

**Experiences of Grade Nine Learners' In Learning Mathematics at a
Secondary School in Umzimkhulu**

By

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Declaration of Originality

I, Mutesi Maureen, hereby proclaim that this dissertation is my own original work. Where other peoples' ideals have been taken, it has been acknowledged through in text citations and has been referenced. This work has not been submitted for any previous degree or examination at any other university.

Ms. Mutesi Maureen's signature

6 January 2016

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ABSTRACT

This study is an exploration of experiences of grade nine mathematics learners in learning mathematics at a secondary school in Umzimkhulu. This case study has been conducted at one of the junior secondary school in Umzimkhulu with five grade nine learners as the participants. I targeted this group in full knowledge that it does not represent the wider population and there is no attempt to generalise the findings (Cohen, Manion & Morrison, 2000). The participants' experiences provided an insight to curriculum developers, classroom teachers and stake holders in need to attaining a successful attained curriculum. Purposive sampling was used in choosing a particular group of learners who have got different experiences when learning mathematics. Cohen et al (2000) urges that purposive sampling is mostly suitable for small scale research and it is less complicated to set up and considerably less expensive. I have positioned myself with in the interpretive paradigm in order to approach this study. This study aims to gain in depth of knowledge and greater understanding of experiences of grade nine mathematics learners at a junior secondary school in Umzimkhulu. It has been conducted within the qualitative framework with semi-structured observations, a focused group discussion, and one-to-one semi structured interviews as data generation methods (Denzin & Lincoln, 2003). The study consequently recommends content centred teaching approach which underpins performance curriculum.

Keywords: Experience, learning, mathematics, curriculum.

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Dedications

I dedicate this dissertation to my son and my husband who supported me throughout this project. It is through your moral and financial support that this journey was a success. To my family thank you for the significant support. Thank you for your love, encouragement and motivation.

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Acronyms

CAPS	-	Curriculum and Policy Statement
DOE	-	Department of Education
RNCS	-	Revised National Curriculum Statement
NCS	-	National Curriculum Statement
C2005	-	Curriculum 2005

CHAPTER ONE

OVERVIEW, CONTEXT AND OBJECTIVES

1.1. Introduction

Mathematics is a powerful gatekeeper because it equips learners with basic numeric skills and knowledge which enable them to fit well and participate effectively in society (Department of Education, 2012). The importance of education was also highlighted in the message of the Director General of basic education written in mathematics hand book of the Foundation Phase teachers. The message indicates that “Mathematics is an essential building block for learners to make a confident start to mathematics” (DBE, 2012, p. 1). South Africa is faced with poor performance in mathematics since the introduction of competence/horizontal Curriculum 2005 in 1998. Grace (2010) defines attained curriculum as a measure of what learners have learned and is reflected in learners’ achievements and experiences. The study intends to explore the experiences of grade nine mathematics learners at a junior secondary school. The experiences were an eye opener to the curriculum implementers, administrators and stake holders who are tasked with improving the mathematics curriculum. This chapter gives the background to the study with an explanation of how it was conducted. It states the focus and purpose, the research question, objectives, and overview of the study.

1.2. Historical Background

Ubiratam (2007) explains that mathematics, as a subject, originated in the Mediterranean Basin, then spread to Northern Europe and later become widely used in the rest of the world. Different procedures and topics were developed such as subtraction, statistics and division. Techniques like timing, comparison and classification help in promoting critical thinking skills and communication methods. Khoza (2015a) explains that South Africa is faced with low grades in mathematics since the implementation of Curriculum 2005 (C2005) in 1998. This suggests there has been a high failure rate of mathematics since the introduction of the horizontal curriculum. The curriculum was amended first to a Revised National Curriculum Statement (RNCS), followed by the National

Curriculum Statement (NCS), and then Curriculum Assessment Policy (CAPS) was introduced in 2012. Moloj and Stray (2005) explain that mathematics curriculum deprived the majority of learners and permitted the minority to advance in their education to higher levels. South Africa participated in a study conducted by Southern and Eastern Africa Consortium for Monitoring Educational Quality study (SACMEQ II) in 2005. This study assessed learners using the Rasch Model and concluded that 80% of the learners in grade six did not attain the eight modules of mathematics. Low standards in the mathematics curriculum were experienced in township schools as they are under resourced and have an inherent lack of infrastructure.

1.3. Rationale

I have chosen this study because of my personal interest which has been influenced by educational policies, and the different experiences of grade nine mathematics learners. I have been teaching mathematics for five years and have observed that mathematics has the highest failure rate especially at secondary education level. I chose grade nine because it's an exit level to college and career guidance is very crucial. Whereby, this motivated me to conduct this study in order to address this problem. Education and training was designed to disadvantage the majority especially the blacks, throughout the apartheid regime. Begle and Gibb (1980) assert that there is no developed theory for studying mathematics. This suggests that the mathematics curriculum still faces poor standards since no theory has been developed to repair the poor standards in mathematics.

Kulik (2002) asserts that various ways have been implemented to investigate different methods of learning mathematics. This has been achieved by revising the curriculum, resources, integrating tools and tutorial methods which make learning conducive. This suggests that to enhance a positively attained curriculum learners' experiences have to be understood. Learners' experiences provide an insight to curriculum developers and the teachers in revising and rebuilding the curriculum in order to improve the learning activities. Hoadley and Jansen (2013) believe it is crucial to have a prescribed or attained curriculum because it helps standardise the knowledge which is acquired by learners. This suggests that standardised knowledge helps achieve learning

outcomes. If learners are able to demonstrate learning at end of the lesson this helps to achieve a positively attained curriculum and ensures productive learners who can contribute positively to national development. If the learning outcomes are not achieved, this results into poor performance of mathematics. Therefore, this study could be used to inform the mathematics curriculum designers on areas of concern that prevent or limit learners from doing well in the subject. The results of the study may also be useful to subject policy makers, other university disciplines and other sectors that are interested in mathematics teaching and learning.

Literature Review

1.4. Mathematics

Mathematics is a form of communication that applies codes and techniques for explaining numbers, graphs and geometry. Mathematics is characterised with examining, analysing and exploring different aspects that are linked to mathematical elements. Mathematics helps in building intellectual reasoning skills (Motshekga, 2011). Mathematics is a prominent discipline with its abstract concepts, different cognitive abilities and compatibility with the real world. The tools of mathematics are not only used for its concepts but are also used for other disciplines and social life. One of these tools, may be the most important, is problem solving. Problem solving has a central importance for mathematics and it is accepted as a fundamental tool for understanding and interpreting mathematical knowledge (Jitendra, Griffin, Buchman & Sczesniak, 2007; Kayanve, Cakiroglu, 2008; Polya, 1957 & Schoenfeld, 1987). This fundamental tool is also a special process rather than a concept or subject. Problem solving process involves; verbal and syntactic processing; visualisation; building different types of representations; algorithmic procession; algorithmic learning; and debugging. Mathematics, as a subject, is learned from the lowest to the highest order. Mathematics is alleged to be classified, planned and tricky hence making it hard for learners to learn since they have diverse abilities. This suggests that learners have diverse abilities when it comes to mathematics (Rutheven, 1987).

