentioned that the Jika Imfundo training was constructed differently. The training was in line with the constructivist views on teaching and learning (Mishra & Koehler, 2006). Good subject-matter preparation for teachers in Jika Imfundo

was necessary but not sufficient because teachers said they sometimes tend to follow their own teachers' footsteps unless they have developed a different repertoire of teaching skills. Nevertheless, in Jika Imfundo teachers said they were taught to use presentation notes on their documents when teaching mathematics.

From the participant's responses, it revealed that teachers acquire curriculum knowledge from Jika Imfundo. The trackers that they used contained the content topics that they have to teach a particular grade. With regard to the implementation of the curriculum in schools, it emerged that KwaZulu-Natal schools had no common and effective strategy for the monitoring of curriculum delivery across the twelve districts and no instrument designed to inform the system early enough of the extent to which learners are achieving learning objectives. Through participants responses it also emerged that there was poor management of time on task; poor supervision and monitoring of curriculum implementation at the classroom level by the School Management Team; and a lack of content knowledge among teachers. The participants explained that in Jika Imfundo project they were given time -frames on what to teach at what time when to conduct assessment tasks, where to record them. The HODs also have tools to monitor the progress as well as the implementation of Jika Imfundo as well as curriculum coverage at a school level.

The participants also pointed out that they had adequate content knowledge of the subject they are teaching but they lack knowledge of learners. Although most of the participants had some teaching experiences ranging from five to 25 years, it appeared that some teachers struggled to accommodate learners, which experiences barriers to learning. Most of the teachers reported that even though they had a long teaching experience but they were not aware that learners from different backgrounds could experience different learning barriers. They also pointed out that they did not learn the aspect of barriers to learning formally in Jika Imfundo; they think it is an intellectual development yet it is essential for the teachers to have this type of knowledge.

For the development of subject matter knowledge teachers were provided with CAPS Planners and Trackers, which assist them to plan teaching and assessment, track the pace of teaching and assessment against CAPS expectation, reflect on a weekly basis. Identify pedagogical problems related to curriculum coverage, and to report these to the HOD in a professional and supportive climate so that problems could be identified and solutions collaboratively agreed upon.

Heads of Department are provided with the tools, training to supervise, and support teachers in curriculum coverage. They make it a point that teachers teach what they are expected to teach. They arrange professional development activities like one-on-one meetings, subject phase meetings and coaching and mentoring in order to share their ideas and develop one another. They also monitored and evaluated teacher's documents like lesson plans, trackers, learners work and assessment for the purpose of curriculum coverage. Principals are provided with tools and training to monitor and support HOD in their curriculum management responsibilities.

Through participants responses, it emerged that the Circuit Managers and Subject advisers were given tools like monitoring tools and training to have a curriculum-focused conversation with educators that use the evidence gathered in the school so that problems can be identified and solutions found. It was also their responsibility to arrange professional development activities for teachers after identifying problematic mathematics concepts with subject advisors.

Ball et al (2005) also affirm that teachers need to have learning environments that foster powerful constructions of mathematical concepts; however, the issue of a shortage of resources in schools is still a problem. In rural areas, most of the schools lack teaching and learning resources compared to urban areas schools. Ben mentioned that since January 2018, he is unable to access teaching resources found in USBs because their printing school machine was not on good condition. He asked for copies to his neighboring school. He was unable to create a learning environment that is conducive to learning because even the workbooks and exercises for learners there was a shortage. Other two teachers mentioned that since they do not have an HOD at the moment it was difficult for them to access the teaching and learning resources. They said they are teaching using the 2017 tools and that limited them from obtaining updated information on teaching and learning materials.

Subject matter knowledge was strengthened by adding and integrating different domains of knowledge (Ball, 2008). Therefore, a good content-specific pedagogical preparation is also needed. Teachers with this sort of preparation would be able to create learning environments for their students that foster the development of students' mathematical power. They would also be prepared to pose tasks for their students that are based on sound and significant mathematics and to help students develop a coherent framework for their learning. Most participants claimed that the use of tools that contain instructional teaching strategies that they received from the program made their teaching more improved and effective than before. The teachers mentioned that they

are now able to teach with understanding while their HOD and tools construct their subject matter knowledge so that they will be able to assist their learners.

