



UNIVERSITY OF TM
KWAZULU-NATAL

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**EXPLORING TEACHERS' PERCEPTIONS TOWARDS THE 1+9
MATHEMATICS INTERVENTION PROGRAMME FOR GRADE 9
MATHEMATICS TEACHERS IN UGU DISTRICT.**

By

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A Dissertation submitted to the School of Education, University of KwaZulu-Natal, in fulfilment of the requirements for degree of Master of Education (Mathematics Education).

Supervisor: Professor Sarah Bansilal

2018

DECLARATION

I, Itumeleng Matlali, declare that the research reported in this dissertation is my original work submitted in fulfilment of the requirements for the degree of Master of Education (Mathematics Education).

This dissertation has not been submitted for any degree or examination at any tertiary institution or university.

Where the use of other people's work has been made, such work has been duly acknowledged in the text and referenced.

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PREFACE

This dissertation comprises of the field work carried out in three clusters of Ugu district in KwaZulu-Natal from **March 2016 to December 2016** under the supervision of **Professor Sarah Bansilal (supervisor)**.

This is an authentic and original study by the author and has not been submitted in any form for any diploma or degree to any tertiary institution. Any information that has been used from other sources and work of other authors has been duly acknowledged in the text and has been referenced.

Itumeleng Matlali

December, 2018

ABSTRACT

This study explores teachers' perceptions of the 1+9 mathematics intervention programme for grade 9 mathematics teachers. This intervention programme is understood to be a professional development programme. The study explored the perceptions of teachers by looking at how it has contributed to their professional development in four aspects, namely: content knowledge, pedagogic content knowledge, professional confidence, and the benefits of professional learning communities (clusters). The study used qualitative method and data was generated from both the questionnaires and interviews. Questionnaires were given to fifteen teachers of whom ten were also interviewed. Data was then analysed by using coding strategies.

The findings showed an improvement on teachers' content knowledge and pedagogic knowledge. Teachers reported that their professional confidence was enhanced through participation in the programme. They expressed that the programme afforded them the opportunity to network with other teachers and how such professional learning communities were beneficial. Teachers explained that their understanding of, and how to teach the curriculum has improved, but expressed mixed feelings about their rate on its coverage. Hence, the need for professional development programmes on an on-going basis to benefit the teacher is very important to improve teachers' skills and learners' performance.

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DEDICATION

To my loving family, you have understood that I could not always be available for you during this period of my study. To Refilwe and Rethabile, young as they were, who sometimes stayed up in the night because they wanted to keep me company when I was doing my research. To my friends, for all forms of support you offered and for your prayers. To my late brother who would not see me graduate yet again.

ABBREVIATIONS

ACEML: Advanced Certificate of Education in Mathematical Literacy

ANA: Annual National Assessment

AMESA: Association of Mathematics Educators of South Africa

ATP: Annual Teaching Plan

CPTD: Continuous Professional Teacher Development

CTA: Common Task Assessment

DBE: Department of Basic Education

DIPIP: Data Informed Practice Improvement Project

DoE: Department of Education

ESSA: Every Student Succeeds Act

FET: Further Education and Training

GET: General Education and Training

HOD: Head of Department

KZN: KwaZulu-Natal

NLSA: National Strategy for Learner Attainment

PCK: Pedagogic Content Knowledge

PD: Professional Development

PILO: Programme for Improving Learning Outcome

PLC: Professional Learning Communities

PPN: Post Provisioning Norms

SADTU: South African Democratic Teachers' Union

SP: Senior Phase

TIMSS: Trends in International Mathematics and Science Study

WITS: University of Witwatersrand

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CHAPTER ONE: INTRODUCTION TO THE STUDY

1.1 Introduction

The improvement of teachers' practices through the medium of continuing professional development of teachers receives much attention in many countries. Most education departments recognise that on-going professional development is necessary for teachers to improve their teaching practices once they start their teaching careers (Jita & Mokhele, 2014). Therefore South Africa is no exception as the country is embarking on improving the professional development of teachers from various aspects.

Guskey (2002) views professional development as systematic efforts that bring about change in the classroom practices of teachers, in their attitudes and beliefs, as well as in the learning outcomes of learners. The research literature points to the observation that notable improvements in education almost never take place in the absence of professional development, thus change is almost impossible if professional development is not conducted properly (Guskey, 2000).

In South Africa, not enough attention has been given to teacher development by the Department of Education (DoE). The DBE (2015) has stated that they lag behind in terms of teacher development with specific reference to their Senior Phase teachers. In the problem statement of the 1+4 document, the DBE (2015) identifies some of the problems contributing to the low pass rate in mathematics in grades 8 and 9 was that, for the past 20 years the curriculum sector of the department has not implemented dedicated continuous teacher development on subject content and methodology. Rather, the sector has been occupied with preparing subject specialists and teachers to implement curriculum changes.

Other organs of state in collaboration with the department of education have so far introduced some teacher professional development programmes to improve the effectiveness of the teaching of mathematics at schools especially at both Further Education and Training (FET) and General Education and Training (GET). One such intervention, called "1+ 9", involves Grade 9 mathematics teachers meeting in clusters, once every two weeks to plan for lessons for the next 9 days.

Teachers have had different opinions about professional development; however, the researcher's belief is that having a good perception generally about a developmental

programme enhances interest to participate in it. The core objective of this study was to explore how teachers participating in the 1 + 9 mathematics intervention programme perceive the programme in terms of its contribution towards their professional development.

1.2 Purpose of the Study

The poor results of learners' performance in mathematics in international assessments such as Trends in International Mathematics and Science Study (TIMSS), and the Grade 12 national examinations have raised concerns amongst many stakeholders in South Africa. The Association of Mathematics Educators of South Africa (AMESA) (2012) argued that children's learning is influenced by a myriad of factors. One argument by AMESA is that the explanation for poor learner performance can be found in the quality of the teaching the children get; AMESA recommended that the department of education should attend to appropriate teacher professional development. As recommended by AMESA, the department of education has put in place an intervention programme for grade 9 mathematics teachers to address some of these factors. Therefore, this mathematics intervention programme, called 1+9, is intended to address issues of curriculum of grade 9 mathematics; the end result being to improve the pass rate of mathematics at grade 9 and probably the country's mathematics as a whole.

Nkosi (2008) argues that human development or professional development is based on the premise that employees are unceasingly helped in a planned way to obtain capacities that are necessary for their performance of different tasks that are related to their current expected roles and those in store for them. The 1+9 programme is based on a similar premise with the purpose of supporting teachers in the planning and implementation of lessons that they have to deliver to their students.

This study is new in South Africa and few research references are available but there has been some research in related areas about teachers' perception of professional development programmes in South Africa and internationally. For example, Brijlall (2013) explored teachers' perceptions of a professional development programme for mathematics literacy teachers. Brijlall found that the professional development of the participant teachers was improved by participation in the programme. The component of confidence appeared as a remarkable factor within Brijlall's research about how the teachers' knowledge developed. Their content knowledge and pedagogic content knowledge were enhanced and this

enhancement led to the growing confidence about themselves as mathematical literacy teachers.

During the twenty four years in the field of education as a mathematics teacher working in disadvantaged schools and communities, the researcher was exposed to different experiences about how teachers perceive the in-service training and how their perceptions sometimes help shape how they teach. It is this background that motivated the interest in this research.

The researcher is particularly interested in the grade 9 mathematics performance partly because of the reports about Annual National Assessment (ANA) and more so because of the attempts by the government to check and monitor performance at this exit level in South African schools. The efforts of the government so far have not yielded much as the performance at grade 9 is still at its lowest average of 10.8% since 2011 (DoE, 2014). One example of such attempts to monitor performance was the administration of what was called Common Task for Assessment (CTA). This CTA was also intended to encompass progressive education principles, such as child-centred learning, development of critical thinking and continuous assessment (Bansilal & Wallace, 2008), but this tool also revealed that learners' performance in mathematics was poor.

The DoE had also embarked on continuous research on performance of mathematics since 2011 to 2014 through the Annual National Assessment (ANA). It was observed that grade 9 learners got low average scores of 2.1 % and 13% in 2011 and 2013 respectively (DoE, 2014). Therefore, from these observations the need for DoE to come up with a sustainable, comprehensive, and intensive form of intervention to assist mathematics teachers was inevitable because teachers have been trusted with the responsibility and duty of intervening in identifying and addressing barriers to learning of their learners (Bansilal & Wallace, 2008).

As the response to what CTA and ANA results revealed, as well as informed by AMESA, the DoE devised a developmental intervention programme called 1+9. Here mathematics teachers met once in two weeks to discuss 10 lesson plans already designed by subject advisors (departmental officials) for the duration of a day and then went back to their respective schools to teach those 10 lesson plans in the remaining 9 days. This programme was intended to equip teachers with, but is not restricted to, the basic skills of planning, implementing, and execution of those lesson plans.

With this in mind, the researcher wished to investigate teachers' perception about the 1+9 intervention programme. The research intended to find out whether the way teachers perceive

this intervention programme would help turn things around in terms of teacher competence in content knowledge, confidence, compliance to curriculum and implementation

Dixon (1999) argues that there should be a link between learning, teaching, assessment, and intervention, and in order for teachers to implement this, they need to understand fully all aspects of the learning process. The researcher agrees with Dixon, because in the past the focus of the DoE had been on the development of assessment methods such as CTA and ANA, but not much attention was given to teacher professional development; thus, the link between teaching, assessment, and intervention was not strong enough. The national assessments CTA and ANA have shown that the use of national assessments did not lead to improvement in learner performance. Therefore, the introduction of this intervention programme came at an opportune moment for the researcher to investigate the link between the four components proposed by Dixon.

1.3 An overview of the intervention programme

(a) Understanding the 1+9 intervention programme

This mathematics intervention programme started off in South Africa as 1 + 4, where mathematics teachers in grades 8 and 9 met in clusters once a week to discuss lesson plans and methodologies. They went back to their schools to teach for the remaining 4 days of the week. Because of time constraints and other systemic challenges such as funding and material distribution, the meetings were converted to once a fortnight. The acronym “1 + 9” refers to the 1 day spent at the workshop and the 9 remaining days spent at school.

Some of the activities included the writing of the pre-tests and post-tests. The aim of these tests was to identify the teachers’ content knowledge gaps so that they could be provided with the necessary support while in the programme..

(b) The rationale of the programme and its objectives

The DoE, in noting the poor performance in the national assessments in the Senior phase in the years 2012, 2013 and 2014, that the NSLA sector did not implement dedicated continuous teacher development for the past 20 years, which focused on subject content and methodology, but rather it has been occupied with preparing subject specialists and teachers to implement curriculum changes (DBE, 2015).

The main aim and goal was to improve the current performance of an average score of 10.8% by a minimum of 300% to reach a target of 33%. The initial assumption by the department was that there were topics teachers found difficult to teach; as a result, the initial teacher professional developments were therefore focused on those topics. However, it was noted from the consistent drop in learner performance that teachers were struggling with the entire curriculum (DBE, 2015). The 1+9 mathematics intervention was adopted as an approach to assist teachers with the entire curriculum.

According to the department of basic education, the benefits were to equip the teachers with skills necessary for the curriculum and furthermore to expose them to an extensive engagement, which in return would promote the notion of a teacher being a lifelong-learner (DBE, 2015). The content and methodology of the subject were to be covered simultaneously in these meetings.

1.4 Rationale of the study

The 1+9 mathematics programme was introduced in South Africa in 2015 for grade 9 mathematics teachers. The common practice from many schools is that teachers who teach grade 9 also teach grade 8. The programme was intended for grade 9 teachers, but was also a development that would also benefit the FET band in the long run. This research took place in 2016, which means research in South Africa in this field is at an infancy stage. Furthermore, very little research has been done on teachers' perceptions on this intervention programme. This current study aims to fill this gap.

The national learning council for staff development defines professional development as a comprehensive, sustained, and intensive approach to improving teachers' effectiveness in raising student achievement, (DoE, 2015). From its inception this mathematics intervention programme was meant to be a comprehensive, sustainable, and intensive programme that would equip teachers to be conversant with, for example, the curriculum they teach and pedagogic content knowledge (PCK) aspects in general.

As mentioned in the introduction, the intervention came as one of the recommendations by AMESA's committee to DoE due to the poor performance of grade 9 learners of the ANA tests, with the purpose to equip and assist teachers. On the other hand ANA has had its fair share of criticism in terms of its objectives, how it was implemented, the timing of execution, level of difficulty and contribution to learners' progression, as well as the

frustration it has caused teachers (SADTU, 2014). It is in view of the background above that the researcher had an interest to conduct this study.

This study was set up to explore the perception of 10 Grade 9 mathematics teachers from three clusters under Ugu district towards the 1+9 programme. The aim was to discover how the programme has been received by teachers especially when they think that it came because of ANA.

It is hoped that the findings can contribute to improvements in the design and implementation of the programme. On a broader level, the study hopes to add knowledge about the influence of teacher professional development programmes on improving teachers' teaching practices.

1.5 Research questions

The critical or main research questions of this study were as follows:

1. What are some contributions made by 1+9 mathematics intervention programme towards the professional development of the mathematics teachers?
2. How has participation in the 1+9 mathematics intervention programme influenced teachers' professional development?

1.6 The context of the study

This study was conducted in South Africa, at Ugu district formerly known as the Port Shepstone district. The schools were organised into clusters for convenience of the teachers being able to attend (DoE, 2015). The current study selected participants from three clusters which are unique in many aspects. They are referred to as clusters P, Q and R for the purpose of the study.

Cluster P is a place which is mostly inhabited by one ethnic group from a low to average socio-economic background. Most learners are orphans living with their grandparents who rely solely on their social grants and the majority of people employed work in the sugar cane fields or are domestic workers with low wages. There is an electricity supply and the majority of schools use water from the tank reservoirs collected from the rain. There are gravel roads which are not usable during heavy rains. The learners walk long distances to schools and some are unable to make it to school if rivers flood, as their paths cross the rivers. The guardians of the majority of learners are illiterate, while a few are literate. The literate ones

are siblings to the learners. The core responsibility of learner-support in terms of school work is insignificant.

Cluster Q is almost in the heart of the town but schools forming this cluster are both urban and semi-urban. The participants were selected from former Model C schools (these were schools reserved for white children only under the previous apartheid government). Here learners are from mixed ethnic groups with the majority being Whites, Indians and a few Blacks. Learners are from families where there is at least one person who is professionally employed. Parents are educated and the understanding of learners' school work support is mandatory per school policy and practice. Roads are tarred and there is school transport for the majority of learners, while other parents use their own vehicles to transport their children to and from schools. Running water and sanitation are in place. Library and teacher assistants are also available.

Cluster R is comprised of a few urban schools, but the majority are rural schools. There are gravel roads but schools have electricity. There were three participants from this cluster, one from an urban school and two from rural schools. The urban school has a mixture of both Indian and African learners with the majority being Indians. The socio-economy of the population here is above the standard, at least one parent or guardian has an income (self-employed or from the employer). The school is equipped with study facilities like a library and laboratories. The school does not have teacher assistants. The population of the school of the other two participants is relatively similar to cluster P, for example, learners walk long distances to school. There is only one ethnic group in these two schools, the Blacks. There is neither a library nor a laboratory and there are no teacher assistants.

Factors such as proximity, time, and financial constraints informed the researcher's choice of the above context of the study as it was convenient to collect data and more importantly the participants met the criteria, as they were participants in the 1+9 mathematics intervention programme. Data collected was intended to assist the researcher to explore teachers' perceptions of this mathematics professional development, as well as how the programme has impacted on their teaching.

1.7 The overview of the thesis

Chapter one outlines the background of the study as well as its purpose. It highlights the rationale of the study as well as the context in which the study was carried out. The research questions are also stated.

Chapter two describes the reviewed literature which is relevant to the field of study from various researchers both locally and internationally, giving an insight into what has been discovered to date in this field. The chapter explores how professional development programmes enhance teachers' content knowledge, pedagogic content knowledge, curriculum coverage, and professional confidence. In addition, the role of professional learning communities as a mechanism to improve teaching will be discussed. The theoretical framework of the study is also discussed in this chapter.

Chapter three outlines the discussion of the methods and methodology employed in this study.

Chapter four presents findings as analysed from questionnaires and interviews.

Chapter five highlights a summary of the research findings and answers the research questions. This chapter also states the recommendations, the limitations of the study as well as the implication for further study.

1.8 Conclusion

This chapter introduced the study and further discussed the background, the rationale of the study, and stated the research questions. It also shed light on the context of the schools of the participants and presented an overview of this study. Teacher professional development can not only benefit the novice teachers, but it becomes very important for all in the education system because education is not a static phenomenon but dynamic and ever changing. Thus, to be correctly relevant and align appropriately with one's work as a teacher, it becomes necessary that teachers be life-long learners themselves (Thembela, 2012). The following chapter gives an in depth review of teacher professional development with a focus on other scholars' views.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter focuses on the review of the existing literature based mainly on teacher development programmes, which may have taken various forms such as once-off workshops, in-service training, and a continuous planned programme conducted over a period of time similar to the 1+9 mathematics intervention programme. This review looks at local research as well as other international research studies. This literature refers to books, journal articles, media reports, policy documents, dissertations, and theses. The literature review also compares what other researchers share about how professional development programmes help improve teachers' content knowledge, teachers' professional confidence, teachers' ability to cover the curriculum and the impact of professional learning communities in the teaching sector. The issue of networking or use of clusters in professional development interventions is examined. The next section explores and aligns the arguments by discussing the existing literature on the meaning of teacher professional development.

2.2 The meaning of teacher professional development

Steyn and Van Niekerk (2002) explain professional development as a formal systematic programme that is designed to assist professionals such as teachers promote their personal growth. Du Plessis, Conley and Du Plessis (2007) concur with the above definition and further summarise teacher professional development as the total sum of all the activities carried out by an individual or system in order to promote staff growth or renewal. Bansilal and Rosenberg (2011) argue that teacher professional development enables already qualified teachers to reskill in a new learning area. These definitions can be understood to mean that professional development is intended to encourage participants to pursue a quest for personal growth.