1.5. Experience

Experience refers to something that is personally undergone or lived through. Individual experiences are a crucial foundation of acquiring knowledge. Experiences help in recalling certain knowledge and steadily fabricating means of intelligence (Shook, 2008). To explore different learners' experiences in learning mathematics through active involvement encourages learners towards self-exploration (Liang & Zhou, 2009). The learners have different experiences when learning mathematics; some may be more direct whilst others are acquired unconsciously. Experiences involve learning through exploring and discovering, which can occur through acting, doing or feeling something personally.

1.6. Location of the Study

The Umzimkulu circuit was selected because it is situated in a rural location which is faced with low mathematics standards. This study was conducted at Junior Secondary School in Umzimkulu circuit in Sisonke District.

1.7. Objectives

The objectives of this study are:

- Identify and understand the experiences of grade nine learners in learning mathematics at secondary school in Umzimkhulu.
- Understand the reasons why grade nine learners have particular experiences in learning mathematics.

1.8. Questions to be asked

- What are grade nine mathematics learners' experiences in learning mathematics at a Junior Secondary School?

- Why grade nine mathematics learners have particular experiences in learning mathematics?

1.9. Research Approach

This study adopted a qualitative a research approach with the aim of gaining an in-depth knowledge and understanding the experiences of grade nine learners. The research being investigated focuses on exploring the knowledge and different experiences of grade nine learners while learning mathematics at secondary school. Qualitative research focuses on the preliminary explanation of collective events which informs how the world is inhabited by the people (Hancock, 2002). Research in this field involves the opinions, experiences and feelings of individuals by producing subjective data. Henning, Gravert and Van Resburg (2005) define research design as plan for generating and analysing data. This study adopts a case study approach or research style.

1.10. Case Study

As a form of a qualitative research this study will adopt the case study as a research approach. Case studies are implemented when the researcher intends to support their argument by a thorough analysis of a person, a group of persons, an organisation or a specific project (Christiansen *et al*, 2010). From an interpretive perspective, case studies aim towards a deeper examination of how participants interrelate with each other in a particular state that arises from the phenomena under study (Maree, 2007). This is synonymous with simulative theory which believes there should be interaction and participation among participants involved in an activity in order to achieve desired outcomes. The case study is one method of investigating a particular topic and is chosen as an appropriate research method. The phenomenon under study is therefore examined within its context (Yin, 1988).

As a research style, an interpretive case study of five mathematics grade nine learners at a Junior Secondary School will be suitable for this study. Cohen *et al* (2011) assert that a case study is the study of particular group of people and a particular environment. This suggests that those findings

cannot be representative of the wider population and it helps to understand different behaviours. A case study helps to deeply explore various data sources. This study can therefore assist other mathematics learners in schools where this study was not conducted. Silverman (2013) identified different forms of case studies; the intrinsic case study, the instrumental case study and the collective case study. In intrinsic case studies there is no effort made to generalise beyond the single case; in instrumental case studies a case is scrutinised to offer insight for a concern; and collective case studies investigate general phenomenon through a number of cases. This study therefore uses the case study because it sets out to explore the experiences of grade nine mathematics learners at a secondary school. This study intends to explore the different experiences of mathematics learners in a secondary school.

1.11. Sampling

Sampling was taken according to gender and performance in class. I selected five grade nine learners who scored poorly in mathematics tests. Christiansen *et al* (2010) define sampling as selecting a particular group of people, location, actions and activities for study. This suggests that sampling is a component of analysing a particular group, situation, and events. Different factors are considered when sampling, such as research approach and data generation methods. This suggests that the research methods will determine the sample size. Cohen *et al* (2011) define sampling as a particular number of people that will be selected for research. Sampling is determined by certain factors such as location, resources and timing. There are different methods of sampling; random sampling and purposive sampling. A particular group of people is used in that it can represent the total population.

This study adopted purposive sampling and I made a decision about the specific group of people to be used as a sample. According to Christiansen, Betram and Land (2010), purposive sampling describes the process of choosing a particular group of people to be used as a sample. The sample was made up of grade nine learners since they are learning mathematics and have different experiences. Furthermore, this study will adopt convenience sampling where by grade nine mathematics learners are easily accessible. Grade nine mathematics learners as a sample; do not

represent the wide population. Convenient sampling refers to particular group that is easily contacted by the researcher. This suggests that the sample group should be easily accessed by the researcher. The grade nine learners are easy to reach, since the school is near to me and it is the same circuit in which I work.

1.12. Research Methods

Research methods are data generation techniques which are used by the researcher during the course of studying the research problem (Kothari, 2004). There include methods that are concerned with the collection, analysis and interpretation of data. There are many research methods and each research paradigm has methods that are most suitable in attaining the intended aims. Case studies involve the use of a combination of different methods depending on the case studied. Three data generation methods will be used in this study.

During the semi- structured observation, the researcher does not go through a check list ticking off boxes or rating particular activities occurring, but writes a free description of what is observed (Christiansen *et al*, 2003). I will not rely on the opinions or perceptions of others but I can see what is actually occurring in a classroom. One- on- one semi-structured interviews are described by Cohen, Manion and Morrison (2011) as an exchange of ideas between different people on a particular subject. It emphasises the vital individual relations for producing information and enables multiple sensory channels to be used. One-on-one semi- structured observation will be used for gaining insight into situations. In this case one-on-one semi-structured interviews was preferred with the five participants because it allows for flexibility by giving the interviewee a chance to loosen up and give different ideas while the researcher probes for more responses. Hennink *et al* (2011) assert that the use of in-depth interviews will help understand the context in which mathematics learners operate and therefore understand their experiences. The one-on –one semi- structured interviews will be carried out in a conducive and comfortable atmosphere giving the participants the chance to present information. A focus group discussion will be used to yield a collective view on their experiences. During the focused group discussion the participants' views dominate and are given chance to interact with each other. Grade nine mathematics learners will

be able to discuss their different experiences whereby giving a more reliable record (Cohen *et al*, 2011). Silverman (2013) asserts that different people intermingle with one another during their focus discussions. Cohen *et al* (2011) believe that this method is suitable in cases where a group of people have been learning together as is the case of grade nine mathematics learners. Focus group discussion was conducted once for sixty minutes and confidentiality was up handed although it's not guaranteed.

1.13. Trustworthiness

Lincoln and Guba (1994) define trustworthiness as the way a researcher is able to convince the readers that the findings of study are accurate and are of high quality. Issues of trustworthiness have to be considered at the data generation, data analysis and data interpretation stages. This will ensure that the findings of the study reflect what is happening on the ground and readers will trust the findings of the study. Bassey (1999) indicates that the trustworthiness is more concerned with meanings and personal experiences of individuals. The concept of trustworthiness aims to describe personal experiences and not to measure. According to their studies Mertens and McLaughlin (2004) and Christiansen *et al* (2010), agree that the concepts of credibility, transferability, dependability and conformability should be used to ensure the quality of research studies. I ensured trustworthiness in my study by attending to the concepts explained below.