5.2.8 Pedagogical Content Knowledge (PCK)

The second domain of teacher knowledge identified by Hill, Rowan and Ball (2005) is pedagogical content knowledge. Adapting from Shulman's categories of teacher knowledge they defined pedagogical knowledge as the knowledge that involved knowledge of the curriculum materials for teaching, knowledge about the purpose of teaching a subject at different grades or levels, knowledge of learners understanding about different topics and knowledge of representations and strategies of teaching certain topics. Participating teachers pointed out that one of the key aspects that they learn from Jika Imfundo is pedagogical content knowledge but they were not aware of it.

Ball (2008) defined curriculum knowledge as the range of programmes that are designed for teaching a particular subject and topics at a certain grade or level. This includes the materials that are put in place for teaching that subject. In Jika Imfundo the participating teachers agreed that they were given mathematics tools including trackers according to the grades they teach. These trackers contained information about the mathematics content and concepts that they teach as well as the strategies for teaching that concepts. The trackers also identified pedagogical problems related to curriculum coverage, including the pace of a tracker compared to learners pace. In the tracker, teachers also found suitable materials that were useful to them in teaching and learning.

In this case, the trackers referred teachers to a list of recommended textbooks and page numbers that they consulted during teaching. They also received teaching aids that supplemented their textbooks and workbooks. Jika imfundo emphasizes what to be taught, how it might be taught and the steps or sequence of how it could be taught. However, some teachers found materials frustrating because they believe that they should use their own strategies to teach different topics. Some of these strategies were traditional forms of teaching; they did not consider a learner-centered approach that is why it was difficult for them to use learner-centered materials. Secondly, they complained that it was time-consuming to go through all the wide range of recommended textbooks to select the one that is suitable for them and their learners. They tend to choose those textbooks that they are familiar with not looking at the depth of information they got from different books.

Teachers also pointed out that in Jika Imfundo they acquire knowledge of mathematics and how to teach it since some of them they have no experience of teaching it. Through this programme, they were able to prepare for instructions and ways of delivering it to learners. They make use of presentation notes found in their CAPS documents. The tracker arranged for them mathematical topics and concepts that are related. It was the duty of the teacher to understand how he/she will teach these topics referring to the guidelines given to her by the programme. Teacher's reflection should indicate if the lesson was successful or not. Jika Imfundo emphasizes the importance of giving the learners an opportunity to construct their own mathematical knowledge and understanding so that they will become lifelong learners.

The teacher should relate mathematical topics to real-life situations of learners so that they make sense to learners. The time spent on mathematics tasks should also be taken into consideration as Jika Imfundo stated the time that should be spent on each activity. During Jika Imfundo training, they said the facilitators highlighted some points on quality of instructions that could be given to learners. For example, the activities should neither not too difficult nor too easy so that they will make transitions to new topics. The findings revealed that all the teachers participated in this study learned a lot from Jika Imfundo project.

5.3 Limitation of the study

The research study involved a small sample that was purposively selected. Six teachers teaching mathematics at different schools who participated in the Jika Imfundo 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 aim of qualitative research is not to generalize but the researcher tries to develop a complex picture of the issue under study (Creswell, 2013). My position as a foundation phase teacher also participating in Jika Imfundo in the same ward might have affected the participant's willingness to respond truly and freely because they would think I would evaluate their work and knowledge. However, at the beginning of this study, I explained my position that I am both a teacher and a researcher in order to ensure the reliability of the study. Most of the time the participants were using their home language (IsiZulu), but this has not affected the study negatively because participants did the proofreading in the transcripts.

5.4 Recommendations

Based on the findings of the study, I can recommend that Jika Imfundo programme should be implemented and conducted across all provinces in South Africa. Based on the research question one the study revealed that Jika Imfundo is an effective professional development activity because it provided all the characteristics of effective professional development activity mentioned by Desimone (2009). I suggest that all mathematics teachers should be given an opportunity to attend the training workshop, as it appeared that only the HOD, one mathematics teacher per school was invited to attend, and that led to dissatisfaction to participants. I also suggest that the time frame for classroom support and monitoring should be extended since some participants experienced dissatisfaction based on class visits. Regarding research question two, it was evident that teachers acquired different kinds of mathematics knowledge domains mentioned by Hill, Rowan and Ball (2005). I recommend that in Jika Imfundo teachers should be taught how to deal with learners who experienced barriers in learning. Lastly, I recommend that the activities in the tracker should also cater for those learners with barriers to learning as participants complained about the pace of the tracker.