For teachers to achieve personal growth, it is important that they attend some form of professional development programmes. However, it is important that the development programmes are formal and systematically organised so that these programmes can assist the teachers to reskill in areas in which they need assistance, while also targeting the areas of greatest need within the system as a whole. Professional development programmes, according to the above definitions, should be designed such that they are in a position to address the aspect of a broader human growth or teacher growth so that teachers can attain such in relation to education. The type of growth to be experienced may involve the acquisition of

skills, concepts, and attitudes in order to enhance teachers' performance as argued by Guskey (2000).

On the other hand, Wideen and Andrews (1987) view teacher professional development as designed to encourage the continuous personal and professional growth of educators within a respectful, supportive, and positive climate. The use of the three key words, respectful, supportive, and positive climate, in the above argument suggests that when these three have been well taken care of in the design of the development programme, teachers will benefit from participating in such a development programme. The issue of support of teachers is also emphasised by other researchers such as Rathogwa (2006) when he acknowledges that the department of education has noted that without the support of teachers and support to teachers, fundamental policy changes can never be put into successful practice. Therefore, the DoE noted that changes will be effected by the assistance of the teachers; until such teachers have been through a development programme which informs them of what is required, educational policy will not succeed. Hence, the success of teacher development programmes depends on this two-way approach. The DoE needs teachers to implement education interventions successfully through development programmes, and teachers need support from stake holders for them to implement or participate in the interventions. Hence the need for regular departmental workshops or teacher development programmes so that teachers are kept abreast of the changes, as echoed by Bansilal, Webb and James (2015).

The professional learning association of United Kingdom (UK) called Learning Forward, (2010) defines professional development as a comprehensive, sustained and intensive approach to improving teachers' effectiveness in raising student achievement. The association views professional development as activities that are an integral part of the school and local agency strategies of providing teachers with knowledge and skills necessary to enable students to succeed in getting a well-rounded education. The association goes on to describe what these activities should not be and suggest what they should be; for example, they should not be stand-alone or one day or short term workshops, but rather activities that are intensive, collaborative, job embedded, and classroom focused. It is envisaged that programmes which emphasise these aspects will impact on teachers' effectiveness and also improve students' achievement.

The definitions of professional development as quoted from the Learning Forward association emphasise the words sustained, comprehensive and intense which are in contrast

to stand-alone, one day and short term workshop. This contrast informs what the developers of professional development should bear in mind if they want successful programmes. This means that the calibre of the professional development to yield the required results should be sustainable in order to achieve the intended objectives. Participation of teachers in a sustainable programme can be monitored and for those participating, the benefits will be great depending on what the programme has to offer. If a professional development programme is comprehensive, it would also touch on many aspects necessary to equip the participants with the skills that they need for their jobs.

According to Bansilal et al. (2015) professional development needs to provide opportunities for teachers to engage in critical reflection about the mathematics they teach, about its purpose, how they teach it, and why they teach it the way they do. This means it is important that teachers are assisted to reflect critically on their teaching by being critical about what they teach, why they teach it and for what purpose and to who do they teach it.

Moodley (2013) argues that professional development should be understood as a space to offer meaningful, intellectual, social, and emotional engagement with ideas, materials and with colleagues both in and out of teaching. Therefore, governments and departments find it necessary to design interventions in the forms of workshops or seminars with the aim to reskill and transform human resources so that participants can adapt to the changes in the country's education.

Mahlaela (2012) is of the view that professional development should be seen as a process by which teachers review, renew, and extend their commitment as agents of change to the moral purposes of teaching. Thus, when DoE or associations or sometimes Non-Government Organisations (NGOs) plan to run professional development workshops or programmes, it is to afford teachers space and time to review how they teach. By so doing teachers will be able to check if they are still in line with what the curriculum demands them to do or not.

The 1+9 mathematics intervention programme was a programme that ran fortnightly for two years; the long duration of this professional development programme became unique for grade 9 mathematics teachers. Professional development that is of a long duration and time span is more likely to contain the kinds of learning opportunities necessary for teachers to integrate new knowledge into practice (Penuel, Fishman, Yamaguchi & Gallagher, 2007). These teachers were exposed to opportunities to integrate new knowledge into practice.

While many researchers have argued that professional development is for teachers to reskill, integrate their knowledge with a new one, and extend their commitment as agents of change, Moletsane (2004) adds another dimension to the definition. He argues that professional development should be seen as more than mere learning of knowledge and skills; rather, it should include personal development, enabling teachers to grow in character and maturity, and also allowing them to cope with the multiple challenges placed on them.

2.3 Knowledge for teaching Mathematics

2.3.1 Content knowledge

This study considers two main dimensions to teacher knowledge, namely content knowledge and pedagogical content knowledge (PCK). Sullivan (2008) identified three perspectives of knowledge and stated that ‘the complexity and challenges of identifying expected knowledge for teaching of mathematics include:

- Knowledge of mathematics which deals with learners’ methods of finding answers through algorithms and intuitive reasoning;
- Knowledge for teaching mathematics that deals with the teachers’ ability to identify and link specific concepts within a question and link them to concepts in the curriculum; and
- Knowledge of pedagogy, where the teacher faces the challenge of converting the question to a learning experience.

The above three aspects overlap with Ball, Thames and Phelps’s (2008) view, who identified four domains of mathematical knowledge. One of their four domains is knowledge of content and teaching where “teachers need to know the sequence of the topics and the knowledge at the intersection of content and teaching” (Ball et al., 2008, p.401). Therefore, this shows how important it is that the initiatives of professional development focus on improving teacher’s content knowledge.

The importance of a teacher having a sound knowledge base cannot be over-emphasised. Brijlal (2013, p. 39) explains that “schools are only as good as their teachers, regardless of their high standards, how up to date their technology or how innovative their programmes”. Brijlal did a study with thirty one mathematical literacy teachers, and investigated how the Advanced Certificate in Education in Mathematical Literacy (ACEML) enhanced their

progress and improved content knowledge in their new studies. The findings revealed improved content knowledge as an emerging factor from the participants. The comments on improved content knowledge from the study resonates with what participants of 1+9 mathematic intervention programme explained as the benefits from this programme.

The subject knowledge on its own is insufficient, but the important issue is how to integrate further learning of the subject with learning about how students in school experience subject teaching (Adler & Reed, 2002). A teacher must be able to take the knowledge he or she has learnt and be able to deliver that content to the type of community of learners he/she teaches.

Bansilal (2012) believes that research should go further than just categorising the gaps in knowledge. It should also identify the ways in which such poor knowledge manifests in the classroom. The research can also be used by teachers to address the issue of lack of or gaps in content knowledge which affects classroom performance so that the perpetual decline of learners' performance can be curbed. The gaps in teacher knowledge may be manifested in the way they teach and probably in the way learners perform in the assessment, especially the external assessment which is one factor among many that contribute to learners' poor results (Widener University, 2006).

According to Kelly (2006), individuals acquire skills or knowledge in one setting which is particularly designed for a certain purpose, but they subsequently get to use these skills and knowledge and understanding somewhere else. Brijlal (2013) cautions that when designing interventions for teachers, it is important to consider the teachers' context because learning or development is going to take place in that context. She further argued that in line with the above points, there are two parts of learning which she classified as what a person learns as a set of knowledge, and the situation in which the person learns and experiences.

The school and education system can be categorised according to teachers' level of practice, Beeby's (1996). He further contends that there are different circumstances that are constraints to teachers' work especially in developing countries such as South Africa, which include different contexts in which they work. Furthermore, because of differences in the systems within which individuals work, any form of professional development needs to take into consideration the diverse contexts (which varies from deep rural places to urban in the KwaZulu-Natal province) in which teachers work. Participants in this study explained how working in their respective places (which range from suburban to rural) affects how they do their job and how their learners learn. Therefore, the teachers' contexts influence how the

content knowledge is passed to their learners. This 1+9 mathematics intervention programme was also about supporting mathematics teachers and assisting with the teaching of grade 8 and 9 mathematics.

2.3.2 Pedagogical content knowledge

Pedagogic content knowledge (PCK) is described by Shulman (1986) as subject matter knowledge which includes an understanding of what makes the learning of specific topics easy or difficult, and the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning of most frequently taught topics and lessons. One of the two main dimensions of teacher knowledge mentioned earlier under content knowledge was the pedagogic content knowledge (PCK). Content knowledge is a notion linked to PCK and it is inevitable that a discussion of one aspect will entail a discussion of the other; in fact Shulman (1987), in his professional knowledge categories, stated clearly that there exists interdependency between the categories (general pedagogic knowledge, content knowledge, curriculum knowledge, knowledge of learners and their characteristics) and these could not exist without each other. Teachers should know what misconceptions learners have and be able to use different skills and strategies in imparting the subject matter and giving meaning to it. Shulman (1987) further recognises PCK as having the greatest impact on teachers' classroom practice. The importance and relevance of PCK for quality education in a classroom cannot be overemphasised. This can be demonstrated when teachers have mastered the art of knowing the subject content and the manner in which the students can learn the subject content. Van Driel, Verloop and De Vos (1998) classify PCK into four components namely:

- Purpose for teaching mathematics;
- Learners' understanding, conceptions and misunderstanding;
- Curriculum and curricular materials;
- Instructional strategies and representations for teaching topics;

With good PCK the teacher should be able to map ideas that will enable him/her make decisions with regards to classroom objectives, the strategies he/she is going to use, tasks or assignment that will be given to the learners, curricular materials and assessment of learners.

Bansilal et al. (2015) describe PCK as the knowledge needed by teachers to mediate the teaching of the mathematics content successfully. PCK enables teachers to interpret the

subject matter and find different ways of representing it to the learners, further making it accessible to learners. Shulman (1987) further mentions that teachers require proper subject matter knowledge and a high level of PCK to ensure effective teaching. Teachers' mathematical knowledge was found significantly related to students' achievement gains in first grade and third grades by Hill, Rowan and Ball (2005). Given the amount of research supporting the importance of instructor knowledge, it is clear that the professional development plan must address the issue of content knowledge and pedagogical content knowledge for all mathematics teachers (Brijlal, 2013). James et al. (2015) support the view that teachers should develop PCK during the professional development programmes.

Brijlal (2013) also contends that not only is the teacher's deep understanding of mathematical content knowledge important, but his/her pedagogical knowledge also plays a key role in student learning. Teachers' content knowledge and PCK have also been shown to have a profound effect on the manner in which teaching and learning takes place. Ball et al. (2008) also emphasise the fact that "pedagogical content knowledge bridges the content knowledge with practice of teaching, assuring that discussions of content are relevant to teaching and that discussion of teaching retain attention to content" (Ball et al., 2008. p.3).

The findings of the study by Brijlal (2013) reveal various ways in which the PCK was enhanced. The study explored the contribution of ACEML towards mathematical literacy teachers' professional development programme. The teachers explained that after the ACEML programme they were able to take ownership of their subject and stated that they had become confident with their new content knowledge and the pedagogic content knowledge. Jita and Mokhele's (2014) study which was about teachers' collaborations or cluster approach to professional development discussed how best they can improve their content knowledge and PCK; the study found that teachers were able to make significant gains in terms of both content knowledge and PCK.

The actual classroom practice is that what the teacher uses for a group of students on a particular day with a topic can only be selected from the teacher's stock of his pedagogical knowledge (Graven, 2002) and when teachers are confident with their PCK, they are able to deliver their lessons with ease.

2.3.3 Curriculum coverage

Curriculum is a broad term with multiple definitions, and this study presents how some authors define curriculum. This study attempts to show how lack of curriculum knowledge affects teachers. The simplified definition by Jansen (1998) refers to curriculum as what is being taught, how it is being taught, and how it is managed.

Shulman (1986) explained that curriculum is represented by the full range of programmes designed for teaching particular subjects and topics at a given level with instructional material available to those programmes in particular circumstances. He further argues that teachers' understanding of the curriculum ought to go beyond their classroom practices. It must also include being cognizance of the various programmes and material for the given contexts.

According to studies there are different aspects that the curriculum theory usually focuses on. For instance, Aikenhead (2006) refers to the intended curriculum as accounts of what ought to happen in schools, and is compiled by the curriculum designers. The implemented curriculum refers to enactment of the interpreted curriculum in the classroom (Mils & Treagust, 2002) and the attained curriculum refers to the skills and approaches recognized in seminal and summative assessments.

For the purpose of this study, it becomes useful to think of curriculum as comprising of diverse levels of curriculum (Phaeton & Stears, 2017) in attempt to make its analysis and understanding to be more explicit. How researchers distinguish curriculum depends on the domain that is being observed. There are three common distinctions used in curriculum theory (Phaeton & Stears, 2017, Van den Akker, 1998); namely the intended curriculum, the interpreted curriculum, and the implemented curriculum, where the intended curriculum refers to strategies and actions that suggest what schools should be doing. The interpreted curriculum refers to curriculum by teachers and text book writers, and the implemented curriculum to the actual instructional practices and the attained curriculum competencies and approaches learners show because of the teaching and learning process. The above classifications merge together to reflect what should be expected to take place in the school (Umugiraneza, Bansilal & North, 2017). The findings of the study by Umugiraneza, Bansilal and North (2017) on teachers' understanding of the curriculum in relation to the mathematics and science teaching indicated that although 60% of the teachers in the study used the

curriculum, only 32% had some knowledge about how to incorporate it in when they teach as a result the students were affected. Also only a small number of teachers were able to see the link between the vertical and horizontal curriculum while the majority of teachers were not able to relate the two, being mindful of the fact that teachers are mainly the ones who often are closely working with students and are also entrusted with the responsibility to explain and outline curriculum objectives and hypothetical ideas into classroom practice. The study therefore suggested that curriculum dialogues be important factor to consider as part of the interventions by the professional development establishments. Furthermore, the results of the study suggested that training of teachers about the use of curriculum cannot be postponed further in order to enable them to connect content knowledge and pedagogic expertise to cater for curricular provisions.

In the DBE's circular outlining the plan to implement 1+4 mathematics intervention programme, the DBE explained why there was a need for the intervention. The initial assumption by the Department of Education in South Africa was that there were topics teachers found difficult to teach (DBE, 2015); hence, the focus on designing a professional development programme to equip teachers in that area. However, the department now has a new thinking, informed by the consistent drop in learner performance that teachers are having serious challenges not only with parts of the curriculum but the entire curriculum (DBE, 2015).

Bertram (2012) notes that numerous studies locate the poor learner performance to the attained curriculum, while some point to inadequate knowledge and poor teaching methods of the mathematics teachers (Motshega, 2016; Spaul, 2013). Moreover, others refer to inadequate analyses of the curriculum design (Mattson & Hartley, 2003), while others refer to matters such as tardy pacing, inadequate curriculum coverage and low level of cognitive demands of lessons (Reeves, 2005; Stols, 2013). Mji and Makgatho (2006), and DBE (2014, 2016) shared the same sentiment when they argue that one of the reasons identified for learners' poor performance in mathematics is inadequate curriculum coverage, with teachers apparently neglecting to cover certain aspects of curriculum. According to the curriculum management and delivery strategy of the KwaZulu-Natal Department of Education (KZN, DoE, 2012), there is a need for an effective strategy for monitoring curriculum coverage delivery that will inform the system of the extent to which the curriculum coverage has improved.

Across many studies, the consensus seems to be that South African mathematics teachers are struggling with implementing the school mathematics curriculum (Motshekga, 2016; Reeves & Muller, 2005). Some studies point out that curriculum is poorly taught by teachers who are unable to answer the questions in the curriculum in which they teach (Bohlmann, Prince & Deacon, 2017; Spaul, 2013; Umugiraneza, Bansilal & North, 2017). Pournara, Hodgen, Adler and Pillay (2015) argue that poor teacher training and insufficient resources have been the main obstacles which limit the implementation of the curriculum in schools across various areas. Hence, teachers are unable to perceive links between different parts of the curriculum (Ngxola, 2012).

A study by Reeves and Muller (2005) also revealed the limited curriculum coverage by teachers, with average coverage from 22% to 29% for grades 6 and 5 respectively. The greater concern was that of 71% of the topics were covered in grade 6, 50% and more were topics covered at least in Grade 5. Teachers' subject content knowledge and pedagogy knowledge may influence what parts of the curriculum teachers read and use within their interaction with students (Zangori, Forbes & Biggers, 2013). Jones and Eick (2007) argue that teachers' use of curriculum material depends on factors such as teachers' orientation towards curriculum material, their beliefs about their students, and level of comfort with the content or curriculum. Penuel et al. (2007) argue that professional development is widely believed to be required for supporting implementation of curricula. In addition, they further share that some large scale survey studies have shown how professional development can influence teachers' knowledge and practice. The findings by Reeves and Muller (2005) were that policy documents such as curriculum frameworks and guidelines in South Africa need to provide teachers with a clear picture and guidance in terms of pace that they need to maintain so that they can cover the curriculum. The study further suggests that teachers require more assistance with planning of work schedules and learning programmes across the grades and phases so that the curriculum across learners and learning careers could be achieved.

Amimo (2009) states that there will never be a perfect curriculum for all ages as the environment keeps changing and this creates new needs in the society. The curriculum has to change continuously in order to address these needs. Therefore, there will always be a need for the professional development to address the issue of improving curricular knowledge.

There are many interventions that the DoE has put in place to address the issue of curriculum; examples are 1+9 mathematics intervention and Jika iMfundo launched in 2015. The Jika

iMfundo intervention came as an initiative of the KZN DoE and programme for improving learning outcomes (PILO) to respond to poor results which are due to the problems related to curriculum (Mkhwanazi, Ndlovu, Ngema & Bansilal, 2018). The main aim of Jika iMfundo was, among other things, to provide district officials, teachers, and school management teams (SMTs) with appropriate tools and training to enable them to initiate professional, supportive and evidence-based conversations about curriculum coverage. Mkhwanazi et al. (2018) explored mathematics teachers' usage of the curriculum planner and tracker in secondary schools in King Cetshwayo and Pinetown districts as pilot districts. Their study was done in 14 schools with a total of 21 teachers participating. The initial results of their study revealed that the curriculum tools used in this intervention programme had low use rate especially in secondary schools. The study also discovered that there are issues with accountability with how the programme is run.