1.14. Data Analysis

This study will use guided analysis because units of analysis will emerge from both the theory (curricular spider web) and data. According to Samuel (2009), guided analysis is flexible in terms of allowing researchers to modify principles of theories to accommodate important issues that emerge from the data. Concepts will then be grouped, related and categorised (Rice & Ezzy, 2000). Themes that emerge from data and theory will then be identified and contextualised by referring to the literature (De Vos, 1998). As stated by Kothari (2004), there are two types of data primary data and secondary data, and the researcher has to make a choice between the two data types they need for their study and when. After data generation the data will be analysed in order to make meaning of the results. Data analysis involves generating data from the findings of the participants, concepts, groups and uncertainties (Cohen *et al*, 2011). It is very heavy on

interpretation and these interpretations may differ from one person to the next. Qualitative data derives from sources like field notes, documents, audios and many others.

Kothari (2004) describes data classification as arranging data into groups or classes on the basis of common characteristics. Christiansen *et al* (2010) explain that data reduction as a procedure of choosing, conceptualising, attending and changing data. Data reduction facilitates the researcher to understand the complex links between various aspects of people's situations, mental processes, beliefs and actions. It is a continuous process that takes place during all stages of the research. Hennink *et al* (2011), describe qualitative data analysis as a coherent presentation of people's experiences and how that reflects on the complexity of human behaviour. An approach using the components of the curricular spider web as the conceptual framework will be used to help organise and sort the data generated from this study into categories. This will be done such that it allows new categories and themes to arise from data. This categorised data will then be analysed using thick descriptions that not only describe behaviour but also the context within which that behaviour occurs (Hennink *et al*, 2011).

1.15. Ethical Issues

Christiansen *et al* (2011) state that since research involves humans it is therefore important for the rights of these individuals to be sheltered from any damage originating from the study. Participants must receive clear explanations of what the research expects of them because this will allow them to make informed decisions in their voluntary participation.

Consent to carry out this study was received from the Department of Education and from the school principal where the study was conducted. Consent from participants was obtained by having them acknowledge the letter of consent by signing it after they received it. According to Cohen *et al* (2011) the acknowledgement letter should have the following; clarification of the steps to be taken; explanation of the inconveniences and dangers; the merits of the participants; free response to show their opinion; participation is involuntary; and that answers depend on person's opinion.

Participants will remain anonymous. Video footage will be done only with the permission of the participant. Burton and Bartlett (2005) agree that these ethical issues should be taken into consideration before embarking on a research project and also taken into account whilst the research is ongoing.

1.16. Anticipated Problems/Limitations

During the interviews it is anticipated there can be untrue responses trying to please the interviewer where as deceptive behaviour can be portrayed during the observation. Cohen *et al* (2011) argues that case studies can lead to subjectivity and bias because can't be double checked. This is possible because the researcher might tend to seek answers, during the interviews, which supports their preconceived notions.

1.17. Overview of the study

The following are the six chapters into which data has been organised in this study.

1.17.1 CHAPTER ONE

Chapter one gives the foundation and the account of the study. In addition, it explains the gap that needs to be covered in the mathematics curriculum and how the research will benefit society. Chapter one explains and discusses the purpose of the research, rationale behind the study, objectives, research questions, literature review, research design methodology, data analysis, validity/reliability ethical issues and limitation of the study.

1.17.2. CHAPTER TWO

Chapter two brings together all the literature that I have read in relation to the topic of this study. Studies conducted abroad as well as those conducted in this country are brought together to give the readers information about the experiences of grade nine mathematics learners at secondary schools. The conceptual framework as curricular spider web underpins this study, is intensely discussed.

1.17.3. CHAPTER THREE

Chapter three is the core of the study as it discusses the paradigms and the approach in which the study is located, as well as. The sampling and methods used to collect data. It also focuses on the ethical issues considered in this study, data analysis, and the limitations of the study.

1.17.4. CHAPTER FOUR

This chapter covers the findings of the study. The findings are presented as per participant response to the study's critical question. The discussion will also be based on the curricular spider web that frames the study.

1.17.5. CHAPTER FIVE

This chapter five presents the conclusion as well as the recommendations by answering each research question.

18. Conclusion

All in all, Chapter one presents the overview of what the study entails. Each chapter has been brought to the reader's attention. The following chapter will discuss the local and international literature connected to this study.

CHAPTER 2

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1 Introduction

Boote and Belie (2005) define a literature review as an assessment of different studies originating in the literature relating to a particular area of study. The literature review helps in explaining, reviewing, assessing, simplifying. It involves exploring different ideas involving classification and the expression between literature and the study. The literature is determined by the nature of the study and rationale of the study. Silverman (2013) argues that a literature review serves as an opportunity to set the stage on what to do in the subsequent sections; it is a synthesis and evaluation of earlier studies. This suggests that the researcher engages in discussion with other researchers who have researched on the study before. Furthermore, the literature review serves to explain the link between this study and previous studies in order to improve on this finding in this study. In addition, this study brings together all the literature on the studies conducted abroad, as well as in this country, to give the reader information on the experiences of grade nine learners while learning mathematics at secondary school. This chapter will cover the experiences of grade nine learners, the curriculum, conceptual framework and the mathematics literature as based on the ten components of curricular spider web. The conceptual framework, which is the curricular spider web and its ten components, will be used and the relevant studies of mathematics will be covered in this study to understand why grade nine learners have particular experiences. Figure 2.1 illustrates the summary of the literature review.