5.5 Conclusion

This study was conducted with the objective of identifying the types of professional development activities that the intermediate phase mathematics teachers participating Jika Imfundo engage in and to determine the kinds of knowledge they acquire in Jika imfundo. This study discovered that a vital step in improving teaching should be better subject-matter preparation for teachers. Teachers mentioned that they enjoyed working with the toolkits and other resources provided to them. It makes their teaching work easier. Discussions suggested that Jika iMfundo had increased the teachers' and HODs knowledge on how monitor, plan and implement the curriculum through the use of tools for the curriculum management purposes and to ensure content coverage towards more effective learning and teaching. Jika iMfundo's approach to accountability and evidence-based approaches were raised, the teacher knows what to do as well as the HOD knows his/her duties and they are able to monitor and evaluate their work. It is easier for the teachers who left behind to access support from the HOD and his/ her peers for the collaboration and cooperation purpose. The findings and discussions also highlighted that Jika iMfundo has, for the first time, brought about uniformity in curriculum management within schools in King Cetshwayo District and circuits. All the participants remarked that Jika iMfundo helped them to deal with CAPS in a practical way and they implemented it successfully in their schools. One participant revealed that,

prior to her participation in Jika iMfundo, he could not understand CAPS documents the tracker helped them for unpacking CAPS since before Jika Imfundo there was no proper planning and monitoring. The ready-made lesson plans encouraged teachers to create a positive learning atmosphere and most participants effectively mastered curriculum coverage. Therefore, it can be concluded that the six teachers who engaged themselves in Jika Imfundo development activities inside and outside their schools acquired different kinds of mathematics teacher knowledge that influenced their teaching practice in a positive way.

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APPENDIX A: Ethical Clearance from University of KwaZulu-Natal



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Miss ENO Mpungose 217075583
School of Education
Edgewood Campus

Dear Miss Mpungose

Protocol reference number: HSS/0132/018M

Project title: What knowledge do Intermediate Phase Mathematics teachers acquire through participating in Jika imfundo: A case study of six teachers at Phangandawo Primary School in King Cetshwayo District

Full Approval – Expedited Application

In response to your application received on 12 February 2018, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL**.

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

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

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

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

Yours faithfully

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

/pm

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

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

Westville Campus, Govan Mbeki Building

Postal Address: Private Bag X64001, Durban 4000

Telephone: +27 (0) 31 260 3587/8350/4557 Facsimile: +27 (0) 31 260 4609 Email: ximbap@ukzn.ac.za / snvmanm@ukzn.ac.za / mohunp@ukzn.ac.za

Website: www.ukzn.ac.za

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APPENDIX B: Ethical Clearance from Department of Education



education

Department:
Education
PROVINCE OF KWAZULU-NATAL

Enquiries: Phindile Duma

Tel: 033 392 1041

Ref: 2/4/8/1397

Miss ENO Mpungose
PO Box 467
Nkandla
3855

Dear Miss Mpungose

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **“WHAT KNOWLEDGE DO INTERMEDIATE PHASE MATHEMATICS TEACHERS ACQUIRE THROUGH PARTICIPATING IN JIKA IMFUNDO PROJECT: A CASE STUDY OF SIX TEACHERS AT GRACE PRIMARY SCHOOL IN KING CETSHWAYO 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 November 2017 to 09 July 2020.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Phindile Duma at the contact numbers below
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report/dissertation/thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education.

King Cetshwayo Primary School

Dr. EV Nzama
Head of Department: Education
Date: 28 November 2017

KWAZULU-NATAL DEPARTMENT OF EDUCATION

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

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

APPENDIX C: Letter to the Principal seeking permission to conduct research

P.O BOX 467

Nkandla

3855

18 May 2018

The Principal

Phangandawo Primary School

Nkandla

3855

Dear Sir /Madam

REQUEST FOR PERMISSION TO CONDUCT A RESEARCH IN YOUR SCHOOL

RESEARCHER

Full Name: Esther Nomthandazo Onso Mpungose

School: Social Sciences

College: of Humanities

Campus: Pietermaritzburg

Proposed Qualification: Masters in education studies(TDS)

0761164596

Email: enompungose@gmail.com

SUPERVISOR

Dr Nonhlanhla Mthiyane

School: Social Sciences

College: of Humanities

Campus: Pietermaritzburg

Contact details: 033 260 6131 Contact:

Email: MthiyaneN@ukzn.ac.za

PROJECT TITLE: THE TYPES OF KNOWLEDGE THAT INTERMEDIATE PHASE MATHEMATICS TEACHERS ACQUIRE THROUGH PARTICIPATION IN JIKA IMFUNDO PROJECT: A CASE STUDY OF SIX TEACHERS AT KING CETSHWAYO DISTRICT.