Therefore, the study suggests that any curriculum intervention should be accompanied by a focus on strengthening the internal accountability system within a school. Internal accountability is explained in this context as when teachers provide the necessary learning opportunities to learners so that the learners will have an equitable chance of participating in mathematics. Thus, this study further argues that accountability at the interface between the mathematics teacher and the HOD (who is the subject leader in the school) is a crucial layer within the reciprocal accountability system of the school as a whole. The principle of reciprocity is argued as very necessary and should be the governing principle between the school leadership and teachers (Mkhwanazi et al., 2018). "I can only do as a teacher, what I know how to do. So your responsibility as a leader is to set conditions in place that permit me to have access to the work that you as a leader expect me to do" (Elmore, 2004, p. 11).

Through his research, Taylor (2008) found that most teachers in mathematics did not have the knowledge that the curricula demanded to teach the learners proficiently. Hence in his study there was a need to emphasise some form of expertise knowledge, as the teaching of mathematics requires content knowledge as well as knowledge of the curriculum in terms of how learners learn.

The teachers further identified that they required help in terms of curriculum and assessment. The area of their concern was issues related to the interpretation of curriculum documents and assessment policies (Bansilal et al., 2015). One way in which teachers could be reskilled to be able to efficiently deal with the curriculum was by a teacher development programme.

Therefore, the 1+9 programme became relevant to what teachers lacked. Somehow the programme was going to address the issues of the curriculum, its understanding, and being able to unpack and implement it as attested by the participants in this study.

2.3.4 Improving professional confidence

Graven (2004) explained ‘the notion of confidence as pivotal in understanding and explaining mathematics teacher learning’. Her argument emerged from a study of mathematics teachers’ learning through a 2 year senior phase (grades 7-9) in-service teacher education programme which was structured to enhance participation in community of practice, in relation to South African curriculum change. She argued that confidence should not be considered only as internalised knowledge and belief but rather confidence is part of an individual teacher’s way of learning through experience (Graven, 2004). The study found that the on-going professional development within mathematics education enables and develops the confidence of mathematics teachers. Also of interest Graven found that confidence enabled some of her participants to accept that they do not have to know everything in order to be a competent professional mathematics teacher. The teachers in this study explained that instead of being shy that they may not know other things, they were rather able to work confidently from what they know to access necessary resources for that which they must still learn, positioning themselves as life-long learners. Graven (2004, p. 208) then summarises the above argument thus “Confidence as a product of learning which enabled teachers to move from being *teachers of mathematics* towards being competent and confident *mathematics teachers*”.

Another study which looked at the importance of teacher confidence was that by Brijlal (2013) where she explored teachers’ perceptions of a professional development programme for mathematics literacy teachers. The component of confidence emerged as a striking factor within her research about how the teachers’ knowledge developed. Their content knowledge and pedagogic content knowledge improved and this improvement led to an increasing amount of confidence about themselves as mathematical literacy teachers.

Lessing and Witt (2007), in their study titled “The value of continuous professional development: teachers’ perceptions”, found that 67% of the participants shared that participation in workshops on the continuous professional development (CPD), helped boost their professional confidence.

A further noteworthy finding in the study by Ingaverson, Meiers and Beavis (2005) was the role of follow-up support of a professional development at school level. This study examined the effects of structural and effects of professional development programmes on teachers' knowledge, practice and efficacy from 2002 – 2003. According to this study, teachers reported a significant increased sense of knowledge and confidence.

A survey of 764 teachers on teachers' perception on implementing computer technologies by Wozney, Venkatesh and Abrami (2006) found that one of the two greatest predictors of teacher technology use was their confidence, that they could achieve instructional goals in using technology. This study suggests that time and effort should be devoted to increasing teachers' confidence for using technology, instead of accomplishing administrative and communicative tasks to achieve student learning objectives. How teachers can be helped to gain confidence appears to be exposing them to (intense) situating professional development programmes within the context of teachers' on-going work (Wozney et al., 2006). For teachers possessing the relevant knowledge, confidence, and beliefs, it then becomes necessary to empower them to integrate technology into their classrooms in meaningful ways.

Ertmer and Ottenbreit, (2010) argue that one of the explanations for the gap between what teachers know and what they do relates to their confidence or self-efficacy for performing the tasks successfully. Ertmer and Ottenbreit (2010, p. 269) state, "The most powerful source of efficacy information is personal mastery followed by vicarious experience", and both of these provide useful strategies for building confidence among pre-service teachers.

However a change in teacher confidence can take an extended amount of time (Brinkerhoff, 2006) and it is best implemented in small steps. Therefore, when professional development is spread over a longer period, teachers are more likely to try new ideas in their classroom with confidence. Brinkerhoff's argument comes from his study which looked at effects of a long-duration professional development academy on technology skills, computer self-efficacy, integration beliefs, and practices, which found that after two years of professional development, teachers were less fearful and more confident towards using technology.

Ertmer and Ottenbreit, (2010) note that professional development programmes afford teachers the opportunity to observe others and when observing the successful, others can build confidence especially in observers who tend to believe in 'if he/she can do it, then I can do it too'. The more examples the pre-service teachers observe, the more likely they are to

gain the knowledge and confidence needed to attempt similar uses of technology in their own classroom (Ertmer, 2005).

Professional confidence is sometimes an important outcome of professional development, meaning even if the professional development programme did not necessarily aim for confidence, it may still emerge as a benefit to the participants. Rose and Bruce (2007) conducted a study with 106 Grade 6 teachers using 20 items on mathematics. This study was on professional development of teachers on efficacy, which consisted of one full day followed by three 2-hour after-school sessions. The study found that while the attention of that professional development for mathematics teachers focused on acquisition of instructional skills which was the main objective, their results indicated that PD contributed to more confident teachers.

Peters (2016) argues that teachers' professional confidence can also be found in the teaching process when teachers are fully equipped about what they teach and how to teach it. He locates professional development programmes as programmes which can be used to assist teachers to attain their professional confidence. He further contends that when teachers feel confident, they feel empowered. Therefore, a rich, broad, and well-focused professional development can also help boost teachers' confidence.

Graven (2016) asserts that a benefit of intervention programmes is that they can increase teacher confidence and commitment to practice that foreground sense-making and conceptual understanding of mathematics. She further notes that features of professional development which include changes in content knowledge and teaching practices would eventually lead to improvements in student achievement.

2.3.5 Professional learning communities (PLC)

Teacher professional development programmes have shown interest in collaborative forms of teacher-learning. Jita and Mokhele (2014, p. 790) explain "Networks, communities of practice [professional learning communities] and clusters are related concepts that describe forms of collaboration between schools and/or teachers that encourage learning". They further argue that in South Africa teachers' clusters represent relatively recent and popular experiments in teacher professional development and that there is no available evidence about their effectiveness. Learning communities and the concept of school clustering will be used interchangeably to refer to groups of schools that are brought together for what is mostly administrative or organisational capacity purposes. Although the concept of clusters can be

traced back further than the 1960s (Giordano, 2008), in recent times the concept with different names can be found everywhere in rural or urban areas of developing countries, and now has more objectives compared to the 1960s (Jita & Mokhele, 2014). They further argue that recently the objectives are not only restricted to pedagogy and administration but they also include economic and political tasks. In South Africa the teacher clusters represent recent experiences and are seen as being suitable for helping teachers to reskill in areas where they feel they need assistance.

The KZN DoE's adaption of the 1 + 9 methodology was that teachers will be grouped into clusters of between ten to twenty teachers, for which there will be a lead teacher in the ratio of one cluster leader to twenty teachers (DBE, 2015). To have a professional learning community, Owen (2014) suggests that it can start off with a small group of teachers who come together as a team to help one another to improve student learning. Members of PLC share and reflect on their practice and personal experiences, observe each other's practices and study and apply research and best practices together.

There is no universal definition of professional learning communities because it has different interpretations in different contexts. Some studies have consensus meaning that suggests PLC as a group of people sharing, and critically interrogating their practice in an on-going reflective, collaborative, inclusive, learning oriented and growth-promoting way (Mitchell & Sackney, 2000; Toole & Louis, 2002; Stoll et al., 2006).

Teachers are in the habit of networking, which sometimes was done informally between individual teachers with another or a group of teachers through meetings, communication, and dialogue or formally by institutionalising relationships (Lieberman, 1999). These networks have generated a process whereby teachers are able to communicate, observe one another's work, share, and develop expertise in various aspects of their teaching experience and practices (Huberman, 2001). Muijs (2008) further argues that schools in disadvantaged communities benefit more from teachers networking, as it offers them a platform to exchange teachers between the schools; combined resources, and leadership are also shared. The concept of clustering and collaboration for teachers was researched by Jita and Mokhele (2012) and found that there is no evidence of how effective it has been in relation to CPD. The findings of this study aim to fill that gap.

Stoll et al. (2006, p.223) further give a summary of PLC as a professional learning community in which "teachers in a school and its administrators continuously seek and share

learning in order to enhance their effectiveness as professionals for the benefit of the students". Seashore, Anderson and Reidel (2003) concur when they refer to PLC as an establishment of a school-wide culture that makes expected collaboration to be inclusive, genuine, on-going and focused on critically examining practices to improve student outcomes. While there are other benefits of effective PLC such as to promote and sustain the learning of all professionals in the school community with collective purpose, its core is to enhance students' learning (Stoll et al., 2006).

Learning communities are grounded in two assumptions: firstly, it is assumed that knowledge is situated in the day-to-day lived experiences; and secondly, that teachers who are actively engaging in PLC will increase their professional knowledge and enhance student learning (Vescio, Ross & Adam, 2008).

While some schools have a 'traditional community' where work is co-ordinated to reinforce traditions and other schools have a teacher learning community where teachers collaborate to reinvent practice and share professional growth, at the core of it, teachers will be able to help improve students' performance (Seashore et al. (2003).

Owen (2014) carried out a case study of three schools on PLC and his findings revealed that PLC support teachers in building skills and capacities appropriate to a changing role as co-learners and facilitators of student learning. Secondly, the study found that teachers in PLC are able to examine various sources of data about improvements in student learning, co-assess student work and debate its quality with the purpose of improving the quality of assessment tasks. In the process, teachers were open to learning from each other and adopt new innovative practices with on-going support within teams; the ultimate beneficiaries are the students.

Where a professional community exists teachers share and trade off many good attributes such as being mentors to others or advisors or specialists of their subjects. The other important aspects that PLC brings forth are peer coaching, team teaching and structured classroom observations which help to improve pedagogy and collegial relationships (Louis & Mark, 1998). The study by Louis and Mark (1998), with 24 schools which were a national sample of restructuring schools, brought out an aspect of pedagogy. The research looked at pedagogy and social structure of the classrooms in examining teaching practice, the connection between the quality of classroom pedagogy and the core existence of PLC. The

research reports that the presence of a professional community in a school contributes to higher levels of pedagogy.

Brodie (2014) argues that successful PLC creates environments where teachers can explore their strengths and weaknesses with colleagues, develop collaborative solutions to problems of practice and implement new ideas collectively for the benefit of students. She did a study with phase two teachers in the DIPIP project at the University of the Witwatersrand (WITS). Her findings led her to conclude that PLC can be a mechanism for supporting teachers to challenge fundamental assumptions about how they work with learner errors and to grow toward interpreting and engaging with learner errors and their knowledge. The ultimate focus of PLC in the school context is student learning and Vescio et al. (2008 p. 81) stress "... clear and consistent focus on student learning and reflective dialogue, which leads to extensive and continuing conversations among teachers about curriculum, instruction and student development".

On the basis of the survey by Ingaverson, Meiers, and Beavis (2005), which examined the effects of structural and process features of professional development programmes on teachers' knowledge, practice and efficacy, the professional community activity turned out to be a significant predictor of impact. The survey examined the extent to which programmes strengthened, or integrated with PLC and the impact of the programmes on the nature and extent of collaborative work amongst colleagues in their schools.

Scholars (Jita & Mokhele, 2012) and Muijs (2008)) concur that clusters have several advantages, including building strong teacher professional communities which enhances a school's general performance. A study by Avalos (2011) revealed the impact of co-learning as it was emerging strongly from the studies he reviewed. He explained that PLC may start with informal conversation exchanges in school cultures then continue in networking and interchanges among schools' situations and later be strengthened in formalised experiences such as workshops. Avalos (2011) further contends that teachers naturally talk to each other and such talks can take on an educational purpose.

2.4 Theoretical framework

The theoretical framework within which this study is located is teacher professional development. Generally teacher professional development can be seen as a formal systematic programme that is designed to assist teachers to promote their personal growth (Steyn & Van Niekerk, 2002). Wideen and Andrews (1987) emphasise that teacher professional development must take place within a respectful, supportive and positive climate. In terms of promoting personal growth of a teacher, it is important that professional development meets the teachers' needs. In developing a framework that can be used to understand the growth in the professional knowledge of teachers who were participants in the 1+9 teacher development programme, the researcher draws upon the four dimensions which are content knowledge, pedagogic content knowledge, confidence and learning in professional learning communities; these are described below.

2.4.1 Teacher's mathematics content knowledge

Many research studies point out the importance of teachers having a strong content knowledge in fostering the understanding of their learners as argued by (James, Bansilal & Webb, 2015; Bansilal & Rosenberg, 2011; Ball et al., 2008; Adler et al., 2009; Kriek & Grayson, 2009; Bansilal et al., 2015). Authors James et al. (2015) emphasise that teachers need to develop the necessary knowledge competence of the subject that they teach. Hence, mathematics teachers need to know, at the very least, the content of the mathematics they teach. In this category aspects of the teachers' content knowledge that is required for teaching Grade 9 mathematics are explored.

2.4.2 Teacher's pedagogic content knowledge

Subject matter knowledge on its own is not sufficient for teachers to teach mathematics effectively. Shulman (1986) refers to pedagogic content knowledge (PCK) as an in depth understanding of how the subject matter is to be taught: "The most useful forms of representation of ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations - in a word - the ways of representing and formulating the subject that makes it comprehensible to others" (Shulman, 1986, p.7). Grossman's (1998) four dimensions of classification of PCK include learners' understanding, conceptions and misunderstandings, curriculum, and curricular materials.

With good PCK, the teacher should be able to map ideas that will enable him/her to make decisions regarding classroom objectives, the strategies to be used, tasks or assignment to be given to the learners, curricular materials and assessment of learners.

Many researchers point out that successful teacher professional development programmes should enable teachers to improve their pedagogic knowledge (PCK) because of their participation in such programmes (Van Driel, Verloop & de Vos, 1998; Bansilal & Rosenberg, 2011).

Hence, in this category of the framework, the aspects of the teachers' PCK in mathematics which include teaching strategies; lesson planning; curriculum knowledge, assessment skills; as well as knowledge of learners' misconceptions are considered.

2.4.3 Professional confidence

Wenger (1998) explained that as teachers' learning changes, his or her identity changes in many ways. Graven (2004) argued that confidence should not be considered only as internalised knowledge and belief, rather confidence is part of an individual teacher's way of learning through experience. Her study found that on-going professional development within mathematics education enabled and developed mathematic teachers' confidence. Similarly, Brijlall (2013) found in her study that success in the formal professional development programme helped the teachers feel they had reached another milestone in their lives and that the subject revived their passion for teaching. Their new content knowledge as well as the new pedagogic content knowledge boosted their self-confidence (Brijlall, 2013).

In the current study, the aspects of teacher confidence related to their skills of learning and teaching mathematics, as well as their self-efficacy and willingness to share their knowledge and fears with other teachers are explored.

2.4.4 Teacher learning as part of a community

Lave and Wenger (1991) emphasised that professional development of teachers should involve teachers learning in an interactive manner, while engaging in a process of co-participation, and not as individuals. These authors prioritise the importance of participation in practices of a community and identity as primary features of learning (Lave & Wenger, 1991). Hence, teachers who participate in organised professional development communities are in a stronger position to increase their learning than those who do not. Learning communities are grounded in two assumptions; first it is assumed that knowledge is situated in the day-to-day lived experiences and the second is that teachers who are actively engaging

in PLC will increase their professional knowledge and enhance student learning (Vescio, Ross & Adam, 2008). Brodie (2014) argues that successful PLC creates environments where teachers can explore their strengths and weaknesses with colleagues, develop collaborative solutions to problems of practice and implement new ideas collectively for the benefit of students. The KZN DoE's adaption of the 1+9 methodology was that teachers will be grouped into clusters of between 10 to 20 teachers, for which there will be a lead teacher in the ratio of one cluster leader to 20 teachers (DBE, 2015).

In this category of the framework the ways in which the professional learning communities, represented by the 1+9 clustering, promoted the learning and teaching of mathematics by the teacher participants is considered.

2.5 Conclusion

This chapter gave a review of the literature and discussed the meaning of professional development as expressed by other scholars. Theories by Shulman (1987), Bansilal (2012), and Ball et al. (2008) were used to discuss content knowledge and pedagogic content knowledge as the main dimensions of teacher knowledge. The classification of PCK by Grosman (1998) was used to illustrate the importance of how sound knowledge is paramount for teaching and learning. How curriculum should be understood and managed was explored and the importance of adequate curriculum coverage was discussed.

The usefulness of the professional learning communities was also discussed and the notion of confidence highlighted itself through improved content knowledge, PCK and participation in the PLC. The chapter also discussed the theoretical frame of the study.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

In this chapter the research design and methodology that were used in the study will be discussed. The research method used which is the qualitative method will be presented. A brief explanation of the 1+9 intervention programme will be given. The selection of participants and a summary of their characteristics will be presented followed by a description of the data collection process. Finally there will be a discussion of issues of the validity and trustworthiness of the study and then a report of how the ethical considerations and challenges were addressed in the study.