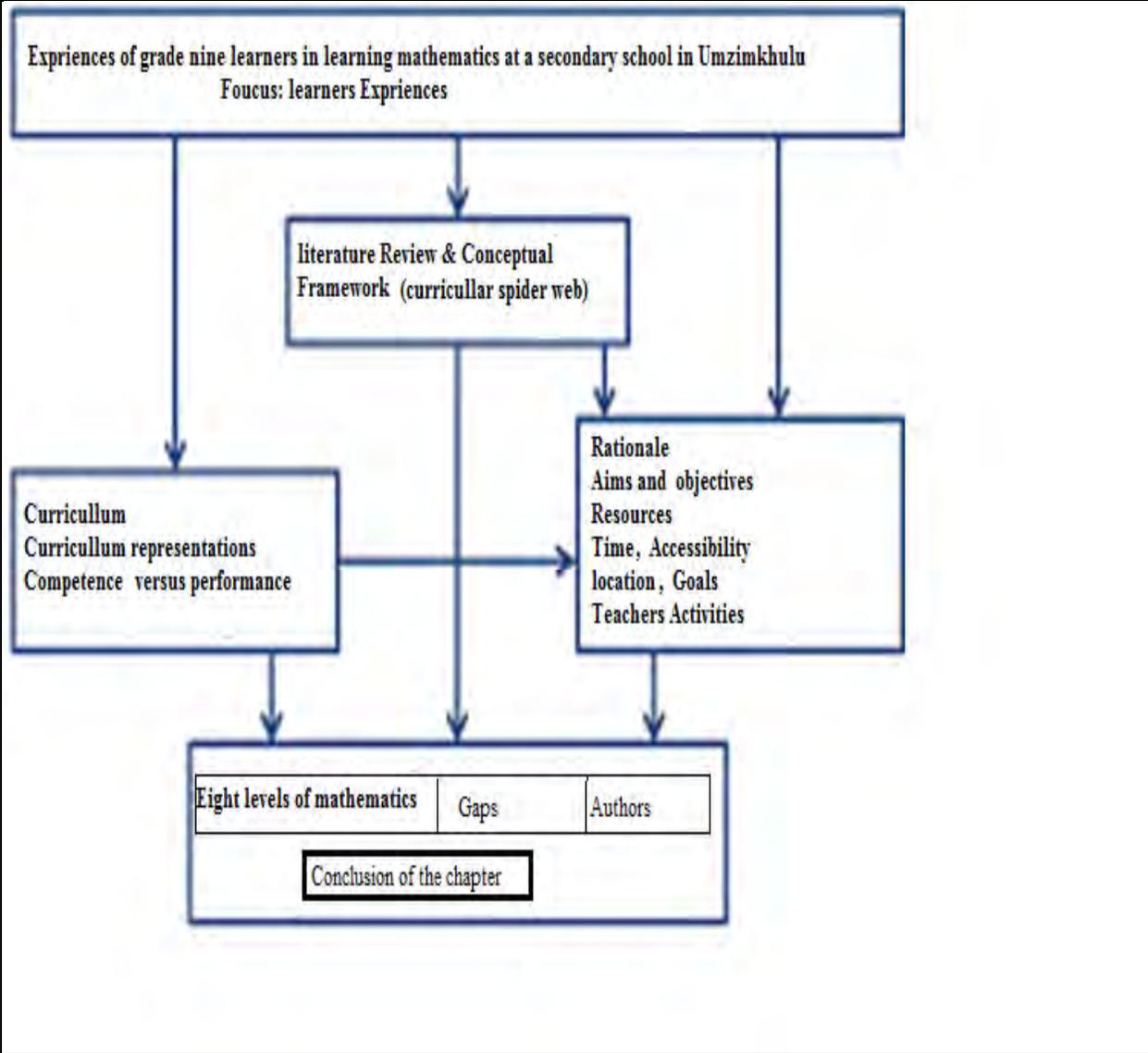


Figure 1: Summary of literature.

2.2 What is Curriculum?

Talla (2012) defines curriculum as a map of events or printed syllabus that includes strategies for achieving aims, objectives and learning outcomes. This map of events can cut across all the five levels of which the curriculum operates. This suggests the curriculum is defined from attained position rather than intended. Arulsamy (2010) suggests that a curriculum embodies all the experiences which are utilised by the school to attain the aims of education. Curriculum is

comprised of different attained experiences when learning. Rao (2010) explains a curriculum as a body of knowledge, content or subjects and education. Curriculum is a process by which these subjects are transmitted or delivered to learners by the most effective methods that can be defined. According to their studies Talla (2012), Arulsamy (2010) and Rao (2010), share the same idea that curriculum includes content and knowledge to be transmitted to the learners. This is a view that curriculum is synonymous to the syllabus which hinders planning determined by the body of knowledge which can be transmitted. Wilson (1990) defines curriculum as a tool used during the learning process. Curriculum is defined from intended position perceived by the teachers in the real process of teaching as they use the necessary tools. This suggests a curriculum should be well planned before it is transmitted to the learners, an example like making a lesson plan. The lessons should be designed to meet the learners' needs. The tools should be effectively used in order to achieve national goals. Pinar (2004) defines curriculum from the implemented/enacted curriculum representation. Curriculum involves the analysing the planned or prescribed curriculum by the teachers during the teaching process. The study encourages an interrogation of teachers' infinitive autobiographical nature of their lived experiences in defining curriculum. Berkvens, van den Akker and Brugman (2014) define curriculum as a plan for teaching/learning from the intended position (the designer's levels). The curriculum to be attained the teacher should be prepared for the lesson. Preparations like making a lesson plan before going to teach are guided by the curriculum. Van den Akker, de Boer, Folmer, Kuiper, Letschert, Nieveen and Thijs (2009, p. 9) describe the curriculum as a "preparation for learning". This suggests that curriculum involves organising the different tools, materials, resources and environment which will be used during the learning process. Khoza (2015a) sums it all up by defining curriculum as being the first layer as a plan for teaching/learning, and from the second or third layer as the plan of teaching/learning. This suggest the curriculum as the plan for teaching/learning is defined from the planned representations which involves written policies guided by educational theories while as curriculum as plan of learning which explained as the intended or assessed which involves learners' experiences evaluated through learning outcomes. Tannenbauem et al (2011 p. 29) asserts that curriculum is a plan for education as:

“A curriculum is an overall educational plan embraced by an educational institution for a given training institution. It includes training goals and objectives, content and structure

of the programme, teaching and learning methods, involves the learning environment, assessment programmes and evaluation process”.

In addition to above definitions, curriculum is a written tool designed by government to achieve the educational objectives. The written policies designed by educational structures are driven by the educational theories (Khoza, 2015a).

2.3. Curriculum Representations

Van den Akker *et al* (2009) described the five levels at which a curriculum operates; Supra curriculum operates on the international level (international curriculum); the Macro curriculum operates at the national level (national curriculum); the Meso curriculum operates at the institutional level (school curriculum); the Micro levels describe the teacher who does the teaching and the Nano curriculum includes the learner who is learning (learner curriculum). Plummeridge (2002, p. 9) states that “... No matter how well frameworks or curriculum specifications are designed and presented, they are nothing until translated into effective action in the classroom”. This suggests that the curriculum will remain theorised unless it is effectively attained in the classroom. Curriculum is designed by educational structures influenced by educational theories. Effectiveness of the curriculum can only be achieved if the gaps can be identified among the three main layers, as explained below.

Van den Akker *et al* (2009) asserts that there are three layers of curriculum; the intended, the implemented and the attained. The different layers of curriculum are experienced at various layers and for effective enhancement of curriculum all the different layers have to be attended to. The intended/planned or formal curriculum is reflected in curriculum guides, syllabi course outlines and text books adopted by the department of education. Different documents can be used at different levels of the curriculum that is to say mathematics syllabus, work schedule, lesson plans and text books. Khoza (2015a) suggests that planned curriculum is in written policies guided by the educational theories. In South Africa, the Ministry Of Education develops the intended goals or specification of content. The implemented curriculum is the one that is taught in class. The

implemented/enacted/practised curriculum is the interpretation of the intended curriculum as perceived by teachers and the actual process of teaching in operation. The Cohen *at el* (1998) acknowledges that content coverage is related to learners' achievement. The attained/achieved/assessed curriculum is what the learners have achieved, and is reflected in learner's achievements and attitudes. The attained curriculum, which is the learning experiences as perceived by learners, is measured through their learning outcomes. Curriculum in development is based on the three layers and tends to be influenced by two major types of curriculum. The two types are competence/horizontal/integrated curriculum and performance/collection/ vertical curriculum (Hoadley & Jansen, 2014).

2.4. Competence/horizontal/ integrated versus Performance/vertical/ collection curricula

Hoadley and Jansen (2012) describe two distinct models of curriculum, that is to say the 'competence' model and the 'performance' model. These two models provide us with an ideal type against which we can review the current curriculum debate in South Africa. The ideal types, or models, are considered ideal because they are essential in teaching. The two types or models of curriculum are analytic tools that help us clarify our thinking. Bernstein (1999) suggests that the two types of curriculum are oppositional rather than complimentary. The table below compares and contrasts the two types of curriculum as illustrated below.