I, Esther Nomthandazo Onso Mpungose, Student no 217075583, Med student, at the Humanities and social science at the University of Kwazulu Natal. I request your permission to conduct research project at your school entitled: The types of knowledge that intermediate phase mathematics teachers acquire through participating in Jika imfundo: A case study of six teachers at King Cetshwayo District. The aim of the study is to explore the kinds of knowledge that intermediate phase mathematics teachers acquire through participating in Jika imfundo project in our District, Cetshwayo District. Through your intermediate phase mathematics teachers, I hope

to understand the kinds of knowledge they acquire in Jika Imfundo as well as the types of professional development activities they engage in through this project. I guarantee that their responses will not be identified with their personality. Their participation is voluntary and there is no penalty if they do not participate in the study. The questionnaire for biographical details will take approximately five minutes to complete, and then the interview will follow for a period of one hour. As they will be participants in the study, they have a choice to participate, they are at liberty to withdraw at the study at any stage, and they will not be penalized for taking such risk. Their confidentiality is guaranteed, as their inputs will not be attributed to them in person, but reported as an opinion of a member in a population. Pseudonyms will be given to participants as a result it will not be linked to their names. The copies of drafts and the final dissertation will be made available to participants.

In the event of any problem or questions/concerns, you may contact the researcher or the UKZN Humanities & Social Sciences Research Ethics committee at the above-mentioned details. Your signature below confirms that you have read the above and you are willing to grant me a permission to conduct the study in your school. Please sign on the dotted line to show that you have read and understood the contents of this letter.

Thanking you in advance

Principals signature.....

Date.....

APPENDIX D: INFORMED CONSENT FORM

Social Sciences, College of Humanities,
University of KwaZulu-Natal,
Pietermaritzburg Campus,

Dear Participant

INFORMED CONSENT LETTER

My name is Esther Nomthandazo Onso Mpungose; I am a part time student studying towards Master's Degree in Teacher Development Studies at the University of KwaZulu-Natal, Pietermaritzburg campus, South Africa.

I am interested in exploring the kinds of knowledge that mathematics teachers acquire through participating in Jika imfundo project in King Cetshwayo District. I would also like to know the types of professional development activities that you engage in through participating in Jika imfundo. To gather the information, I am interested in asking you some questions in the form of interview.

Please note that:

- Your confidentiality is guaranteed, as your inputs will not be attributed to you in person, but reported only as a population member opinion.
- The interview may last for about 1 hour and may be splited depending on your preference.
- Any information given by you cannot be used against you, and the collected data will be used for purposes of this research only.
- Data will be stored in secure storage in the supervisor's office in the locked cabinet and destroyed after 5 years.
- You have a choice to participate, not participate or stop participating in the research. You will not be penalized for taking such an action.
- The research aims at knowing the kinds of knowledge you acquire from participating in Jika imfundo, as well as the types of development activities you engage in through this project.
- Your involvement is purely for academic purposes only, and there are no financial benefits involved.
- 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		

I can be contacted at:

Email: enompungose@gmail.com

Cell: 0761164596

My supervisor is Dr N. Mthiyane who is located at the School of Social Sciences, Pietermaritzburg campus of the University of KwaZulu-Natal.
Contact details: MthiyaneN@ ukzn.ac.za Phone number: 033 260 6131

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

Thank you for your contribution to this research.

DECLARATION

I..... (full names of participant) hereby confirm that I have been informed about the study entitled exploring the kinds of knowledge that intermediate phase mathematics teachers acquire through participating in Jika imfundo by Miss E.N.O Mpungose
I have been given an opportunity to ask questions about the study and have had answers to my satisfaction.

I consent to participating in the research project voluntarily and that I may withdraw at any time without affecting any of the benefits that I usually entitled to.

SIGNATURE OF PARTICIPANT

DATE

.....

.....

APPENDIX E: INTERVIEW SCHEDULE FOR TEACHERS

TITLE OF THE STUDY: WHAT KNOWLEDGE DO INTERMEDIATE PHASE MATHEMATICS TEACHERS ACQUIRE THROUGH PARTICIPATING IN JIKA IMFUNDO IMFUNDO: A CASE STUDY OF SIX TEACHERS AT KING CETSHWAYO DISTRICT

SECTION A

BIOGRAPHICAL DETAILS

1. Age group:

0-19	20-29	30-39	40-49	50-59	60-69	70+
1	2	3	4	5	6	7

2. Gender

MALE	FEMALE
1	2

3. Marital status

SINGLE	MARRIED	DIVORCED	WIDOWED
1	2	3	4

4. Level of education

4.1	Matriculation	
4.2	Diploma(specify)	
4.3	Undergraduate	
4.5	Postgraduate(Specify)	
4.5	Other(Specify)	

6. Please write down the subjects you passed in your matric (grade 12)

Provide the institution name where you received your teacher education(initially)	What qualification did you received there	Year obtained

7.