3.2 Research paradigm

Epistemologically, this study is located under the interpretive paradigm. This is because the researcher wanted to develop a better understanding of the meanings, opinions, perceptions, attitudes and experiences relating to teachers participating in this mathematics intervention programme. The interpretivist philosophy suggests “reality is not simply to be observed, but rather interpreted” (Corbetta, 2003, p. 21). The interpretive paradigm was suitable for this study because, among other things, it allows the researcher to find the ultimate goal of deepening the understanding of complex phenomena instead of making simplistic predictions or quantified measurements. The research studied participants in their natural settings, and as such interpretive paradigm assisted in providing rich descriptions and explanations from the perspective of the participants (Denzil & Lincoln, 2005). According to Neuman (2000), the interpretive approach is the systematic analysis of socially meaningful action through direct and detailed observation of people in their natural settings in order to arrive at the understandings and explanations of how people create and uphold their social world. While questionnaires were used to arrive at socially meaningful action, the researcher felt it was important to conduct semi-structured interviews so that detailed behaviour of participants could be observed as well.

At conceptual level this study was linked to the effectiveness and usefulness of the developmental intervention for grade 9 mathematics teachers with the relationship to assessment results from their learners. Nkosi (2008) argues that human development is based on the premise that the employees of an organization are continuously assisted in a planned

way to acquire or enhance capacities required to perform various tasks associated with their present and future expected roles.

3.3 Research design and methodology

A research design is intended to give an overview of how data is to be collected, what research instruments will be used, and how these instruments help. The evidence collected was used to assist in the exploration of teachers' perceptions of the mathematics intervention programme, as well as how it impacted on their teaching. On one hand, a research methodology explains the theory of getting 'knowledge' from the relevant source or people perceived to be rich with knowledge and assist in conducting the study.

This study adopted a qualitative approach as its research design method. Qualitative research is a naturalistic study which seeks to understand a certain phenomenon (Smith, 2005). Smith further argues that qualitative methodologies such as observations and interviews are important in research in order to explore day to day interactions. This is also supported by Neumann (1997) who highlights that qualitative data are empirical and involve documenting real events, recording what people say and observing specific behaviours, written documents or examining visual images.

The qualitative approach aims to elicit rich experiential and interpretive data about teacher professional development of the participants of this 1+9 mathematics intervention programme, within which it is negotiated and made meaningful (Crawford, 2009).

The design in this study is that of a case study of 10 grade 9 mathematics teachers from three clusters organised under Ugu district, by case in this context the researcher refers to a group of participants in the 1+ 9 programme. A case study is described as an investigation approach used to describe a complex phenomenon thoroughly, in order to unearth new and deeper understanding of that phenomenon (Lapan, Quartaroli & Reimer, 2012). Zaidah (2007) concurs by arguing that case studies explore and investigate contemporary real-life phenomenon through detailed analysis of a limited number of events or conditions and their relationship. Zaidah further elaborates that a case study enables a researcher to examine the data closely within a specific context. Additionally, in a case study method, a researcher selects a limited number of individuals within a small geographical area like it was done in this study. A case study research is comprehensive and involves in depth inquiry into a small number of defined cases (Cousin, 2009).

3.3.1 Sampling of participants

According to Cohen et al. (2007) researchers can handpick the cases to be included in the sample on the basis of their judgement of the particular characteristics being sought from the participants. In this study the participants were handpicked from a sample of teachers participating in 1+9 mathematics intervention programme because they had in-depth knowledge about what the study intended to explore. This is supported by Stakes (2005) who recommends that the researcher should choose participants from whom s/he could learn the most.

The study is a qualitative research and the sampling of participants adopted purposive sampling because the study is not intended to generalise the findings to the rest of South Africa, this programme was the national programme (done country-wide). To ensure that the sample was credible and covered the main groups in which the researcher was interested, one strategy that was used was maximum variation sample (Patton, 2007). This strategy involves selecting demographic variables that are likely to have an impact on participants' view of the topic; such variables include age, socio-economic background, rural or urban as well as ethnicity. In this study, the participants included various combinations of variables, they were of different age groups, and gender is well represented. Participants worked in schools where there are low and high income earning parents. Schools are from rural areas, while some are from urban areas, and the study covers different ethnic groups. Schools for this intervention programme were grouped into 13 clusters according to the proximity of the schools to one another and the centrality of the host school. Participants of the study came from clusters P, Q and R with a population of 8, 9 and 14 members per cluster respectively. The two cluster coordinators who took part in the study also came from two of the three clusters mentioned above.

The participants had been in the programme since its inception in 2015 and the study was done in 2016. As a facilitator in the 1+9 mathematics intervention programme, I was in contact with participants twice a month from one of the participating clusters, so I approached them to take part in the research. I had forged a good relationship with the participants during the sessions, so it was easy for me to get them participate in the study. The choice to use these participants in the study was because of proximity to the researcher's work place and most importantly they attended almost every session of the programme. The convenience sampling method used in the study is a non-probability sampling appropriate for

qualitative research and according to Cohen et al. (2007), it involves choosing the nearest individual to serve as respondents. The study was concerned with grade 9 mathematics teachers' perceptions of the programme and its impact on their teaching. These participants were best placed as they had been in the programme for the second year and they taught mathematics in grade 9 prior to the programme. According to Bernard (2000), in purposive sampling, the researcher decides for what purpose s/he wants the participants and goes out to find such participants for the purpose intended.

The 1+9 intervention programme is constituted by three parties, the department of education, the grade 9 mathematics teachers, and the cluster coordinators. However, this study data was collected from the two latter parties, namely the grade 9 mathematics teachers and cluster coordinators.

3.3.2 Characteristics of the participants

The following tables present the profile of the participants at the three clusters as well as the two cluster coordinators who took part in the interviews. The teachers in the study are identified as TA–TH, whereas the clusters are named P, Q, and R. The cluster coordinators are named CA and CB.

Table 3.1: Teachers at cluster P

Codes for teachers	Gender / Race	Teaching Math experience (in years)	Teaching experience @ grade 9 (in years)
TA	Male / African	5	3
TB	Male / African	5	2

Table 3.2: Teachers at cluster Q

Codes for teachers	Gender / Race	Teaching Math experience (in years)	Teaching experience @ grade 9 (in years)
TC	Female / African	9	7
TD	Female / African	22	22
TE	Male / African	24	20

Table 3.3: Cluster R

Codes for teachers	Gender/ Race	Teaching Math experience (in years)	Teaching experience @ grade 9 (in years)
TF	Female / White	7	2
TG	Female / White	3	3
TH	Male / African	1	1

Table 3.4: Cluster coordinators

Code of teachers	Highest qualification	Teaching Math experience (in years)	Teaching experience @ grade 9 (in years)
CA	NPD, ACE and Maths 2	7	6
CB	PGCE, Stats in Maths and Physical Science	12	7

The tables above present attributes of the two categories of participants in this study, namely the grade 9 mathematics teachers who took part in the 1+9 mathematics intervention as well the two cluster coordinators. It is important to note that the cluster coordinators were trained in mini-workshops every term before they could facilitate the discussions of the meetings of these sessions.

3.4 Data collection instruments

The aim of the study was to explore teachers' perception about 1+9 mathematics intervention programme with grade 9 mathematics teachers. To gather such data two instruments were used, namely questionnaires and semi-structured interviews which were audio taped.

Twenty teachers out of thirty one took part in completing the questionnaires; however, not all of the questionnaires were fully completed. Of the twenty participants who were given the questionnaires, only fifteen were fully completed and then analysed. The questionnaires were

given to participants at two main locations which were at the cluster meetings as well as the schools of the participating teachers. At the cluster meetings, participants were asked for their consent and freely participated. They used their lunch time to complete the questionnaires, while others took the questionnaires home to complete. A register of those to whom the questionnaires were given was made to enable collection from the participating teachers. This approach was applied to participants in the cluster where the researcher was also attending the 1+9 intervention programme; therefore, means of collection was arranged as all participants stayed nearby. For those given to participants from the other two clusters, the researcher had to wait for them to be completed and then collected them on the same day as the researcher wanted to guarantee the protection of participants' views. This was because if they were left at school, there was a risk that they might be read by anyone around the school.

3.4.1 Questionnaires

The aim of the questionnaire was mainly to elicit biographical data of each participant as well as some details about how participants used the time spent at work preparing for teaching and the actual teaching. The questionnaires comprised of four sections: Section A was about the biography of the participants, and preparation time for the class, their involvement in any PD programmes as well as finding information about curriculum tracking and coverage; while in section B they were asked to choose from 'strongly agree' to the other extreme 'strongly disagree' and this section wanted information regarding their school context as well as checking their opinion about the 1+9 intervention mathematics curriculum of grade 9. This section also required participants' views about the usefulness of the 1+9 in their teaching. Section C was about participants' understanding of the 1+9 mathematics intervention programme. The responses were from 'strongly agree' to 'strongly disagree'. Section D was open-ended questions intended for rich and free account responses. This section was about participants' general view about the 1+9 mathematics intervention programme. Furthermore, the open-ended questions were used to triangulate the data provided by these questionnaires and interviews. The questionnaire appears in Appendix 3.

The questionnaires were given to the participants individually by the researcher prior to the actual completion/ responses so that participants had time to interact with the instrument before they attempted answering. Moreover, in cases where the participants needed clarity in terms of what was meant the researcher was there to provide such clarity without necessarily

influencing the responses. As the participants were not in one venue and they did not participate all at the same time, it was important that permission from the principals was sought first before the research tools used were administered to them.

The questionnaires were not the primary source of data for this study but instead were administered with the intention to gain a general understanding of the study and an initial insight of how teachers perceived the programme. More detailed methods such as interviews were employed in an attempt to gain a rich, descriptive interpretation of the participants' perceptions.

3.4.2 Semi-structured interviews

This study is qualitative and is informed by an interpretive paradigm, so the use of interviews as an instrument to collect data was paramount. By its nature interpretive paradigm informs the researcher that humans are not only seen as just manipulative objects from whom data can be captured, but rather regards knowledge as generated between two humans through conversation (Cohen et al., 2007). They further argue that the order of interviews may be controlled while giving space for spontaneity where the interviewer can press not only for complete answers, but for responses which seek complex and deeper issues. Therefore interviews became the best tool to help the researcher collect data.

According to Cohen (2006) interviews enable participants to discuss and interpret the world in which they live and how they perceive situations from their own viewpoint. As put across by Bertram (2004) interviews are a good research tool that can be used for finding out a person's knowledge of the issue under discussion. In general, one can say that an interview is not simply concerned with collecting data about life but it is a part of life itself as its human embeddness is inescapable (Ndlamlenze, 2011).

In this study semi structured interviews were chosen in order to be able to get in depth knowledge about how educators perceive the 1+9 mathematics intervention programme. Semi structured interviews are more flexible and allow the interviewer to probe for more meaningful information about the topic (Ndlovu, 2012; Kremer, 2005). As an attempt to find responses which the questionnaires could not supply in detail, it was of the utmost importance that the interviews sought to get informative responses to the questions posed. Ndlovu (2012) expresses the other benefit of the interview is that the interviewer can observe nonverbal behaviour from participants, since the interviews are conducted face to face. As

this was not a group interview but an individual interview, the interviewer got independent responses because participants were not assisting one another and this allowed for resourceful responses. Interviews were conducted at the individual schools of the participants. The duration of the interviews ranged from thirty minutes to one hour. However, there are some disadvantages with interviews, for instance, the time restraints. Interviews are lengthy and require more time, which is a challenge when one has to get an appointment with educators who have busy work schedules. Another problem is that the participants may wish to respond according to what they think the interviewer expects from them instead of genuinely expressing how they feel; this poses a factor of biasness. In order to address the above challenges, the participants were given the interview schedule to read through the questions. It was also clarified that this study intended to improve the intervention programme and to inform the department of how the programme might be improved. Therefore, it was important that the participants expressed what they thought and felt about the development programme.

With the interviews, there were ten participants. Of the ten participants who took part in the study, eight were participating teachers and two were cluster coordinators. The interview schedules appear in Appendices 4 and 5 respectively.

These interviews were audio recorded. The recordings allowed the interviewer to be more attentive and the interviewee to concentrate. They gave an opportunity for the exact words of the participants to be captured (Patton, 2002). Bernard (2000) regards tape recordings as permanent records of primary information. The field notes may be misplaced and fade with time but recordings can be kept for a long time.

3.5 Data analysis procedure

Data analysis is a systematic and taxonomic process of sorting and classifying data with the aim of searching for patterns in the data, recurrent behaviour, or a body of knowledge (Srivastava & Hopwood, 2009). Once a pattern is identified it can be interpreted in terms of a social theory or the setting in which it occurred (Neumann, 1997). With qualitative data, analysis is primarily an inductive process whereby data is organized into categories and patterns from data identified into categories, (McMillan & Schumacher, 2001), then conclusions and theories may be drawn. Srivastava and Hopwood, (2009, p.77) argue that “the patterns, themes and categories of analysis emerge out of data rather than being imposed on data prior to data collection and analysis”. However patterns, themes, and categories do

not emerge on their own, rather they are driven by what the researcher wants to know. Data analysis can also involve examining, sorting, categorising, evaluating, synthesising and reviewing the raw and recorded data (Cohen, 2007), but it does not suggest that the steps are done in a linear fashion. Therefore, the researcher focused on how people expressed themselves verbally in their everyday social life.

Formal systems of analysing qualitative data such as coding strategies were used in this study. These systems assisted the researcher to mark the underlying ideas of data by grouping similar kinds of information together in categories, bringing similar ideas and themes together in order to synthesise and summarise observations made from the data (Cohen et al., 2007, and Rubin & Rubin, 1995).

Once questionnaires were collected, data was read, collated, and summarised. For the interviews, the first stage of analysis process involved transcribing fully all the audio-taped oral interviews into written form to help the research analysis process. Throughout the process of data analysis, the researcher maintained a reflective research diary, which was used to keep notes and develop thoughts arising from the data and the process. Transforming qualitative data into meaningful and relevant findings through the analysis is “commonly iterative, recursive and dynamic” as well as complex, partly due to “multiplicity of data sources and forms” (Crawford, 2009, p. 95).

The interviews allowed the researcher to gain deeper insight into the individuals’ experiences because interviews involved close interaction with the participants (Graven, 2006). Analysis of data generated from the interviews involved a lot of moving ‘back and forth’ in order to make sense of the data.

The critical research questions were used to categorise data into themes. The themes were further broken down to supply data. The researcher was then able to elaborate on the findings, draw conclusions, and make recommendations. Because this study adopted a qualitative approach, the analysis was interpretive, more of a reflexive, reactive interaction between the researcher and interpretations of the participants.

3.6 Reliability and trustworthiness

Cohen, Manion and Morrison (2007) explain that reliability in qualitative research is when the researcher’s recorded data and what actually happened in the natural setting reflect the same information. In this study interviews, as one of the data collection methods, were tape

recorded and transcribed. One way of ensuring the reliability, is to verify the written transcripts, with the audio tapes. In this study, the interviews were transcribed by a research assistant. The researcher then listened to each interview and corrected the transcripts wherever necessary to ensure that the written transcript captured the interviews accurately. Similarly the data that was captured from the questionnaires was laboriously checked and cleaned before the analysis commenced.

3.7 Triangulation

To ensure validity and hence credibility, of the findings in this research, the methods of collecting data were triangulated in order to support, confirm, or disconfirm findings that emerge from one data source. Cohen et al. (2007) defines triangulation as the use of two or more methods of data collection in the study, in this study questionnaires and semi-structured interviews were used as methods of data collection. According to Vilakazi (2010), triangulation is based on the assumption that the biasness inherent in a particular data source would be neutralised when used in conjunction with other data sources, investigators and methods.

3.8 Ethical considerations

It is very important for a researcher to consider the ethical issues when conducting a study, especially when there are participants involved. These issues include autonomy, beneficence, as well as justice (Patton, 2002). It implies that the participants have the right to determine which activities they would or would not participate in. The researcher had an obligation to maximise benefits for the participants, but at the same time to minimise the risk to the participants.

The researcher abided by the ethical procedures of both the University of KwaZulu-Natal and the department of education in KZN. The certificate of clearance from the department of education in KZN, consent forms of participants and letters of permission from gatekeepers at the research sites are attached as Appendices 1, 2, 6 and 7.

The participants were given consent forms which clearly explained the intention of the study, and were afforded the opportunity to ask questions for clarity. The forms clearly showed that this was a voluntary participation from which they were free to withdraw any time they felt they no longer wanted to participate in the study and that the information would be kept as confidential as possible by the university. In summary, the consent forms ensured full

knowledge and cooperation while relieving or resolving any possible tension, aggression, resistance or insecurity of the participants (Strydom, 2006). These forms ensured the participants' right to privacy, anonymity, as well as confidentiality. Pseudonyms were used instead of their true names (Haverkamp, 2005). They also had a right to the information given about them.

3.9 Limitations of the study

The participants of this study were teachers participating in the intervention programme. Since it is a new programme, department officials had subjected the teachers to some form of monitoring checks by interviewing them. This fact made the participants reluctant to participate because they were thinking that the information might be used against them by the department; therefore it became very important to explain that it was for the purpose of the current study as was stated on the consent forms. They were informed that the information shared with them would not be in any way used by the department to victimise them. In addition, the participants did not write their names or put any form of identity in the questionnaires. As with the semi-structured interviews, they did not introduce themselves by their names.

3.10 Conclusion

Throughout chapter, a comprehensive account of the philosophy and methodology of the study have been presented. In order to answer the critical questions of the research, the study was conducted through qualitative methods using a case study approach, where questionnaires and semi-structured interviews were employed.

In this chapter, the researcher contended reasons why the methodological approaches selected for the study were the most suitable in order to allow the voices of the participants of the 1+9 mathematical intervention programme to be heard. The case study research reflects on human experience especially of those with the experience related to the study (Stake, 2005). Thus the study does not suggest that the findings could be generalised as being pertinent to all the districts of South Africa, but gives an insight into general perception and impact of 1+9 mathematic intervention for grade 9 mathematics teachers. However, the findings of this study may not essentially be “generalised in the usual sense of the word; they may be transferable” (Crawford, 2009, p. 99).