	Competence/horizontal curriculum	Performance/vertical curriculum
Evaluation	Unplanned	Planned
Epistemological	Subjective	Objective
Content	Segmental	Hierarchical
Social	Intimacy	Distance
Location	Inside	Out side
Voice	Dominated	Dominate
Approach	Linear	Non linear
Organisation	Gemeinschaft	Gessellschaft

Table 2.1: Comparison between competence/ horizontal curriculum and performance/vertical curriculum. Redrawn from Bernstein (1999, p. 158).

2.5. Competence/ horizontal/integrated Curriculum

Bernstein (1999) describes competence/horizontal/integrated curriculum as the type of knowledge classified as informal or day-to-day knowledge. This curriculum is usually known as common sense knowledge. Horizontal curriculum is characterised with the following; knowledge is restricted, environment reliant and exact. Horizontal curriculum evaluation is not planned and aims towards general competence. This suggests that horizontal curriculum focuses on achieving common competence neglecting graded evaluation. Evaluation focuses on what a learner can and cannot demonstrate. Learning is intimate where by the learner have control of the content and the pace of their learning. The content is segmentally organised although all segments have different value and some segments are more important than others. The learning approach is learner centred whereby there is a strong link between learner's experiences and everyday knowledge. Competence/horizontal/integrated curriculum focuses on day-to-day abilities neglecting evaluation. Learning takes place only inside the classrooms and not outside classrooms. "Horizontal requires a plan which is restricted, prepared, environment explicit and reliant for maximum encounters with people and habits" (Bernstein, 1999, p. 159). This suggests that in horizontal/competence curriculum knowledge is in different layers, exact and environmentally reliant.

Hoadley and Jansen (2013) describe competence/horizontal/intergraded curriculum as controlled by the learner and that the teacher's role is hidden. This suggests that the learners have control in selecting the content, sequencing the content and the learning pace. Knowledge is not imposed from the outside, but the competences that learners already have are sought on the inside. This suggests the content is contextually specific and driven by context. Khoza (2015a) asserts that Curriculum 2005 (C2005) was introduced in 1998 and was later revised to RNCS, NCS by the Department of Education. In South Africa, competence curriculum was driven by specified outcomes that were separated in seven critical outcomes and five developmental learning outcomes. The outcomes were emphasised so much that it was not important whether the learners have understood them or not.

Furthermore, Hoadley and Jansen (2014) explain that achievements of outcomes are the most important regardless of how the outcomes have been achieved. Competence curriculum was mostly influenced by opinions, local general knowledge, and oral conversation. In this type of curriculum, knowledge is mostly generated horizontally from simple sources or local known sources. The focus on the learner and everyday experience tends to affirm learners and build their confidence, whatever their background. Competence curriculum blurs the line between school learning and everyday experience, the specific spaces for learning, such as school classrooms, aren't regarded as important. Learning is assumed and can take place anywhere for example at home, at work, and at school. Predictably, then, learning tends to be organised around themes and projects and are based on experience.

2.6. Performance/vertical/collection curriculum

Bernstein (1999) describes performance/vertical/collection curriculum as schooled knowledge. This type of curriculum is coherent, explicit, and hierarchical and operates in a series of specialised languages. Content is hieratically organised from the lowest order to the highest order. Performance curriculum knowledge is driven by educational theories integrating it at lower levels. Knowledge is incorporated at lower levels and learning is distanced where by a learner has little control of the content and the pace of learning. Teacher-centred and subject-centred are used whereby there is a small connection between school knowledge and everyday knowledge. Performance curriculums more specific to what the teacher is should teach and what content should be taught for particular period of time. Evaluation is planned where by specific performance criteria is used. Assessment focuses on graded performance ignoring acquired skills. This requires teachers to know when to assess and how to assess. In terms of location, learning takes place outside the classroom in specialised rooms like laboratories. This type of curriculum is driven on strong distributive rules regulating access namely; the rule of transmission and the rule of evaluation. This suggests the performance curriculum the teacher is decision maker and the header of learning environment. Vertical/performance/collection curriculum knowledge is composed of specialised symbolic structures of explicit knowledge. Performance curriculum requires the

teacher to understand the content and when to deliver it. Mastering the content is very crucial because the learner have to know the content. Knowledge is hierarchically organised and coherent.

Khoza (2015a) explains that performance curriculum, which is called the Curriculum and Assessment Policy (CAPS) in South Africa, was introduced towards end of 2009 by Ministerial Review Committee and was implemented in schools in 2012. In performance curriculum each subject stands on its own and has its own concepts. The content is learned hierarchically from the lowest to the highest order. Performance curriculum is driven by identified content where all learners learn the same body of knowledge from the lowest to the highest order. Performance curriculum is rich in content and controlled by teacher. It also provides the teachers and learners with important ‘ways into’ the formal ‘school knowledge’ that is to be taught, and later with the basis for applying that formal knowledge. Teaching tends to take place in specialised places like the classroom, laboratory, or training workshop where resources are kept. In performance models of curriculum, there are very definite rules about how to learn, and definite ways of judging right from wrong. Hoadley and Jansen (2014) argue that in performance curriculum, assessment aims to develop a clearly defined behaviour or understanding rather than the more general competency. Teaching and assessment focuses on what still needs to be mastered.

2.7. Conceptual framework

Conceptual frame is a printed or an illustration that “describes any realistic or sequences of events, major events to be considered, theory or models and supposed correlation between them” (Miles & Huberman, 1994, p. 18). This suggests that a conceptual frame work is an overall frame work for understanding concepts and terminologies used in the research. A conceptual framework is an analytical tool with several variations and contexts. A conceptual frame is used in analysing different concepts which used in defining the research. A conceptual framework used to make conceptual distinctions and organise ideas. Strong conceptual frameworks capture something real and do this in a way that is easy to remember and apply. This study attempts to understand the activities, actions and operations by participants’ in order to reveal their motives, goals and instrumental conditions respectively on experiences of mathematics learners (Hennink, Hutter &

Bailey, 2011). Silverman (2012) describes a theory as simply a relationship between concepts; deals with specific concepts and relationships that relate to the specific topic of research. It helps provide a simplified view of how the world should be.

Hennink *et al* (2011) emphasise that it is important to incorporate theory in qualitative research which suggest that theory will guide the other design decisions. Therefore, the study will employ the curricular spider web. Silverman (2013) states that theoretical models provide general structure for presenting a certain review to the research problems. This suggests that research should have theoretical models or frameworks that inform the way they look at the issue that is being studied. According to Van den Akker (2003), curricular spider web is away to visualise the relationship between various aspects. The curricular spider web is well designed comprising of the ten concepts which can help in achieving a positive attained curriculum. I may urge that although the curricular spider well designed it does not grant that they is no gap that has to be filled in order to achieve a positive attained curriculum. The curricular spider web is surrounded by the four criteria which include relevance; sustainability; consistency; and practicality. Van den Bakker (2003) and Lappia (2009) suggest that the biggest obstacle in improving curriculum is creating stability and reliability between different concepts of the curricular spider web. The ten concepts are structured in the form of a spider web. This is illustrated very well in figure 2.2.