Teaching subjects you specialized in doing your initial teacher education	
---	--

8. What other professional/ academic qualification(s) you obtained?

Qualification	Year obtained	Institution	Specialization

9. How many years have you been :

9.1 Teaching_____

9.2 Teaching at this school_____

9.3Teaching mathematics_____

9.4Teaching mathematics at this school_____

10 What subjects are you teaching currently?

Subjects	Grade

SECTION B

1. Why did you choose to teach mathematics?

2. Who decides what teachers teach in your school?
3. How is the decision made?
4. Do you enjoy teaching mathematics? If given a chance or choice to teach another subject, which one would you choose?

QUESTIONS ADDRESSING KEY RESEARCH QUESTION 1

WHAT TYPES OF PROFESSIONAL DEVELOPMENT ACTIVITIES DO INTERMEDIATE PHASE MATHEMATICS TEACHERS PARTICIPATING IN JIKA IMFUNDO ENGAGE IN?

1. Please tell me about your involvement in Jika Imfundo
 - When did your school first get involved?
 - When did you get involved?
 - How did you get involved?
2. Please explain about the activities that you participated in, in Jika Imfundo
 - How many workshops have you attended?
 - What was the content of the workshop?
 - How many departmental meetings have you attended?
 - What was the content of the departmental meeting?
- Have you received any documents from Jika Imfundo project? If so, what are those documents? Can you please show me?
- How do you use these documents? Please explain.

How many workshops or meetings do you hold and what these workshops deals about?

- Do you plan together as subject (Mathematics) teachers? If so, do you engage yourself in reflective discussions?
- In your opinion, “teacher reflection part” is useful. Please explain.
- Have you ever hold one-on –one conversation with your HOD? What was the gist of that conversation?
- What the relationship is between what you do in JI workshop and CAPS training workshop?

- Do the facilitators or subject advisors do the follow up on the work done in JI workshop? If so, do they give support and guidance in your work?
- What kind of support you get from your HODs in terms of coaching and mentoring?
- As mathematics teachers in the IP or as clusters do you help each other or do you meet to discuss about mathematics teaching, if you do what actually happens in your meetings?
- To what extent has the Jika imfundo development activities shaped and organized your teaching of the mathematics?
- What suggestions and comments do you think of regarding Jika imfundo professional development activities?

QUESTIONS ADDRESSING KEY RESEARCH QUESTION2
RESEARCH QUESTION2: WHAT KINDS OF KNOWLEDGE DO INTERMEDIATE PHASE MATHEMATICS TEACHERS ACQUIRE THROUGH PARTICIPATING IN JIKA IMFUNDO?

- Earlier you mentioned that one of the activities you engage in in Jika Imfundo is attending workshops. Do you find these useful? Please elaborate on your answer .
- What they have you learnt so far from these workshops.

Probing questions:

- Have you learnt any instructional strategies to teach particular subjects> If so what are these/ (Give specific examples)
- How has what you learnt helped you in your teaching? (In relation to instructional strategies, classroom management strategies or assessment strategies?)
- Have you been able to implement all that you have learnt in your classrooms? Please give me one or two examples of this.
- What sort of knowledge and skills do you think mathematics teachers should possess?
- Would you say that the subject matter knowledge is more important than the methods of teaching that subject? Why?
- In terms of knowledge and skills required in teaching mathematics, were you prepared to teach mathematics when they assigned you to teach it?
- Have you ever observed any of your colleagues when they are teaching mathematics lesson? If so, what have you learnt from such observation? Do facilitators in JI workshop do modelled how to teach a particular topic?

- Has Jika imfundo provided curriculum materials that is CAPS aligned? If so to what extent do these materials helps you in content knowledge, knowledge of assessment and knowledge of the curriculum?
- Did the JI materials provide guidance on what to do at what grade? How?
- If you can comment on the JI curriculum planners and trackers, are they useful to use and easy to follow?
- Did they contain all the knowledge needed by the teacher in order to teach mathematics effectively?
- Is there any improvement in your mathematics classroom practice because of participating in Jika Imfundo?

THE END

THANK YOU