An account of participants' sampling was also given. The rationale behind the use of more than one instrument to collect data as aligned with triangulation was clarified in order to address the aspects of reliability and trustworthiness. This study, like many others, has its limitations; these and efforts to respond to such challenges were given.

The manner in which the validity and reliability of the study were enhanced, as well as ethical considerations, were outlined in this chapter. As for the ethical considerations, permission was sought from the gate keepers and the informed consent forms were signed by the participants.

CHAPTER FOUR: DATA PRESENTATION AND ANALYSIS

4.1 Introduction

This chapter presents, discusses, and analyses the data generated from the questionnaires as well as in-depth interviews with the grade 9 mathematics teachers in the three selected clusters organised under Ugu district. The 1+9 is constituted by three parties, the department of education, the grade 9 mathematics teachers, and the cluster coordinators. Of the ten interviewed participants who took part in the study, 8 are participating teachers and the other two are cluster coordinators. This chapter presents the participants' brief characteristics, identified themes, quotations from the participants' statements in order to emphasise their meaning and understanding of the questions asked, and is followed by a discussion of each theme.

4.2 Characteristics of the participants

The previous chapter gave a detailed profile of the participants in the study. These participants were teachers who were in the 1+9 mathematics intervention programme at the time of the study. Nine of them had been participants since 2015 when the programme was launched and only one started in 2016. Their teaching experiences of grade 9 mathematics ranged from one year to twenty two years. Their schools ranged from rural to suburban in terms of the geographical context.

4.3 Data presentation and analysis

The previous assumption by the department of education after observing a decline in the performance of grade 9 learners from the ANA tests for the years 2012, 2013 and 2014 was that teachers were struggling with some topics. Nevertheless, with learners achieving below the national average of 11% in their ANA examination, the DoE concluded that this assumption was not accurate. The new approach and understanding is that teachers are struggling with the entire curriculum (DoE, 2015). The department therefore decided that a robust and unconventional approach was required in order to turn this situation around so that the learners' performance can be improved.

4.3.1 Participants' understanding of a teacher development programme and the aims of the 1+ 9 intervention programme

Participants shared different views about what they understood about a teacher development programme in general and what they perceived to be the aims of 1+9 intervention

programme. For almost all the participants, the aims of this 1+9 intervention programme were not clearly explained to them. When asked how they did they know about the programme this is what the participants explained: that the circular was issued by DoE to the schools for mandatory attendance and people who were called for this meeting were the principals of the schools. The principals of the schools, by the nature of their job description as managers, are not closely connected to the content of what is being taught. Rather, people who are better placed to have a productive discussion when it comes to understanding the aims of this intervention programme are the HODs, since many are currently teaching the subjects under discussion even if it is in a different phase (FET or GET). Therefore, for all the participants, their understanding of the programme is what they made of it from participating.

In this study the researcher aimed to find out if there was a correlation between participants' understanding of the 1+9 programme and a teacher development programme in general. The six main ideas that emerged from the interviews about the different aims identified by the teachers are discussed below.

4.3.1.1 *To provide help and support to teachers*

For some participants professional development is something that is used for guidance to help teachers. *TA* explained that the programme was “...a way to try help and guide the teachers”. Some participants were a little more specific in their understanding that teacher development was a sort of an in-service programme where teachers come together to share their problems. When teachers present and discuss the problems presented, they can all make suggestions on how to address these problems. This view was captured in the comments below:

TB: ... because teachers share, we come with different ideas on how to deliver different topics to different learners because teachers are not the same.

Emphasising how strongly *TB* felt about his view on the importance of sharing ideas he further added this comment, “*It is good because we come to share things, a teacher cannot know everything*”. In the above view teachers see themselves as helping one another and addressing issues collectively.

4.3.1.2 To improve the professional knowledge of the teachers

Many participants referred to the aim of the programme as being related to improving their own professional knowledge. Some specific aspects of professional knowledge were identified such as content knowledge, pedagogic content knowledge, and keeping abreast of new developments.

For some participants the aim of the 1+9 intervention programme was to equip teachers with the necessary content that they needed to have before they teach. Mathematics is one subject which is classified as a scarce subject in South Africa, and not all teachers who teach mathematics at GET band have a qualification in mathematics from higher institutions of learning. Thus, some participants think that the programme is there to equip such teachers with content:

CB: Many teachers who are teaching grade 8 or 9 are teachers who are not having mathematics background.

TG: ... because the teachers don't know their work as well.

The CK and PCK play a pivotal role in the teaching and learning sphere. When teachers are not well vested with the CK and PCK, they tend to doubt their own teaching methods. Thus, the programme is perceived by other participants as a strategy by the DoE to assist teachers with other ways of teaching in order that the learners perform better.

TA: ...take into consideration the different types of dynamic teaching.

TE: ...to lift the standards of teaching and learning.

TD: ...to improve the teaching methods, as it is clear that learners' performance is poor.

CB: ... to help the teachers to unpack the skills of...

4.3.1.3 To improve internal assessment skills

One other important aspect of PCK involves creating fair and valid assessment tasks and some participants thought that teachers need to have the requisite skills to assess learners' work properly. They felt that one of many contributing factors that made ANA seem challenging is the fact that teachers did not assess as they were supposed to. They further explained that they thought that the ANA examination was assessing in depth that teachers themselves did not. Therefore, in their view, the programme was there to help teachers to be able to assess learners in line with the expected standards and depth. This was made clear

when all participants reported that learners performed better in the examinations set by their own teachers than they performed in ANA examinations. This suggests that there is a perception among some teachers in the programme that the way other teachers assessed was not up to the expected standard as participants expressed earlier on. This was echoed by the participants as they said:

CB: ...and understanding of what is to be taught and what is to be assessed in grade 8 or 9.

TD: learners can tell the difference between ANA and the school examination... the questioning style is different.

And the other participant agreeing with this view explained that learners recognize ANA papers because they are too 'wordy' as compared to the examinations set by their own teachers. That is why learners are able to recognise the examination is set by their own teachers and the one that comes from the department.

To clarify further that the teachers needed assistance with assessment skills was expressed by how they saw themselves in analysing the other assessment and by other educational bodies other than themselves.

TA: ...The assessment is not user friendly....

Other participants viewed professional development as a strategy that is put in place so that teachers can improve their pedagogic content knowledge. The other factor that emerged was that professional development is a programme that is intended to equip teachers with teaching skills, as well as assist them to develop progressive lesson plans:

TD: intended to improve teaching methods and to design lesson plans.

TC: It is a tool that is intended to assist the teachers to be able to plan before they go to class.

Interrelated to the curriculum coverage, is the issue of proper lesson plans. There seems to be a strong feeling that the programme could help all the teachers in the district to make progress through the curriculum by bringing in some sort of standard lesson plans. Some teachers perceived the programme as an attempt to standardise the lesson plans in the district:

TD: I think it is intended to standardise the teaching within the district because we have same lesson plans to use for everyone in the programme.

4.3.1.4 To improve results at different levels

(i) Improving ANA results

Some participants strongly believed that this programme came about because of poor results of ANA examinations in grade 9. The participants' assumption is that the department of education thinks teachers do not know their work or they do not do their work well:

TG: The department said because the results are not as they should be...

TB: it came after the results of ANA, so ANA was measuring whether teachers were doing their job well.

TC: find the easier method of getting learners to understand some of the concepts.

TD: so that our learners can pass ANA first because they are performing poorly.

(ii) To improve matric results for mathematics

The school matric results at school level or nationally are presumably informed by the results at lower grades. More often the good performers at lower grades are often the good performers at higher level. It is with this understanding that some participants thought that 1+9 mathematics intervention programme was a programme that will have long term results, saying it was aimed at improving the grade 9 mathematics results, which in turn would contribute to the improvement of matric results and the country's results as a whole:

CA: ...to improve math result in matric. It is to improve the learner's results in Math in matric and improve the entire country's Math results.

4.3.1.5 To keep teachers abreast with educational developments

A key aspect of the development of teachers' professional knowledge is the on-going or lifelong learning that is expected from the teachers. For some participants, they knew it has been a long time since some colleagues completed their initial teacher training therefore, the teacher programme helped to keep them updated about the current changes in the education system. This perception is aligned to the notion that a teacher should be a lifelong learner:

TH: It has been a long time, some topics I have forgotten. I last did them when I was a student.

CA: to keep abreast of new developments...

4.3.1.6 To increase the rate of curriculum coverage

Teachers' understanding of the aims of the programme ranges from how they were informed about it to how they experienced it as participants. Generally, it seems few participants possessed prior knowledge of what the aims of the programme were. For some, the aim of the programme was to ensure that all teachers cover the curriculum.

It has become a worrying factor from the DoE's point of view that teachers do not follow the curriculum to the letter. The teachers in higher grades share concern that teachers in lower grades do not do justice to the curriculum. They locate the poor mathematics results in matric in the failure of teachers to teach curriculum correctly or to teach per the demands of curriculum from lower grades; this finger pointing goes down as far as primary schools:

TD: being on the same pace so that teachers in grade 10 would have a clear picture of what is happening in grade 9, because they think learners are not being taught properly....

It seems to be a concern of the department of education that teachers do not follow the curriculum to the extent that they are required. For some participants, the aim of the programme was to ensure that all teachers cover the curriculum:

TF: to make sure we follow the curriculum.

TB: teachers are not well equipped with the curriculum

TA: ...to be aware about what they are teaching, the curriculum.

Ever since the department of education decided to respond to familiarising the GET band with common examinations in order to prepare learners for matric examinations, it has set out to monitor teachers' work by giving them the pace setters of the syllabus. Therefore, some participants commented that the aim of the programme was that the DoE wanted all teachers to be on the same pace, which means teachers would be teaching the same topics at any given time so that common examinations set by the district could be administered:

TD: ...in the whole district ...so that we can be on the same pace, doing same topics at the time of training.

4.3.2 Understanding how participants benefitted from participating in the programme

The presentation of how participants expressed how they benefitted in the programme was categorised into four themes namely: teacher's content knowledge, curriculum coverage, professional confidence, and networking ('clustering').

4.3.2.1 *Teacher's content knowledge and pedagogic content knowledge*

The 1+9 mathematics intervention programme can be defined as a teachers' professional development programme which was specifically targeted for a certain group of teachers, that is, teachers teaching grade 9 mathematics. One important aspect of any teachers' professional development is an improvement in their subject content knowledge. For teachers to teach particular concepts, they need to have developed expertise in those concepts. They cannot teach what they themselves do not know. Hence it is critical that any teacher professional development programme must include a focus on improving teacher content knowledge.

The analysis of the questionnaire responses indicated that most teachers felt that the programme improved their content knowledge. Of the 15 responses, there were four teachers who strongly agreed that their content knowledge improved, while seven noted that it improved their knowledge by choosing 'agree' from the choice of responses and 3 were not sure, which the researcher interpreted as meaning it stayed the same. Only one participant chose 'disagree' which meant that s/he did not consider that her/his content knowledge improved as a result of the programme.

With respect to teaching strategies there was one teacher who strongly agreed that his/ her teaching methods improved while 11 were not sure about the change in their content knowledge. Only 2 out of the 15 participants did not agree which indicated that their method of teaching did not improve.

Some teachers pointed out that mathematics at grade 8 and 9 is mostly taught by teachers who do not have qualification in mathematics. *CB* explained that this, in his view, is due to the negative impact of PPN policy that the department is currently applying yearly, where some schools are left with few teachers in the school to offer the same number of subjects that the school previously offered. PPN is a policy that is used to determine adequately the teacher-learner ratio in the school and this is determined by using total learner enrolment. According to *CB's* experience, when the number of learners at school drops, the total number of teachers that the school used to have drops too and yet the number of subjects the school

offers does not change. He further expressed his observation on the impact that this policy has when he explained that the few remaining teachers are left to teach all the subjects. This, in his view, resulted in qualified teachers being designated for matric classes and lower grades like 8 and 9 were “assisted” by teachers who were not necessarily qualified in mathematics. He commented as follows:

CB: They [teachers] are taken by the principals of the school to go and teach there [grades 8 & 9] because there is a shortage of teachers and when those teachers go to the classrooms they don't even understand the content.

Similarly, another participant echoed that not all teachers offering grade 9 mathematics are teachers with mathematics qualification, as pointed out by *TG* explaining that some teachers last did mathematics when they were high school students as explained below:

TA: ... there are some teachers who are teaching mathematics but don't necessarily have the qualifications of that.

The cluster coordinator was of the view that certain categories of participants in the programme benefitted by improving their content knowledge. Hence, the programme is perceived to be more helpful for those teachers who do not have experience in teaching mathematics:

CB: those who are not in the Maths department are benefiting more.

From this data it shows that a gap exists in terms of teachers' content knowledge. By participating in the programme, participants attested to the fact that the programme assisted them by improving their content knowledge. This view also came from the qualified teachers because they expressed that as much as they have been teaching grade 9 for some time, they felt they needed a teacher development programme that would enhance their content knowledge and PCK.

In the programme, the cluster coordinators administered a pre-test at the beginning of the term and a post-test at the end of the same term. The results from the pre-test showed very low average scores of teachers from as low as 20% to 80% for the majority of the tests written. This, in the view of the cluster coordinators, showed that though the majority of teachers are qualified mathematics teachers, the issue of content gap in what they teach could not be ignored. One participant expressed her disappointment that teachers showed lack of confidence in their content knowledge by discussing the tests while writing them:

TG: I was very upset because teachers are now talking while we are doing the test and looking at each other's answers.

The content in the pre- and post-tests was based on the grade 9 syllabus, and it becomes worrying that the same teachers who are to teach such content scored minimum averages of 20% , but after discussion of the related content, the results of the post-test showed great improvements of average scores from 60% to 100%”

CB: teachers got on average scores of 20% to 60% in the pre-test but after discussion and interaction, their post-test averages became 60% to 100%.

One participant, who felt strongly about the need to help teachers with content knowledge, had to repeat this again later:

TG: I understand there are those teachers that don't know their content and they need to still go there and it will be beneficial to learn the content.

Other participants acknowledged that knowledge is not static; therefore, some form of training that keeps them abreast of the changes as teachers was needed, and they felt the programme addressed this need.

Two of the participants acknowledged there were some sections of the syllabus they could not teach before attending the programme, which they were now able to teach after attending the programme. *CB* also reported that some teachers would approach him to confess that they did not know a particular concept that was discussed, but they now do. This is expressed in the following comments:

CB: Some topics the teachers did not understand it [them] but now that they understand it [them] they want to teach that [those] topics. Some of the topics that they had to leave behind they are now doing [teaching] them.

Although the content aspect emerged as the widespread phenomenon that participants agreed has improved, the pedagogical skills of how that content ought to be passed to learners is not clearly indicated by the participants except that the programme was aimed at improving their teaching style as commented by one teacher below:

TA: ... look at their (teachers) knowledge and teaching styles in the classroom.

Some pedagogical benefits of the programme to the teachers are that it assisted teachers to not only consider their content knowledge, but also think of how such knowledge should be transferred to the learners. That aspect required of the teachers to understand how learners learn and what factors should be taken into consideration to ensure that the understanding of concepts was taught:

TA: ... take into consideration the different types of dynamic teaching.

Some teachers expressed that before attending the programme, the way they used to solve mathematical problems was lengthy. They did not break down the problem into small understandable steps which would give more meaning to the question, but instead would include steps that might eventually confuse learners. *TA* explained that he used to take, for example, 10 steps to show learners how to solve a particular math sum, but after participating in the programme, he worked with far fewer steps, due to teaching strategies and skills shared with other colleagues in the programme. This also assisted the participant in identifying and addressing learners' misconceptions.

Teachers' work involves planning what to teach and how to teach it; thus, teachers need to understand their learners and the context of learning so that they decide what pedagogical approaches may be best suited for particular groups of learners and their context. From the views expressed above, the positive impact that the programme has had on teachers' content knowledge was expressed by almost all the participants.

However, what has also become clear from participants' point of view was that while their content knowledge was improved, their strategies of teaching such content were enhanced too. They further expressed that the programme was not limited to assisting with the pedagogical skills but it also assisted them with the ability to link knowledge on teaching with knowledge about learning. *TB* explained that when they came to the programme, they shared different ideas of how to deliver certain topics and the knowledge gained was further shared among their colleagues at their individual schools. Participants acknowledged that they now understand their learners better; they expressed it as follows:

TB: ...but the way we teach has improved a lot. We share new ideas in our school from what we have learned from the programme.

TA: ...that helps me to understand my students better.

TD: ... to improve our teaching methods.

4.3.2.2 *Curriculum coverage*

Curriculum will be understood in this context to refer to what is being taught, how it is being taught, and how it is managed (Jansen, 1998).

Curriculum lays the foundation of what is to be taught and the details of what is being taught should be. It also plays an important role in determining the readiness of the learners to progress to the next grade. Therefore, if it is well covered, it may bring many benefits to the education system as a whole, as it prepares those capable learners to pass even at higher grades.

From the questionnaire responses, it is quite evident that the teachers were not coping with the rate of curriculum coverage expected. Only two (out of the 15) questionnaire respondents said that it was always possible for them to complete the curriculum. Most (9) teachers agreed that they sometimes were unable to complete the curriculum while four teachers confided that they were never able to complete the curriculum.

Views of the participants interviewed show some similarity to those in the questionnaires. When they were asked if participating in the programme has increased their rate of curriculum coverage, they expressed mixed responses, as demonstrated below.

Though some participants felt participation in the programme had not helped them much in terms of the curriculum coverage, more than half of the participants shared positive views after participating in the programme, saying that their curriculum coverage has improved. They added that participation in the programme has impacted positively on their curriculum coverage. For instance, *TB* explained how he delivered and analysed curriculum has improved after participating in the programme. This, in his view, has made him a better teacher than he was before. He commented as follows:

TB: ...but what has improved is the way it [curriculum] is delivered.

Similarly, other participants in agreement with his view commented as follows:

CA: We don't have to stress about time management. It is all there you have to follow the one plus nine and you cover the curriculum.

TC: I must say yes. There were some things that were shared in that programme. I come to my school and put them into practice. I have seen that it has worked for me.