The curricular spider web

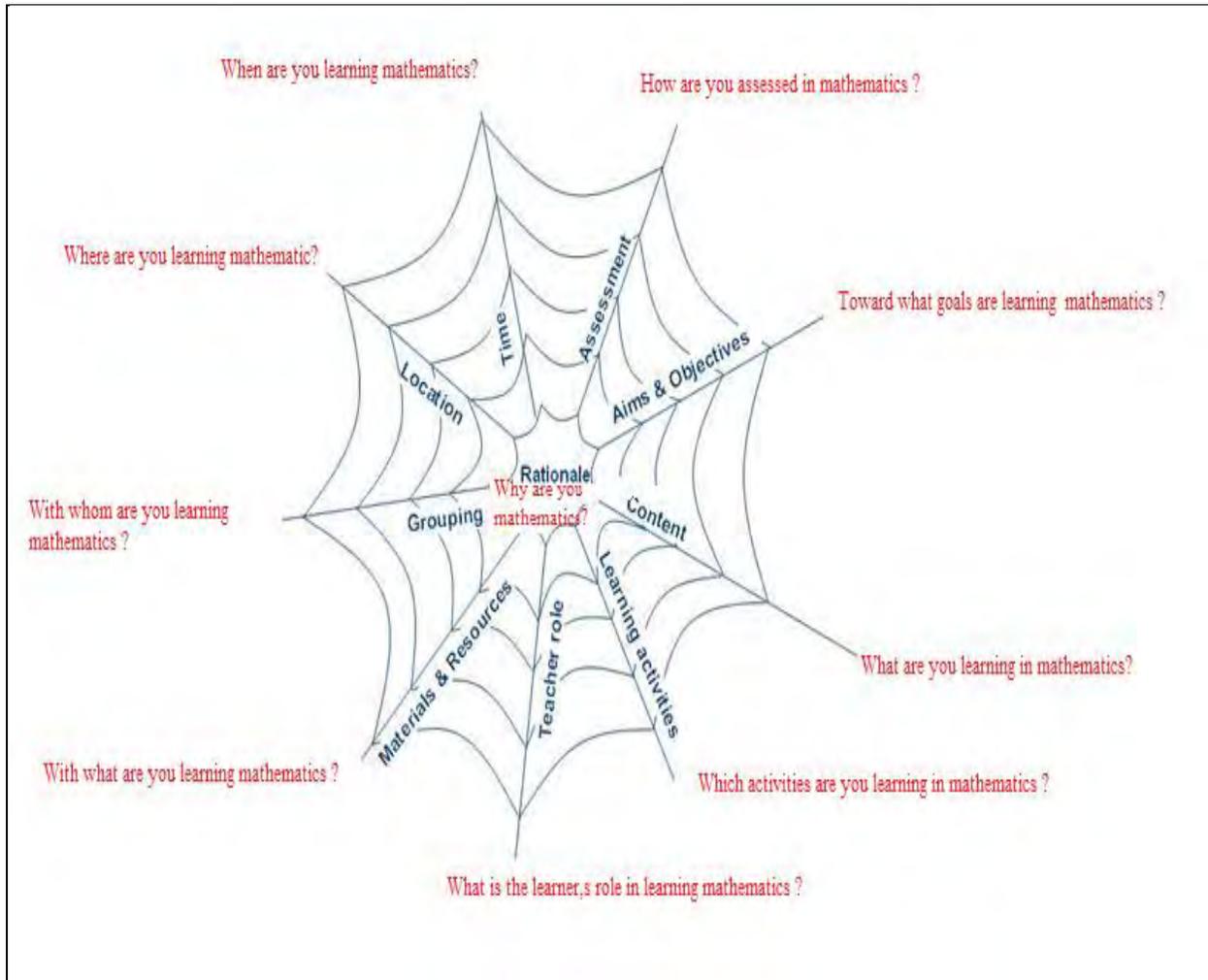


Figure: 2 Curricular Spider Web adopted from Van den Akker (2009, p. 11)

Van den Akker (2003) indicates that the rationale to be a fundamental link connecting all the concepts of the curriculum. The rationale is positioned in the middle as why are they learning mathematics. The components correlated to each other, promoting unity and reliability. The image of the spider web illustrates the weak nature of a curriculum. The curricular spider web is subject change if threads are pulled harder than others. Literature of this study is driven by the ten concepts of the spider web.

It is very crucial for the teachers to attend to all the ten components of the curricular spider web in order to achieve a positive attained curriculum. The ten concepts of the curricular spider web acts as frame work which drives the performance curriculum CAPS. Berkven et al (2014 p.7), assert that it is crucial to note that all the ten components of the curricular spider web “if the components are not addressed in coherence, tension grows until the web rupture rips apart hence affecting curriculum”. Khoza (2015b, p. 123) assert that “curricular spider web does not have learning outcomes yet they are very crucial in terms of measuring the students’ performance”. Performance curriculum emphasizes teacher-centred or content-centred approach of learning because it does not have outcomes..

Table 2.2 shows the components of curricular spider web and relevant questions the will be used in this study.

	Components	Prepositions	Research questions	Authors
1.	Rationale	<ul style="list-style-type: none"> • Personal • Societal • Content 	Why are you learning mathematics?	Klep, Letschert and Thisjs (2004) Khoza (2015b) Vithal (1999) Christen (2007)
2.	Accessibility	<ul style="list-style-type: none"> • Physical • Financial • Culture 	Who is learning mathematics?	Casey, Nuttall and Pezaris (1997) Campbell (1986) Forgasz and Leder (1998)
3.	Goals	<ul style="list-style-type: none"> • Aims • Objectives • Outcome 	Towards which goal are you learning mathematics?	Khoza (2013b) Kennedy, Hyland and Ryan (2006)

				Civil (2007)
4.	Content	<ul style="list-style-type: none"> • Topics • Sub topics 	Which content are you learning in mathematics?	Khoza (2015b) Margo (2013) Carl (2012)
5.	Teaching Activities	<ul style="list-style-type: none"> • Formal assessment • Informal assessment • Continuous assessment 	Which activities are you learning in mathematics?	Bray (2002) Hoardley and Jansen (2013) Kennedy, Hyland and Ryan (2006)
6.	Learners' role	<ul style="list-style-type: none"> • Manager • Facilitator • Assessor 	What is the role of the learners in learning mathematics?	Shindu (2013) Lamont (2002) Byo (1999)
7.	Resources and time	<ul style="list-style-type: none"> • Hard-ware • Soft-ware • Ideological-ware 	What materials are you using to learn mathematics and when?	Kurdziolek (2011) Khoza (2013a) Sresh (2012)
8.	Location	<ul style="list-style-type: none"> • Classroom room • Laboratory 	Where are you learning mathematics?	Salmon (1991) Harre and Gillett (1994)

				Smith and Ragan (1993)
9	Assessment	<ul style="list-style-type: none"> • Formative assessment • Summative assessment • Peer 	How are you assessed in mathematics?	Bray (2000) Kennedy, Hyland and Ryan (2006) Hoadley and Jansen (2013) Boud (1999)

Table 2.2: Curricular spider web prepositions. Re drawn by Khoza (2015a, p. 11)

The above table shows the concepts of the curricular spider web, questions for data generated methods and relevant authors for each component. There should be a balance and consistency among all the components for a successfully attained curriculum; “when considering the functional curriculum in institutions and learning sites, all the concepts must be logically and articulately attended to achieve positively attained curriculum” (Van den Akker, 2010, p. 40). This suggests that no component should be neglected all the components should be effectively attended to. If one component rips, the other components will be affected which ultimately affects the attained curriculum. Van den Akker (2003) urges that planning and improvement of the curriculum can begin with any of the concepts. This suggests that the components are all equal and should be given equal attention. Every component is as strong as its weakest point. Content should be given more attention by research and improving on it. Furthermore, resources like text books are vital for attaining a positive curriculum; location also proves to be crucial aspect of an effective attained curriculum. Timing is an important aspect in the curriculum, specifically how much time is allocated to mathematics and assessment tasks. The ten components of the curricular spider web vary with five curriculum levels namely; Meso; Micro; Macro; and Nano. At the institution and learning level, all the ten components contribute a particular role. The consistency of all the ten components is crucial for a successfully attained curriculum (Berkvens, van den Akker & Brugman, 2014).

2.8.1. Why are they learning mathematics (rationale)?

Van den Akker (2003) explains the rationale as why do they learn mathematics? The rationale is a central component connecting to other components. The rationale can be categorised according to three main perspectives; pedagogical (reason); content (reason) and societal reason. Pedagogical (person reason) refers to the importance of learning and development from the personal view and the interest of learners themselves (Tyler, 1949). This suggests that a personal reason motives the learner to place learning as their first priority. The learner will place significance in learning and acquiring knowledge. There should be a balance between the learners' and society needs helps in order to attained curriculum. Berkvens, van den Akker and Brugman (2014) assert that knowledge development (content reason) focuses on why are they leaning and what learning outcomes can achieve. Berkven *et al* (2014) urge that learners grow by acquitting knowledge and learning broadly. It is necessary for learners to acquire knowledge in mathematics. The rationale is a crucial aspect in ensuring a positively attained curriculum. Khoza (2015b) states that cognitive domains help to identify whether learners are successful or not in that discipline. This suggests that assessing learners in a particular subject helps to identify whether learners have achieved desirable knowledge and skills. Cognitive domains assist in identifying the gap which needs to be filled in term of knowledge. In addition, Khoza (2015b) and Berkven *et al* (2014) share the same view as those above, that selecting the important content is crucial. In order to improve the curriculum, the content should suit the learners' cognitive levels. Furthermore, societal reasoning focuses on learners on the values of education in respect to world and society views (Fiedler, 2008). Learners' learn mathematics because of societal reasons and to meet the needs of the society. Learning is a course or action but not a collection of a product. Learning is a process to acquire knowledge. This suggests that when learners acquire knowledge it equips them with problem solving skills which are used in everyday life.

“We exist in society subjected to imagination, echo and incomplete facts, since it a fast turnover, cannot be resolved, corrected and settled. Diversity, innovation, transform and option are honoured over standardization and stability” (Gilbert, 2005, p. 29).

Vithal (1999) states that mathematics is taught in order to help learners with democratic knowledge/skills. This suggests that mathematics equips learners with problem solving skills which are used in everyday life. It is through learning mathematics the learners will acquire problem solving skills. Blomoj (1999) states that mathematics helps learns to gain critical decision

skills. This suggests that mathematics learners gain skills in making decision about particular situations. Mathematical competences can be applied in cases when the situation is critical. When learners learn mathematics they acquire knowledge and skills like such as the use numeric models; determination of constants; and formulation of connections and relations. Mathematics will help learners by equipping them with skills in making choices about a particular situation. Vithal (1999) and Blomaj (1999) share the same ideas that the learners learn mathematics to acquire problem solving skills and earn respect. Christiansen (2007) conducted a study on tensions in mathematics education for democracy. The study asserts that learners can not apply mathematics knowledge to every day practices. This suggests that curriculum is saturated by the myth of mathematics utility to everyday practices, while the curriculum is largely organised around mathematics that is often not of utility in everyday practices. Learners do not connect mathematics knowledge to every day practises but raises awareness as it part of the vision of the National Curriculum Statement. Yet, many of the contexts invoked are too simple to get insights into complex phenomena or to handle complex problems (Khoza, 2015a).

Bradford, Brown and Cocking (2000) explain that mathematics helps in equipping learner with problem solving skills. Mathematics brings real world problems in classroom to solve and explore. It is through mathematical competences that learners can acquire skills to solve real problems. The problem solving skills help learners in solving challenges they face every day of their lives. These suggest that mathematics equips learners with problem solving skills that will be used in everyday lives. Learners face different challenges in life that require critical thinking. It is through applying mathematical competences that will able to solve these challenges in every day contexts. When learners learn mathematics they acquire skills that are used in everyday life. Problem solving skills are acquired when learning mathematics. A study conducted by Brown, Jones and Taylor (2004), on how geometrical reasoning is developed at Secondary school level, states that learning mathematics is about acquiring knowledge, understanding, and competence in using geometrical properties and theorems. This study reveals that mathematics will equip learners with knowledge that can be used for logical thinking. Logical thinking can be acquired through the use of mathematical knowledge such as numerical models; determining of variables ; and formulation of connection and variables. In addition to above studies, Bradford, Brown and Cocking (2000),

Brown, Jones and Taylor (2004) conclude that mathematics helps to stimulate logical reasoning and developmental reasoning.

Ozdemir (2013) suggests that mathematics is a prominent discipline with abstract concept, cognitive skills and compatibility with real-world. This suggests that mathematics tools are not only used for its concepts but also used for other disciplines. Mathematics is integrated with other subjects. It is very for learners to understand mathematics in order for them to understand other subject because it integrated in other subjects. One of these tools, may be the most important, is problem solving. Problem solving has a central importance for mathematics and it is accepted as a fundamental tool for understanding and interpreting mathematical knowledge (Jitendra, Griffin, Buchman & Szczesniak, 2007; Kayanve, Cakehole, 2008; Polya, 1957 & Schoenfeld, 1987). This suggests that mathematics equips learners with the problem solving skills which is a fundamental tool used in day-to-day life. Mathematics helps learners to reconstruct the process of verbal and syntactic processing, visualising, building different type of representations, algorithmic processing, algorithmic learning and debugging. De Villiers (2004) explains that geometry expands mathematics learners' thinking skills and simplifies other subjects.

2.8.2. Towards which goal are they learning mathematics (Aims/Objectives and Outcomes?)

Khoza (2013b) defines the term aims as an intention indicating what is to be covered. The aims refer to the subject matter to be covered. Aim is a long term goal while objective is a short term goal but they both indicate learners' intentions. On the other hand, outcome is what learners should achieve at the end of a lesson or session (Kennedy, Hyland & Ryan, 2006). The goals are generated from the subject content and measured through assessment processes (Harden, 2002). This suggests that it through learning the prescribed content and assessing learners those goals will be attained. Khoza (2013b) conducted a case study on learning outcomes using university facilitators and the study concluded that teachers should always align aims, objectives and outcomes for them to do justice to their learners. This suggests that the relationship between the aims and the subject content should be considered in order for the educational goals to be achieved. Berkven *et al*

(2014), urge that clear goal is very significant achieving a positive attained curriculum. If the goal are not attended to will not be able to get the right content that develops them.