TA: In a way yes....

One of the participants explained that the lesson plans provided at the intervention programme have assisted her to realise that the time allocated in the ATP for the majority of topics are realistic and made curriculum coverage attainable in the following comment:

TG: I think the times are given in the ATP are mainly realistic, though for some topics it is not, but I found some way to even out. The time given on each topic is fair.

In addition, the other participant further explained how the prepared lesson plans assisted her in her teaching and allowed her more time to deal with the issue of curriculum and remedial work because she now has enough time; this is in line with the following comment:

CA: Yes it has. We don't have to sit and ponder over lesson plans. Even the examples are given. The references are made to the department's blue book. It is a matter of referencing.

The responses from the questionnaire indicated that many teachers were actually unable to complete all the lesson plans that were covered at the 1+9 sessions. Only five teachers agreed or strongly agreed that they managed to complete the lessons for which they were given lesson plans in the programme. This suggests that most teachers still struggled with increasing the curriculum coverage rate as a result of the programme.

Teachers' PCK plays a crucial role in the implementation and adherence of the curriculum. Teachers with strong PCK skills are able to interpret the subject matter and find different ways to represent it and make it accessible to learners (Shulman, 1986). However, participants expressed that there were challenges with the curriculum coverage citing problems of time constraints and the calibre of their learners, where they mentioned that learners' commitment to their work was minimal and as a result they found themselves going back and forth. The most common view was that there was too much to cover in grade 9 mathematics as stipulated by the ATP:

CB: Curriculum coverage has not yet improved because we have not set a way of catching up for the day when we attend on Mondays and what I said earlier does not allow me to cover the curriculum. You can cover the curriculum but if you look whether the learners understood, not many did, so the teaching becomes very bad.

4.3.2.3 *Professional confidence*

One other emerging factor was that teachers felt that the programme gave them a platform to showcase their individual skills in how they delivered certain topics. This, according to participants, helped in boosting their professional confidence. *TA* explained that he was able to contribute to the one plus nine programme by sharing his views in front of many colleagues. The experience in sharing and exchange of expertise is improved when teachers learn together and solve problems collaboratively. According to the participant this personal growth translated to how he taught in class. *TA* further explained that from the experience of ‘teaching’ his own colleagues, he felt more confident to deliver the same topics in his class that were shared with colleagues at the programme.

The other dimension brought up by the cluster coordinators was about their facilitation skills. They explained that in terms of confidence their skills of facilitation were not as good at the beginning as they continued with the job given, meaning as they continued with their duty, their facilitation skills were sharpened. The role of the cluster coordinators was not only limited to helping teachers with challenging topics, but also to liaise between the department officials and the teachers themselves, as well as do the administrative part of the programme like attendance registers, collection and distribution of the materials to be used and to organise and facilitate the common assessment tasks. The role of the cluster coordinators was an intense one, as they had to be hands on as classroom teachers and leaders of the clusters at the same time. In performing their roles, attention was drawn to the leadership role that the programme afforded them, which was distributed in their respective clusters. When asked if this aspect of professional confidence in facilitation translated to his own confidence in teaching, the participant explained that it assisted him to be able to manage his lessons effectively. The cluster coordinator expressed as follows:

CB: ...you must understand that delivering content to people who know like you , you need to be sharp, so going back to my school I felt that I was on top of the game...[laughing].

From the above views, it worth noting that professional confidence had other benefits like managing lesson plans. It can be concluded that even though one benefit was expressed by the participants, there could be other benefits that helped them become better teachers.

4.3.2.4 *Networking and professional learning communities*

The networks generate a process whereby teachers can communicate, share and address issues, observe one another's work and develop expertise in various aspects of their teaching practice:

TF: It is such a good way to interact with people.

Some participants shared how participating in the programme made them realise that the problems they experienced in class did not only happen in their schools:

TD: It has helped me get a clear picture of the challenges that we teachers are faced with in mathematics in grade 9.

The above narrative introduces yet another dimension of the benefits of the programme, that the programme enabled participants to know that what they are doing in their classrooms is no different from what might be happening in another classroom in the same subject across the cluster or district or province. It became essential for participants to know that other educators experience 'similar' things.

It created a platform where teachers realise that challenges they experience at their own schools are not unique to those individual schools, but other teachers experience them too. This realisation made participants share ways of tackling such challenges; this benefited the participants because if there was no networking and socialisation offered by the programme, they felt they would still be closed in their corners without any help. In the sharing of experience, different strategies shared were taken back to school to implement.

4.3.3 Challenges Experienced

Participants experienced some challenges that they strongly raised within the programme; these are categorised into lesson plans, time constraints, and pressure to finish, unrealistic expectations, time tabling and poor attendance.

4.3.3.1 *Lesson plans*

i) Nature of the lesson plans

Teachers expressed concerns about the nature of the lesson plans. They shared a common view that the lesson plans took a 'blanket' or 'one size fits all' approach. In their opinion, lesson plans did not accommodate different learners' needs and abilities, slower or faster

learners and their different academic ability. *TD* explained that she failed to follow the lesson plans as they were because of the gaps learners have; she had to re-teach and do plenty of remedial work before she could implement a new lesson while another participant sharing the same view added:

TE: If you have to move on, you leave behind 20 learners. 36 learners are coping but these 20 learners they are left behind.

ii) Length of the lesson plans

The other concern raised was the length of the lesson plans. Participants explained that they were too long to realistically cover in the hour period allocated. *TD* explained that there were too many notes:

TD: They are very long lessons to implement because of that it is not easy to cover the curriculum.

Moreover, another participant sharing the same view added further that shorter lesson plans may do in the following comment:

TE: The lesson plan is too long and time too little. You cannot finish with the time you are given. I feel that the time is limited. One hour is too little. So there should be shorter lesson plans.

Another concern raised in Section 4.3.2.2 was that most teachers who responded to the questionnaire were unable to complete all the lessons for which they were given lesson plans. Hence their experience was that there were too many lesson plans that they should cover but struggling to.

iii) Activities did not cater for different levels of ability

One other concern raised by the participants is that the allocated time was not enough to complete one lesson plan during the scheduled one hour duration. This is because the same activities are designed to be used by all learners without being discriminative in terms of the type of learners in that class. The contributing factors to learners' understanding were not accommodated; the fact that learners are different in many aspects, whether faster or slower, older or younger, behaviourally compliant or disruptive. So one lesson plan ran over to the next day and this impacted on their failure to complete curriculum. *TE* further explained that he was not able to finish the lesson plans given for two weeks because of time constraints. He

went on to explain that he was going back to attend the programme with ‘arrears’ of the lesson plans and eventually he was not able to finish his work. Another participant shared the same sentiment and further explained that even in the programme there was not sufficient time to discuss all the lesson plans that they were expected to use in class in between the programme and the next session:

TA: you see they are trying to give as much as information as they can and there is little time to finish them. They end up saying take the notes, go and read yourself...this is boring.

4.3.3.2 *Expectations are not realistic*

As mentioned earlier the nature of lesson plans provided at the programme was not accommodating for all types of learners each of the teachers have at school level. There was also rising pressure that participants experienced when it came to implementation. The nature, the length of lesson plans and the activities discussed above resulted in what the researcher wishes to explain in this subtopic. The lesson plans discussed on one day (which was Mondays in this study) were then taken by teachers to implement or teach when they got to their respective schools. The expectation was that after 9 days the full set of lesson plans provided should have been ‘taught’ and this proved not to be achievable by the majority of the participants. The participants explained that this expectation was not realistic due to the challenges mentioned earlier. This translated into the curriculum coverage being at stake. The readiness of learners to progress to the next grade would also be compromised. This reality was coupled with the loss of the one day on which the participants attended the programme. This was due to failure to re-organise the time table by almost all the participants’ schools and as a result it put tremendous pressure on the participants. They explained that for them to make up for the day ‘lost’ they had to find extra time by asking for periods from other colleagues to try and cover their work. The biggest challenge remained because the participants explained that they had to rush over the lesson plans; as teachers sped over content, not all their learners understood. *TE* explained that if he moved with those understanding in his class of 56 learners, only 36 are coping but the other 20 learners are left behind. In agreement with the above one participant added:

TD: I have to teach them another new lesson so that I can cover the annual teaching plan and complete the lesson plans which were given in the one plus nine programme.

The implication here is that the participants would go back to the programme having not finished what was discussed and planned in the previous two weeks. This impacted on the success of the programme. The above concerns by the participants suggest that interventions such as three hour or six hour workshops would not have a lasting impact on classroom practice; instead the professional development which is intense and sustainable and necessary support should be available to maximise the benefit of the programme.

It therefore confirms, as was suggested by the department of education at the inception of the programme, that a more intense and radical intervention was needed as opposed to the normal practice of one-day workshops.

4.3.3.3 Time tabling

It is important to recall that this programme is called 1+9 because it comprises one day of attending the programme and 9 days of teaching. The logic and assumption behind this was that all schools that had teachers participating in this intervention programme would make provision in the school time table to accommodate this one day dedicated to training. However, participants reported that not all schools did this time table adjustment. To be precise, from the ten participants interviewed in this study only one participant had the time table adjusted to accommodate her. She shared her experience about the time table adjustment. This, too, was not to her benefit as she explained that it was only during the first period that effective teaching happened. She explained that when she came to attend her first 'period' her learners were attentive and ready to learn. When she came back for the second 'period' the same day, they did not cooperate and as a result less work was done. When asked what she thought about dealing with the content of the two lessons in the first period and then giving activities in the second period,; she explained that the purpose of the second period was not remedial but to cover for the day lost to the workshop (1+9 programme). In her view what was important was that she teaches all that ought to be taught in order to cover the ATP requirements and the curriculum in general. The following comment expresses how the participant felt about her two periods (each an hour's duration):

TD: ... I have double periods but...challenge is the first period they listen, they have that energy to work with me when I come for the second period they are bored. It is only that they cannot chase me away because they are young and I am old.

The majority of participants expressed how the time was insufficient for them to implement what they had discussed at the programme. Some of the participants had this to say in terms of the time table:

TB: The school must allocate time for 1+9 but at our school it did not happen so as the teacher we have to find our own time to cover...

TF: It is quite difficult because I only see them 4 times a week. That is a big challenge....

When asked what could have caused her school not to make time table adjustments to accommodate her absence on Mondays, her response was:

TF: I don't think they know about it.

An interesting phenomenon that is expressed above draws attention to the lack of support in schools to the participating teachers in the programme. One participant explained that she doubted if her school was aware that provision was to be done for her on the time table for that one day off. This brings a concern about how much support the schools offer for teacher intervention programmes or teacher development programmes.

4.3.3.4 Poor attendance

Attendance of the programme, according to circular S1 of the department of education, was compulsory for all mathematics teachers doing grade 9.

It had been expressed as a worrying factor by some participants how the programme was poorly attended, but they attributed this to the pressure to finish the ATP which was mounting towards the end of the school term as indicated in the following comment:

TF: When we started it was a lot but then became less and less.

Feeling strongly about the importance to attend regularly as per schedule and having observed the benefits that come with participating in the programme, one participant commented as follows:

TF: Because if you are not there how can you share the knowledge with the kids. I think for teachers they need to be there.

However, at the same time attendance in other clusters was relatively fair; the common analysis by the participants was that it became difficult to cope with other clusters due to lack

of school management support to this intervention programme. Those teaching classes other than grade 9 also had pressure to prepare their learners for the departmental common examinations. *CB* explained that at his school, attention towards the end of term is dedicated to preparing grade 12 learners for their quarterly examinations and as a result, he had little time for his junior classes like grades 8 and 9.

4.4 Conclusion

This chapter dealt with detailed findings of the data that was generated from the interviews of the ten participants of the study. This data provided some views and perceptions of these teachers about the 1 +9 mathematics intervention programme. The participants explained their understanding of the aims of the programme and that of a teacher's professional development. The cluster coordinator explained how in his view teachers benefitted from the programme in terms of content knowledge and PCK. Another issue that emerged from the data is improved teacher confidence and usefulness of PLC. However the issue of curriculum as expressed by the teachers still needs attention. The data also revealed some challenges about the programme such as lack of support and systematic problems. The next chapter discusses in depth the data results.

CHAPTER FIVE: DISCUSSION, RECOMMENDATIONS AND CONCLUSION

5.1 Introduction

This chapter gives a brief summary of the whole study, draws conclusions from findings, and makes recommendations based on the conclusions of the study.

5.2 Summary of the research study

This study was undertaken to explore teachers' perception about the 1+9 mathematics programme for teachers teaching grade 9 Mathematics. The above chapters were intended to give a picture of the study before conclusions and recommendations could be shared.

In Chapter one the background and the rationale of the study was presented. The introduction shared how professional development has been taken up by many countries as an important venture that both developing countries and well developed countries do in order to improve their education system. Attention was drawn to the fact that the topic of professional development has been researched but this study in particular sought to investigate the perception of teachers under study and how they perceived this programme which came about as an intervention to address what the department assumed contributed to the low pass rate or poor results of mathematics in grade 9. The researcher's personal experience in the teaching field also contributed to the interest in conducting this study. Many recommendations have been made to the department about improving teachers; hence, the study reports about how teachers themselves perceive the intervention offered, especially in terms of its usefulness. The findings of this study are intended to help in the planning, implementation and execution of the intervention programmes. The chapter gave an overview of the 1+9 intervention programme and how it was intended to work. The research questions were also given. The context of the study was explained to locate how some of the factors to learning can be understood. The chapter concluded by acknowledging that teacher professional development can benefit not only novice teachers but the whole population of teachers because the education system is dynamic and ever changing and it is of importance that education practitioners are kept abreast of the new developments.

In Chapter two, an in-depth review and explanation of what the existing literature was about, teacher professional development programmes and the theoretical framework were presented. A summary of how other researchers define teacher professional development and their suggestions of the form they should take to get maximum benefits for the participants was

discussed. Teacher professional development was defined as a formal systematic, comprehensive, sustained programme with the aim to re-skill and enhances teachers' performance so that students' performance can be improved (Guskey, 2000; Bansilal & Rosenberg, 2011; Moodley, 2013).

The main component of the theoretical framework from which data was analysed was based on Lave and Wenger's (1991) content knowledge, pedagogic content knowledge and professional learning community. Another component that emerged that is closely linked to content knowledge and PCK is teachers' professional confidence, and it was discussed in terms of theories by Graven (2004), Wozney et al. (2006) and Lessing and Witt (2007). Theories of curriculum and how professional development programmes assist teachers to improve their knowledge of curriculum and its implementations were also discussed using Shulman (1986), Jansen (1998), and Mils and Treagust (2002).

In Chapter three the study was described as a qualitative study, epistemologically located under the interpretive paradigm which enabled the researcher to get deeper descriptions and explanations from the participants' perspective. The chapter also explained how many participants took part in the study and how they were sampled. Furthermore, the chapter reported on data generation instruments which were questionnaires and interviews, and theories that informed data analysis so that categories and themes of the study could be pulled out of the data collected. Reliability and ethical issues were also addressed. The chapter presented the limitations of the study and concluded by mentioning that this study does not set out to claim that the findings were applicable across all the districts, but that it gives an insight on how some teachers perceived the 1+ 9 intervention programme.

In Chapter four, the findings of the emergent data were categorised and presented. The themes were summarised into how teachers perceived the programme and the common phenomenon shared by almost all the participants in how the programme was beneficial to them as individual teachers, collectively as colleagues, and their schools in general. Although benefits were many, teachers also shared some challenges encountered in the programme and went further to suggest what could be done to improve it. Their views are more or less in line with the findings of other studies conducted on professional development.

5.3 Research questions

The critical or main research questions of this study were as follows:

- 1) What are some contributions made by the 1+9 mathematics intervention programme towards the professional development of the mathematics teachers?
- 2) How has participation in the 1+9 mathematics intervention programme influenced teachers' professional development?

The words 'what' and 'how' which are the key questioning words that the research attempted to answer are very closely linked and it may be difficult to separate the two. In fact 'what' helps to understand 'how'; similarly, 'how' helps to understand 'what'. Therefore, in this chapter the two research questions were discussed simultaneously.

In order to understand the growth in the professional knowledge of teachers who were participants in the 1+9 mathematics intervention programme, the emphasis was on four dimensions namely: teachers' content knowledge, teachers' pedagogic content knowledge, teachers' confidence, and teachers' learning in the professional learning communities. Hence, in considering the ways in which the professional development of the teachers was influenced by the programme, the following sub-questions were considered as a guide to understand the contributions of the programme:

- To what extent did the participants improve their content knowledge?
- To what extent did the participants improve their pedagogic content knowledge?
- To what extent did the participants improve their confidence with respect to teaching some topics and teaching in general?
- How has the 1+9 mathematics intervention programme affected their professional development as a whole?

The data presented in chapter 4 revealed different ways in which the 1+9 mathematics intervention programme contributed towards teachers' practices especially with regard to improved content knowledge, PCK, teachers' confidence, curriculum knowledge and the rate of curriculum coverage.

5.4 Discussions

5.4.1 Improvement of content knowledge

The importance of a teacher having sound knowledge cannot be over-emphasised. The gaps in teachers' content knowledge may be manifested in the way they teach (Widener University, 2006). In this category, aspects of the teachers' content knowledge required for teaching mathematics in grade 9 were discussed. The study found that teachers' teaching grade 9 mathematics had challenges with some parts of the content which they were teaching. This was observed from the low pass marks they obtained in the pre-tests, as noted by CB (the cluster coordinator) who reported that "some teachers got average scores of 20% to 60% in the pre-test but after discussions and interactions, their post-test averages scores became 60% to 100%". The pre-tests, as explained in the previous chapters, assessed the content (curriculum) of grade 9 mathematics, which the teachers were expected to teach. James et al., (2015) emphasise that teachers need to thrive on the necessary knowledge competence of the subject that they teach. It therefore means that mathematics teachers need to know, at the very least, the content of the mathematics they need to teach as this will help contribute to the improvement of learners' performance.

From the questionnaire responses, most teachers agreed or strongly agreed that their content knowledge improved as a result of their participation in the programme, with only one teacher reporting that there was no improvement in his/ her content knowledge. Four teachers strongly agreed that their content knowledge improved, while 11 noted that it stayed the same by not being sure of the improvement. Hence most teachers found that a benefit of attending the 1+9 programme was the improvement in their own understanding of the mathematics they need to teach.

The viewpoint of the cluster coordinator is that participation in this intervention programme assisted the participants to enrich their content knowledge. The improved marks that the teachers obtained from the post-tests were explained as part of the evidence that the content knowledge of teachers was improved. In addition, CA (the cluster coordinator) explained how teachers expressed that they were not able to teach some of the topics before they participated in the programme; however, this challenge was efficiently addressed at the intervention programme, and the teachers explained that they were now able to teach those topics after participating in the programme. Hence, the teachers' participation enabled them to improve

their content knowledge to the extent that they were able to teach new concepts. Adler and Reed (2002) argue that the teacher must be able to take the content knowledge he or she has learnt and deliver that content knowledge to the community of learners s/he teaches.

Although there were reports of teachers who improved their content knowledge because of participation, some participants in the study could not clearly express how their content knowledge had been improved. Instead, they referred in general to the improvement of content knowledge of other teachers participating in the programme with them. For instance, *CB* explained that many teachers teaching grade 8 or 9 do not have a mathematics background and are the ones to benefit more from the programme in terms of improving content knowledge.

5.4.2 Pedagogic content knowledge

Related to content knowledge is pedagogic content knowledge and the discussion of how it was improved is illustrated below according to the views of the participants. With improved content knowledge participants need to have skills of how such content can be taught. Shulman's (1986) definition refers to PCK as an in depth understanding of how the subject matter must be taught. In this category the aspects of the teachers' PCK in mathematics are considered, which include teaching strategies, curriculum knowledge and its rate of coverage, lesson planning, assessment skills, as well as knowledge of learners' misconceptions.

The questionnaire responses confirmed that most teachers felt that their teaching methods were improved as a direct result of their participation in the programme. With respect to teaching strategies most teachers agreed or strongly agreed that it improved. Only 2 out of the 15 respondents indicated that their method of teaching did not improve as a result of the programme.

Some participants explained how they used long methods to explain a concept to their learners prior to attending 1+9 mathematics programme, but after attending the programme they were able to use shorter and understandable methods or techniques and this helped to address some of the learners' misconceptions. *TA* and *CB* also said the programme was going to assist teachers by exposing them to different types of dynamic teaching and help them unpack the skills of teaching. Shulman (1987) recognises PCK as having the biggest influence on teachers' classroom practice and the mastery of the art of knowing the subject content by teachers may be demonstrated in the manner in which students learn the subject content. *TA* and *TD* in the interviews explained that participation in the programme helped

improve their teaching methods and enabled them to understand their students better. Another aspect to look at is the curriculum and the rate of coverage as explained by the participants. The simplified definition of curriculum by Jansen (1998) refers to what is being taught, how it is taught, and how it is managed. While the DoE (2015) holds a perception that the poor mathematics performance in ANA was due to teachers not being conversant with the curriculum they teach, participants shared mixed feelings about curriculum knowledge. Some participants blamed their failure to cover the curriculum to many topics that they say are in the grade 9 syllabus and this made it difficult for them to cover it. *TC* and *TE* pointed to the calibre of learners they taught who were not academically motivated, and were not compliant if they were given some school tasks like homework. The views do not clearly show ownership of curriculum knowledge by the participants. According to Umugiraneza et al., (2017) the majority of teachers were unable to see methods of working within and across the curriculum bearing in mind that teachers are entrusted with responsibility to translate and shape curriculum goals into classroom practices. Nevertheless, when some teachers were asked if the rate of curriculum coverage improved after participating in the 1+9 mathematics intervention programme, some participants explained that their rate of covering the curriculum had not improved and some blamed the length of lesson plans used in the programme. It seemed as if the participants did not want to take responsibility for the failure to cover curriculum, but shifted blame to what had led them to not cover it. Poor learner performance is located by studies to be due to delayed pacing and limited curriculum coverage (Mattson & Hartley, 2003). The questionnaire responses indicated that the teachers were not coping with the rate of curriculum coverage expected. Only two (out of the 15) questionnaire respondents said that it was always possible for them to complete the curriculum. However, the majority of participants, namely *TG*, *CB*, *TF*, *TB*, *TC* and *TA* (out of ten participants interviewed) explained that the curriculum coverage rate was improved after participating in the programme because they understood exactly what they needed to teach and how to teach it. They added that their paper work was reduced because they were no longer writing their own lesson plans, but used the ones given at the programme. This is consistent with Phaeton and Stears's (2017) view about the implemented curriculum, that the instructional practices, curriculum competencies and attitudes learners demonstrate are mainly as a result of the teaching and learning process.

Another aspect of PCK linked to effective lesson designs which was also mentioned in the previous chapter highlighted that teachers' work involves lesson planning and teaching of

those lessons. It further requires that teachers understand both their learners and the context of learning. This aspect enables teachers to decide which pedagogic approaches are best suited to them. When expressing their views about lesson preparation, participants noted that this intervention programme was going to assist them to develop progressive lesson plans, participants *TD* and *TC* expressed it as "... it is intended to assist teachers to be able to plan before they go to class by designing lesson plans". Some teachers in the study explained that the prepared lesson plans from the department were useful. They further explained that these lesson plans provided them with more free time which allowed them to deal with other important issues like remedial work for their students. *CA* further explained that "we don't have to sit down and ponder over lesson plans,...even references to the text books are there...it is a matter of referring". In addition, *TB* and *TA* further explained that the way they teach has improved a lot after participating in the programme because they now understand their students better and are able to link knowledge on teaching with knowledge about teaching. The study also found that the majority of teachers had concerns about the nature of the lesson plans and that they were too long for the intended one-hour duration. Therefore, it may not be conclusive as to whether these lesson plans were used effectively.

TF, *TB* and *TA* had perceived that this 1+9 mathematics intervention programme was there to assist teachers to be aware of the curriculum they teach, be equipped with how to teach it and to follow it and after participating in the programme they explained that the way they analysed and delivered the curriculum had indeed improved.

Teachers' opinion is that learners did not perform well at ANA because of the way teachers assessed and they felt that the intervention programme would assist them to sharpen their skills on assessment. The participants reported that teachers were able to co-assess their students' work and they debated the quality of the assessment tasks in order to improve them. The findings of this study revealed that participants' assessment skills were improved because they were able to examine various ways of assessing the students' work by debating the quality of assessment tasks and they also co-assessed their students.

The participants' views about how their PCK was enhanced from this professional development programme concurs with the view of James et al. (2015) who argue that teachers should develop PCK during professional development programmes. When teachers are confident with their PCK they are able to easily deliver their lessons.

5.4.3 Improving professional confidence

The importance of teacher confidence and its pivotal role in the understanding and explaining of mathematics teacher learning and teaching cannot be overemphasised (Brijlal, 2013; Graven, 2004; Jita & Mokhele, 2014). In this category the aspect of teacher confidence related to their learning and teaching of mathematics as well as their self-efficacy and willingness to share their knowledge is discussed. The study found that teachers' confidence was improved; this was reported by the participants who explained how they felt about their teaching after participating in the programme. Participants such as *TA*, *TB*, *CA*, and *CB* also reported that the opportunity to share their strategies with colleagues on those Mondays, a different platform from classroom, helped boost their confidence. They further explained that their strategies of lesson delivery were improved in many ways and this made them feel confident to deliver the same content at school level to their students. They also felt confident with their knowledge, PCK, and self-efficacy. This is consistent with the view of Wozney et al. (2006) that it appears that teachers can be helped to gain confidence by exposing them to intense professional development within the context of teachers' on-going work. In addition, the benefit of teachers observing others has been argued by Ertmer and Ottenbreit (2010) who state that professional programmes allow teachers to observe others and observing the successful ones builds confidence. In this study teachers explained that they were able to observe how other colleagues presented some topics and because of the interaction, their levels of confidence were raised by moving from being teachers of mathematics towards being competent mathematics teachers.

5.4.4 Professional learning communities

Professional learning communities and the concept of clusters are used interchangeably in this study to refer to groups of individual teachers or groups of schools that are brought together for sharing and critically interrogating their practices in an on-going reflective, collaborative and inclusive and learning oriented way in order to enhance their effectiveness as professionals for the benefit of the students (Stoll et al., 2006; Toole & Louis, 2002). In this section the researcher will consider the ways in which the professional learning communities, represented by the 1+9 clustering, promoted the learning and teaching of mathematics by the participants. Teachers seem to use the clusters to interact much more deeply with the curriculum frameworks and also to discover and attend to their deficiencies in terms of CK and PCK.

The findings of the study showed that the benefits of clustering have encompassed for the participants important aspects in the teachers' work such as improved content knowledge and PCK, enhanced professional confidence, and to a certain extent, curriculum coverage. Another factor that emerged from the findings is the benefit of sharing classroom experiences, where *TB* and *TD* explained that they were able to learn from other colleagues that their own classroom experiences are not unique to them, but that other teachers have similar experiences. *TB* and *TD* explained that teachers in a cluster came to share experiences: "we come [to the cluster] with different ideas on how to deliver different topics to different learners because teachers are not the same". Therefore, the PLC created environments where teachers could explore their strengths and weaknesses with their colleagues and more importantly develop collaborative solutions to problems of practice (Brodie, 2014).

The core aim of the PLC is to improve students' learning; to this end the focus of collaboration included activities such as understanding assessment. Teacher *CB* reported that participating in PLC through this programme assisted them to understand what was to be taught and what [how] it was to be assessed in grade 8 or 9. From the collaborative solutions developed in the PLC, teachers were then able to implement new ideas collectively for the benefit of the students. For some participants their understanding of the aims of the programme was to assist them with content knowledge and equip them with the teaching skills, and PLC was a platform where this was achieved. *TA* and *TB* explained that teachers brought with them different ideas on how to deliver topics to different learners and because teachers cannot know everything, it can be concluded that discussion of the content in the intervention programme through PLC has enhanced teachers' own content knowledge of what to teach and how they should teach it.

5.5 Recommendations

Some important factors that should be considered when designing and implementing a professional development programme are, for instance, to consider what work is expected of teachers and the contexts in which they work. Teaching takes place in a sociocultural context (James, 2009). This means that connections exist between the individual functioning of the teacher and the sociocultural practices in which an individual takes part. Thus, each teacher's learning and development cannot be understood if professional development is viewed with the teacher removed from his or her everyday actions, referring to the thinking and facilitating learning actions that they participate in (James et al., 2015).

This study has highlighted how teachers perceived the 1+9 mathematics intervention programme and some of the contributions made by this programme towards the professional development of grade 9 mathematics teachers. Based on the conclusions informed by the findings, the implications that the study has had on teachers, the schools and the Department of Education are now discussed.

5.5.1 Implications of the study in relation to the teachers

The teachers who participated in the study have expressed how participation in the 1+9 mathematics intervention contributed to their professional growth. Teachers highlighted how their content knowledge was improved and this improvement enabled them to teach some of the topics which they did not teach before they were involved in the programme. The other important point of development that they shared was their PCK, whereby they were referring to mastery in the art of knowing the subject content and the manner in which the student can learn the subject. Teachers expressed how some of the techniques shared at the intervention programme assisted in helping them understand their students better. The teachers highlighted how their rate of curriculum coverage was improved but shared reservations that much still needs to be done to assist them with regard to the curriculum so that while managing the curriculum, their learners will not be 'left out' as they push for more significant coverage.

Teachers also felt that this intervention programme gave them an opportunity to be present and participate in PLC, which according to the participants created a platform for them to debate and assist one another in the areas where they felt they lacked. Such areas include assessment of students and this also served as practice for their learners for the common examinations which are set by the Department of Education (currently common examinations are run for FET). This shows that the benefit of the programme extends to other grades.

5.5.2 Implications of the study in relation to the schools

Teachers reported that what they learned from other teachers from the programme was shared with their colleagues at school level and used in their own classes. However, the majority of participants complained about lack of support from their school management teams. 9 out of 10 interviewees revealed that their schools failed to do a time table reshuffle to accommodate the one day that they were off to attend 1+9 mathematics intervention programme workshops. The other concern was that school managements emphasised the importance of completing

the curriculum with their grade 12 classes; the teachers explained that this led them to sacrifice their grade 9 classes in order to attend to matric classes.

It is not enough to provide well-designed professional programmes from outside the school if the school administrators do not support them and do not act in ways that demonstrate they value teacher learning. Schools must ensure they support their teachers who participate in the professional development, especially because the improved teachers benefit the whole school and not only the grade for which they were trained. Policy makers and school administrators need to give equal attention to building conditions that will be conducive for schools to provide support for professional learning on an on-going basis and as a routine part of their job. Ingaverson et al. (2005) argued that the role of follow-up support of a professional development at school level by the colleagues and other stake holders was important.

5.5.3 Implications of the study in relation to the Department of Education

Before the implementation of an intervention, DoE should involve all the stake holders especially the people for whom the professional development is intended. This will help participants understand the aims of the intervention programme and be able to participate in order to benefit from it. Richardson (1998) found that teachers often resist change that is mandated or suggested by others, but they do participate voluntarily to change based on their perceptions of what their students need and what is effective and beneficial in their classroom.

The DoE should consider the fact that teachers are at diverse stages of their development professionally and as such, they require different interventions. Teacher development should be based on principles which allow teachers to improve their levels of education and training (Hugo et al., 2010; Rogan, 2007). The needs analysis of teachers should be paramount so that the intervention programme should be the one teachers need and only for those teachers who need it most; this will also assist to improve teachers' attendance at the professional development programmes.

Although it appears that considerable effort is put into creating and developing PLC (Ingaverson, Meier & Beavis, 2005), there is still much to learn about their sustainability. However there are many studies, as was discussed in chapter 2, whose findings seem to support propositions that collective participation (networks) is one of the most important features to give thought to when designing and implementing a professional development programme. Therefore, it may be important that the DoE formalise this PLC for teachers.

The context of two thirds of the population of the participants is rural schools with limited resources and low socio-economy as described in chapter one. Kelly (2006) argues that individuals (teachers) acquire skills or knowledge in one setting which is particularly designed for a certain purpose or context, they subsequently get to use those skills and knowledge and understanding somewhere else. It is important that when materials are prepared for the development programme that DoE takes into consideration the contexts of the participants so as to avoid a blanket approach to things because ‘one size fits all’ may not necessarily give the best of the programme.

Some researchers have found that strategies to encourage teacher participation in continuous professional development may be to offer incentives such as salary increases or credits for promotion or attendance certificates which may be significant when they apply for a more senior position, or to introduce penalties for nonparticipation. For instance, failure to attend may be regarded as a negative element in the appraisal of teachers (Peters, 2016); perhaps the DoE should consider this view.

The DoE should appoint a panel of teachers to design the lesson plans so that they can be more classroom-based and achievable than theoretical. The DoE should strengthen the monitoring of the mathematics teacher development programmes by using mathematics subject advisors who would contribute to the discussion at these workshops. Cluster coordinators reported that while the programme was running, the DoE used to send non-mathematics subject advisor to the ‘cluster’ workshop and that subject advisor would only perform the administrative work which the cluster coordinators were already doing, but could not contribute to the discussion because s/he was not a subject advisor for mathematics.

With the changing curriculum, there is still a need for on-going intervention programmes for mathematics teachers in order to assist them to keep abreast with new developments and to address the gaps that this study has revealed.

5.6 Limitations of the study

Although the study has shown a reasonable success rate in teacher professional development programme in terms of improvement in teachers’ content knowledge, PCK, enhanced professional confidence and benefits of PLC, it also showed some shortcomings. The study was carried out in three clusters in Ugu district and the sample was too small to represent a population that would be generalizable. The 1+9 mathematics intervention programme came when teachers were having serious debates about ANA and as such, the participants were of

the view that it was there to respond to ANA. If participants held a certain view about the study the chances that the data obtained was biased are great. In addition, participants have a tendency to change their behaviour simply because they are being studied, and give responses they think the researcher is looking for (Shuttleworth, 2009). The study is on teachers' perceptions about the 1+9 mathematics intervention and its impact on teachers' practices, so there is a possibility that participants could have exaggerated the benefits and minimised their criticism.

5.7 Conclusions

The aim of the study was to explore how participation by teachers in the 1+9 mathematics intervention programme has contributed to their teaching practices and how the teachers perceived the programme.

In summary, the study revealed the following:

The 1+9 mathematics intervention programme is located under teacher professional development and teachers were exposed to opportunities that afforded them the following benefits: improved content knowledge, improved PCK, more understanding of the curriculum and how to implement it. The clusters or professional learning communities were also used to enhance their assessment skills and promoted more networking among teachers. The teachers also reported how their professional confidence was improved and that PLC was encompassing the totality of the benefits from the programme.

The participant teachers are now more confident and have gained some skills in content knowledge and pedagogic content knowledge; hence, they will serve as resources to schools. There is still a concern about the level of support that school management has given to participating teachers and lack of motivational support to encourage teachers to continue to actively attend the programme.

With the form of funding that the DoE had invested in this programme (materials used, meals and remuneration for the cluster coordinators), it is advisable and will be profitable for the DoE to consider strengthening issues of compliance especially from schools, in ensuring that those teachers who were supposed to attend attended. Although in some clusters the attendance was very poor, the department was very successful with those teachers who stayed on the programme as the findings show how these teachers benefitted from the programme. In addition, the DoE needs to have a plan that will assist it to respond to systematic

challenges probably by engaging in a more participative consultative approach with the managers of the schools; this could also help address issues of importance of curriculum coverage across all the grades as was highlighted by the cluster coordinators.

5.8 Implication for further research

The 1+9 mathematics intervention was a national programme, but the study was conducted in only three clusters of Ugu district. These three clusters represent only a small number of the teachers who participated in this teacher professional development programme for grade 9 mathematics teachers. It would be interesting to find out how teachers from other districts and provinces have experienced the intervention programme.

It is recommended that further study be conducted to obtain the views of a reasonable sample of the cluster coordinators and the mathematics subject advisors who did not form part of the study. It would be interesting to have a study that would investigate the impact of this programme on students' performance.

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APPENDICES

Appendix 1



07 June 2016

Ms Itumeleng Matlali 215081321
School of Education
Edgewood Campus

Dear Ms Matlali

Protocol reference number: HSS/0331/016M
Project title: To explore teachers' perception and attitudes towards (1+9) Mathematics intervention programme for grade 9 mathematics teachers at three schools in the Ugu district.

Expedited Approval

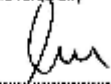
In response to your application dated 05 April 2016, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol have been granted FULL APPROVAL.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. Please note: Research data should be securely stored in the discipline/department for a period of 5 years.

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

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

Yours faithfully


.....
Dr Shemuka Singh (Chair)

/px

cc Supervisor: Prof Sarah Bansilal
cc Academic Leader Research: Dr SB Khoza
cc School Administrator: Mrs B Bherigu-Mnguni, Mbalehleh Ngobo, Philisiwe Ncayiyana, Tyzer Khumalo

Humanities & Social Sciences Research Ethics Committee

Dr Shemuka Singh (Chair)

Westville Campus, Goven Mbeki Building

Postal Address: Private Bag 254001, Durban 4000

Telephone: +27 (0) 31 260 3587/8950/4567 Facsimile: +27 (0) 31 260 4609 Email: shs@ukzn.ac.za / hrm@ukzn.ac.za / ethics@ukzn.ac.za

Website: www.ukzn.ac.za

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Appendix 2: Permission from the Department of Education to conduct research.



education

Department
Education
PROVINCE OF KWAZULU-NATAL

Enquiries: Phindie Duma

Tel: 033 392 1004

Ref.:24/3787

Miss I Matlali
PO Box 158
Mthwalume
4186

Dear Miss Matlali

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: "TO EXPLORE TEACHERS' PERCEPTION AND ATTITUDES TOWARDS (1+9) MATHEMATICS INTERVENTION PROGRAMME FOR GRADE 9 MATHEMATICS AT THREE SCHOOLS IN THE UGU 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 25 April 2016 to 30 June 2017.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Connie Kehlogile 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.

UGu District

Nkosinathi S.P. Sishi, PhD
Head of Department: Education
Date: 29 April 2016

KWAZULU-NATAL DEPARTMENT OF EDUCATION

POSTAL: Private Bag X 9137, Pietermaritzburg, 3200, KwaZulu Natal, Republic of South Africa ...dedicated to service and performance
PHYSICAL: 247 Burger Street, Anton Lembede House, Pietermaritzburg, 3201. Tel. 033 392 1004 beyond the call of duty
EMAIL ADDRESS: kehlogile.connie@kzndoe.gov.za / Phindie.Duma@kzndoe.gov.za
CALL CENTRE: 0860 598 363; Fax: 033 392 1203; WEBSITE: www.kzndoe.gov.za

Appendix 3: Grade 9 Mathematics Teacher Questionnaire

Dear Participant

Thank you in advance for your participation in this questionnaire. Please answer the questions below as honestly as you can. This questionnaire consists of 4 pages and 10 questions.

SECTION A

1. Please tick or write a number in the relevant box

Gender /classes		Years of experience teaching maths		Qualification	
M		<5		3-yr diploma in maths	
F		5-10		PGCE	
		11-15		Bachelors' Degree	
No. of gr 9 maths classes in school		16-25		Higher than a bachelor's degree	
No of Gr 9 maths classes you teach		>25		Other: (Specify)	

2. In a typical school week, estimate the number of (60-minute) hours you spend on the following for this school. Please write a number in each row and round to the nearest hour in your responses. Write 0 (zero) if none.

	Time
a)Teaching of learners in school	
b)Planning or preparation of lessons either in school or out of school	
c)Administrative duties either in school or out of school (including school administrative duties, paperwork and other clerical duties you undertake in your job as a teacher)	
d) the amount of non- teaching time you have in a typical school week	
e) the amount of time you spend marking learners' work	
f) the amount of time you spend teaching a single Gr 9 class mathematics	
Other (Specify)	
.....	
.....	
.....	

6 During the last 18 months, how many times have you attended any of these professional development activities? Rate the activities you attended on a scale of 1 to 5 where 1 is the least and 5 is the most useful.

Continuous professional development activity	No of times	Rating (1-5)
School maths meetings with HOD and teachers		
Cluster meetings with other schools		
Workshops on mathematics by subject advisor		
A visit at your school from your subject advisor		
Workshops in mathematics by your union		
Mentoring visit from a colleague or School Management Team (SMT)		
AMESA workshop		
1+9 workshops		
Other (specify)		

4. Textbook use in my school. Tick one box for each option	always	Sometimes	never
All the Gr9 teachers use one textbook for Grade 9maths			
I write my own notes for my learners.			
I use the Gr9 workbooks			
Any comment about textbook use:			

5. Curriculum tracking. Tick one box for each option	always	Sometimes	never
In my school, the HOD or senior teacher checks on my curriculum coverage.			
I use the CAPs guidelines.			
I use the KZN annual teaching plan (ATP)			
I am part of the 1+9 programme			
I use the PILO trackers			
I think it is not possible to complete all the topics in the Gr 9 curriculum			
Any other comment			

SECTION B. Using the following 1-5 scale, please indicate by circling the most correct response where necessary, the degree to which you agree with the statements listed below:

1 Strongly disagree	2 disagree	3 Neutral	4 agree	5 Strongly agree
------------------------	---------------	--------------	------------	---------------------

6. My School environment.

- 6.1 I am solely responsible for what I teach and assess in my gr 9 class 1 2 3 4 5
- 6.2 All the Gr 9 teachers teach according to the same common plan 1 2 3 4 5
- 6.3 All the Gr 9 teachers do the same assessments for all the Gr 9 classes 1 2 3 4 5
- 6.4 My HOD checks that I am on track with my teaching 1 2 3 4 5
- 6.5 If I have a problem with the maths, I go to my HOD who helps me 1 2 3 4 5
- 6.6 My maths colleagues are supportive of the work I do 1 2 3 4 5
- 6.7 My Gr 9 learners appreciate my work 1 2 3 4 5
- 6.8 Parents are supportive of our work 1 2 3 4 5
- 6.9 Our mathematics department works together as a team in the school. 1 2 3 4 5
- 6.10 Our mathematics head ensures that everybody does their share of work 1 2 3 4 5

7. Gr 9 Maths Curriculum

- 7.1 I am pleased with the pace of the Gr9 curriculum 1 2 3 4 5
- 7.2. All the topics in the Gr 9 curriculum are necessary 1 2 3 4 5
- 7.3. The sequencing of the topics according to CAPS makes sense 1 2 3 4 5
- 7.4. We stick rigidly to the departmental planning guidelines 1 2 3 4 5
- 7.5 Any comment about how the Gr9 curriculum can be improved? _____

8. The 1+9 intervention

- 8.1 The 1+9 programme has been useful to me as a gr 9 maths teacher 1 2 3 4 5
- 8.2 My content knowledge has improved because of the programme 1 2 3 4 5
- 8.3 My method of teaching has improved 1 2 3 4 5
- 8.4 I find the pre-tests useful for me to figure out my problems 1 2 3 4 5
- 8.5 I was forced to attend by the principal/department. 1 2 3 4 5
- 8.6 My school has re-organised the timetable so that I do not miss any lessons when I attend the 1+9 programme. 1 2 3 4 5
- 8.7 My learners are kept busy with mathematics activities when I am not there 1 2 3 4 5
- 8.8 I manage to complete all of the lesson plans 1 2 3 4 5
- 8.9 What are some suggestions on how the programme can be improved? _____

9. Gr 9 Maths ANA in 2014 and 2015

- 9.1 The average percentage attained in the 2014 ANA in my school was _____
- 9.2 I have read the DoE 2014 ANA report (Yes/No)
- 9.3 The Gr 9 learners in my school wrote the ANA in 2015 (Yes/No)

- 9.4. The ANA provides a good measure of learners' ability 1 2 3 4 5
- 9.5 I am happy with the length of the ANA test. 1 2 3 4 5
- 9.6 I think the levels of questions in the ANA were suitable 1 2 3 4 5
- 9.7 I think the instructions in the ANA are clear and unambiguous 1 2 3 4 5
- 9.8 In my school, the Grade 9 ANA results are used to determine whether learners are channelled into studying mathematics or Mathematical Literacy in Grade 10 1 2 3 4 5

9.9 Any other comment about the ANA

9.10 Any comment you would like to give to the Department of Education about mathematics or education in general? _____

SECTION C

Educators understanding of the 1+ 9 intervention programme

In this section you are presented with statement to which you should indicate the extent of your agreement/ disagreement.

Q1. I was aware if this 1+9 intervention programme before I took part in it.

Strongly agree	Agree	Not sure	Disagree	Strongly disagree
----------------	-------	----------	----------	-------------------

Q2. My participation in the 1+9 programme has helped me plan better and execute lessons better

Strongly agree	Agree	Not sure	Disagree	Strongly disagree
----------------	-------	----------	----------	-------------------

Q3. My learners are now performing better after I took part in the 1+9 programme

Strongly agree	Agree	Not sure	Disagree	Strongly disagree
----------------	-------	----------	----------	-------------------

Q4. I am happy with the current form of the 1+ 9 programme

Strongly agree	Agree	Not sure	Disagree	Strongly disagree
----------------	-------	----------	----------	-------------------

Q5. Teachers should be participative in the design of the lesson plans used in the 1+9 programme.

Strongly agree	Agree	Not sure	Disagree	Strongly disagree
----------------	-------	----------	----------	-------------------

SECTION D

In this section you are urged to provide any reason that best expresses how you feel.

1. Lesson plans are user friendly. Do you agree? Give reasons.

2. Some teachers argue that this programme is not useful. Do you agree? Give reasons.

3. Some improvement has been observed in terms of learner performance. Do you agree? Give reasons.

THANK YOU

Appendix 4: Interview Schedule For The 8 Participants.

SEMI STRUCTURED INTERVIEW

N.B All information will be treated very confidentially

Questions

1. How long have you been teaching mathematics
2. How long have you been teaching mathematics in grade 9
3. Have you been participating in 1+9 intervention and for how long?
4. What are the things which have impacted on your teaching in grade 9 mathematics this year?
5. Has participation in the 1+ 9 programme impacted on your teaching of grade 9? And how?
6. Can you say something about ANA? The implementation or administration of ANA had an impact on your teaching.
7. How has administration of ANA impacted or influenced your teaching?

On curriculum

1. There is a concern on curriculum, many people are saying they have a challenge with curriculum coverage and at many schools teachers are saying they are not covering what they are supposed to teach. What is your opinion about that?
2. In your school do you keep track of the curriculum? Do you have any monitoring tools that every teacher can keep up with the coverage of the curriculum?
3. Do you think that all the topics that are taught in grade 9 Math are necessary?
4. What do you think about the sequencing of the topics, the way the topics follow one another?
5. Is it possible for you to complete the curriculum to accommodate the ANA as ANA is written in September?
6. I believe some schools prepare their learners for ANA. Does this not affect everyday teaching to complete curriculum. Does this not affect the completion of the curriculum coverage?

On assessment

1. What is your comment about the assessments in grade 9 mathematics?
2. How has 1+9 intervention help you with how you assess your students?
3. Last year Ana was postponed and many schools did not write ANA, how did you feel about that postponement?
4. How do you feel about the ANA papers? Are the questions in line with ATP or not?
5. Were your learners able to tell the difference between the Ana exam and your school exam?
6. What makes them able to identify the difference between your paper and the ANA paper?
7. Where do you think the gap is, with the teaching or with the examination?
8. Are you comfortable with the language that is used in the ANA question paper? I know English is not their first language.
9. What is your general feeling about ANA? And how can it be improved?

On 1 + 9 mathematics intervention programme

1. Please share with me your understanding of a teacher development programme
2. What is your understanding of the aims of one plus nine mathematics intervention programme?
3. Has your curriculum coverage improved after participating in the 1+9 programme?
Do you think it has made a difference in your curriculum coverage?
4. I understand that one plus nine designed such that you go once in two weeks to attend the programme, then you come back to teach. Have you found it easy to make up the time when you attend the one plus nine programme when you come back to school?
Do you make up the time that you have lost?
5. What challenges did you encounter when participating in 1+9 programme?
6. In your opinion, does the lesson plan at 1+9 programme meet the standard of the ATP?
7. What do you think needs to be done so that 1+9 intervention programmes can be made better?

Thank you for your participation in my study.

Appendix 5: Interview Schedule for Cluster Coordinator

Semi Structured Interview

NB. All information will be treated very confidentially

Questions

1. Which qualifications do you have as a teacher and which ones do you have in Mathematics?
2. How did you become the cluster coordinator?
3. What are your roles/ duties as a cluster coordinator?
4. Do you have any content support from department to be able to execute your duties and from whom?
5. What do you understand by teacher development programme?
6. What is your own understanding about the aims of 1+9 programme?
7. In your own opinion is the programme achieving its aims? If not why do you think it is not?
8. Has your curriculum coverage improved after participating in the 1 +9 programme? Do you think it has made a difference in curriculum coverage by the participating schools?
9. What challenges have you encountered when participating in the programme?
10. According to your observation, how have the teachers participating in the programme accepted the programme?
11. Have you seen any changes in teachers' attitudes since starting the programme?
12. Which teachers do you think have the most to benefit from the programme?
13. What do you suggest can be done better by the department so that the 1+9 programme is better?
14. What do you suggest can be done better by the teachers so that the 1+9 programme is better?
15. What do you suggest can be done better by the cluster coordinator so that the 1+ 9 programme?

Thank you for your participation in my study.

Appendix 6: Informed Consent Letter

P.O. Box 158

Mthwalume

4186

10 March, 2016

Dear participant,

INFORMED CONSENT LETTER

My name is Itumeleng Matlali. I am Masters' degree student studying at the University of KwaZulu-Natal, Edgewood campus, South Africa. I am interested in exploring teachers' perception on 1+9 mathematics intervention programme and how it is impacting on their teaching. To gather the information, I am interested in asking you some questions.

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 questionnaire may last for about 30 minutes to 45 minutes.
- Any information given by you cannot be used against you, and the collected data will be used for purposes of this research.
- Data will be stored in secure storage and destroyed after 5 years.
- You have a choice to participate, not to participate or stop participating in the research. You will not be penalized for taking such an action.
- Your involvement is purely for academic purposes only, and there are no financial benefits involved.

Declaration Form

I..... (Full names of the participants) hereby confirm that I understand the contents of the document and the nature of the research project, and I consent to participating in the research project.

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

Signature of participant

Date

I can be contacted at:

Email: i.matlali58@gmail.com

Cell: 083 328 9884.

This study is supervised by Professor Bansilal S. who is located at the School of Education, Edgewood campus of University of KwaZulu- Natal who has the following contact details:

Email: bansilals@ukzn.ac.za

Phone number: (031) 260 3451

You may also contact the UKZN Research Office through:

Ms P. Ximba (HSSREC Research Office)

Email: ximbap@ukzn.ac.za

Tel : (031) 260 3587

Thank you for your contribution to this research.

Appendix 7: Gatekeeper Permission Letter

P.O Box 158

Mthwalume

4186.

10 March. 2016

The principal

I am currently registered as a Masters student in the school of Education at the University of KwaZulu- Natal, Edgewood Campus. The programme is a two year degree which involves course work and dissertation.

The aim of my study is exploring teachers' perception and attitudes towards the (1+ 9) Mathematics intervention for grade 9 mathematics teachers. It will also contribute to the knowledge related to in-service training.

I would be grateful if you grant me permission to undertake the research with your teachers from March- August, 2016.

The study will involve self-completion questionnaires and interviews. This will involve teachers participating in the intervention programme.

Teachers' participation is completely voluntary and they are at liberty to withdraw from participating at any stage of the study and for any reason. Please note that there will be no financial gains in participating in the research. Pseudonyms or codes will be used so as to ensure participants' confidentiality and the information gathered will be treated with confidentiality and used for the research purpose.

Thanking you for giving attention to my request.

Yours in the advancement of education

Itumeleng Matlali

Contact details as follows:

Cell: 083 328 9884

Email: i.matlali58@gmail.com

Student no: 215 081 321.

This study is supervised by Professor Bansilal S. who is located at the School of Education, Edgewood campus of University of KwaZulu- Natal with the following contact details:

Email: bansilals@ukzn.ac.za

Phone number: (031) 260 3451

If you have any queries or concerns about your participation you may contact the UKZN Research Office through:

Ms P. Ximba (HSSREC Research Office)

Email: ximbap@ukzn.ac.za

Tel : (031) 260 3587 .

Thank you for your contribution to this research.

Appendix 8: Editor's Certificate

The Revd Mabel Jean Dalby (B.Th.)
77 Carey Road
Pelham
Pietermaritzburg
3201

mjmccd@gmail.com
082 487 2627

11 August 2018

TO WHOM IT MAY CONCERN

TITLE OF PAPER: EXPLORING TEACHERS' PERCEPTIONS TOWARDS THE 1-9 MATHEMATICS INTERVENTION PROGRAMME FOR GRADE 9 TEACHERS IN UGU DISTRICT IN KWAZULU-NATAL

STUDENT/AUTHOR: ITUMELENG MATLALI (215081321)

The above-mentioned dissertation submitted for the Degree of Master of Education (Mathematics Education) was proofread by me for English language, grammar, spelling, punctuation and formatting errors. I endeavoured throughout the process to retain the writing style of the student/author and to remain true to her research content and intentions.

Please note that Tables, Figures, Charts, Graphs, Calculations and References (Bibliography) were not checked for accuracy although obvious errors, for example in headings, were corrected.

My suggested changes may be accepted or not at the student's and your discretion.



M J Dalby

Appendix 9: Turnitin Certificate

12/4/2018

Turnitin

Itumeleng Matlali User Info Messages Student English Help Logout


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