Croaky (2005), Stathopoulou and Calabaras (2007) urge that learners' link their experiences to mathematics in day-to-day life. These suggest that mathematics knowledge is used in an everyday context. Learners use mathematics in every day context by linking their representations to key mathematical ideas. It can be applied in everyday situations and this can be done through rebuilding of mathematics knowledge. Clement and Sarama (2009) explain that learners need to be given a chance to explore their abilities by applying mathematics knowledge. These suggest that through exploring their abilities, learners are able to link mathematical ideas in day-to-day context. Exploring different experiences makes learning more powerful and concrete. However, "successfully incorporation of knowledge into syllabus requires hard work, time, dedication and changing a person's beliefs" (Clements, 2002, p. 174). This suggests that for learners to apply mathematical knowledge it need commitment and hard work. In addition, these studies suggest that by exploring their experiences, mathematics ideas are linked and made concrete.

Yelland and Kilderry (2010, p. 91) explain that "different tasks that learners experience in the first years when learning mathematics are single dimension in making. Thereby focusing on acquisition of particular skills." This suggests that in early stage of development, when children explore they acquire specific skills in different tasks. The specific skills acquired are powerful and help learners to acquire critical skills. This helps to improve critical thinking which was neglected before. The study recommends that various mathematics activities should be given to learners which will keep them focused in return to enhance the learning outcome. In other words, this suggests that the use of technology enables learners to get used to media and explore their experiences in learning mathematics. Civil (2007) assert that mathematics learning can be applied to everyday knowledge. This suggests that learners' experiences can be linked to mathematics to achieve learning outcomes.

"This suggests that the use of technology enables learners to get used to media and explore we expand learners' experiences that focus on capability of learners mean while helping

them to progress in studying of mathematics” and “what are the effects of crucial pedagogy for mathematics curriculum of disadvantaged student?” (Civil, 1996, p. 48).

Knott (2007) conducted a study on issues of ethics and principles in career development of mathematics educators. The study concluded that societal rules and rules when learning mathematics are made in mathematics classroom. This suggests that social norms and mathematical norms are expected from the learners. Sometimes the rules include neat work; underlined answers and that answers must be detailed and fully explained. Classroom rules are a must when learning mathematics. In other words, social norms in mathematics classrooms train learners to be obedient to certain rules. Social norms groom learners to be responsible for their work and activities in everyday lives. However, this affects learners’ contribution and involvement in classroom hence affecting the attained curriculum. This suggest that the teacher tend to focus to societal and classroom rules neglecting the learning out comes and learners abilities. The classroom rules effect the learners’ contributions which in turn affect that attained curriculum. However mathematical norms sometimes have negative influences such as hindering investigation and exploring.

Mellin and Olsen (1993, p. 243) assert that, “Knowledge of possible application of some mathematical knowledge and the application itself is not the same knowledge as the mathematical knowledge itself”. The study states that learners deal with mathematics content in different ways; for example geometry and some forms can be taught as theory instead of practical. The learners should be able to relate to this forms of knowledge and be able to relate them to each other This suggest that the practical part of mathematics is neglected, thereby affecting the attained curriculum. The study concludes that the learners should be able to demonstrate or do what is taught by the end of the lesson in order to enhance the attained curriculum. Mathematics learning is dynamic, personally motivated, and ambitious which relates individual knowledge (Mihalica & Milea, 2007). These suggest that learners can gain mathematics knowledge through exploration and discovery. This can be achieved by allowing them to play and discover their abilities. If the learning environment is democratic it won’t limit learners in discovering their abilities. Educators

“it is necessary to be alert not to imagine the learners’ views, circumstances, struggles or solutions like adults. Good educators comprehend the learners’ actions, reasoning and attempting to view the circumstances from the learners’ point of view” (Clements & Sarama, 2009, p. 4). This suggests the learners discover and investigate their personal knowledge through play, thereby helping them in mathematical discovery. Furthermore, the study concludes that teachers should be able to discover the learners’ abilities through play by relating it to the mathematics curriculum. Through play, learners are able to relate mathematics knowledge and build on it. Sarama and Clements (2009, p. 329) suggest “the significance of good prepared, controlled play, suitable for the learners’ age must not be neglected. Mathematics plays contribute to learning of mathematics.” This suggests that free play promotes the learning of mathematics and effectively builds on it.

The Ontario Ministry of Education (OMOE, 2011) conducted a study on maximising student mathematical learning in their early years. The study suggests that when children come to school they are full of energy, curious and with exciting experiences which they relate to mathematics knowledge and day-to-day experiences. Lipton and Spelke (2003) assert that abilities in mathematics are manifested in early stages of learners when they are able to distinguish between different groups of objects and different numbers. Lipton and Spelke (2003) and OMOE (2011) share the same view that abilities in mathematics start at an early age and can be acquired through different experiences. In addition, learners expand their capability in mathematics through exploring different avenues with or without the involvement of adults. “Once learners are given unrestricted play prospects it overcomes the difficulty demonstrated in mathematics in spite of the learners’ intellectual, social and economic setting” (Ginsburg, 2003, p. 235). This suggests that learners acquire knowledge through different experiences by involving them in various tasks of mathematics. Recognising the beginning point of each child is crucial in building on mathematics knowledge.

2.8.3. What are they learning in mathematics (Content)?

Content refers to the topics to be taught, experiments to be carried out and tasks to be assessed in a particular period of time (Berkven *et al.*, 2014; Kelly, 2009; Hoadley & Jansen, 2013). Khoza

(2015a) explains that the mathematics curriculum (performance), as a subject, stands on its own and has its own collection of concepts (theories, language and culture). It is driven by identified content where all learners learn the same body of knowledge from the lowest to the highest levels. Mathematics content should therefore be balanced, well sequenced, organised and move from the known to the unknown. The content developed need to march with cognitive ability so that learners can easily cope with prescribed content (Carl, 2012). Content of cognition (what is known) and the process of cognition (how is it known) are interrelated. Mathematics is a form of communication that makes use of signs and techniques for recounting algebraic, statistical and geometric construction (CAPS, 2011). This suggests that mathematics is a language which makes use of symbols and notations in explaining numeric and graphical relations. Mathematics is referred to as an individual action that involves surveying, demonstrating and exploring samples that relates to physical and social events linking to mathematics objects. Mathematics enables learners to acquire sound and significant thinking skills. Rutheven (1987) explains that mathematics involves classifying, planning and analysing information which makes it hard for learners with different abilities. Mathematics tends to be tricky and hard for learners to contemplate. Lorenz (1982) asserts that learners perform differently in mathematics, depending on their abilities. This suggests that learners have different abilities which influence their performance in mathematics.

Margo (2013) conducted a study on geometrical constructions in dynamic and interactive mathematics. The concluded that the ease with which learners and adults can engage in these un-moderated and un-evaluated activities using smart phones or I-Pads thereby leading to potential for learning mathematics that is either wrong (or detrimental to further mathematical development). I provide one example that I find very disturbing.

Fraction App by Tap to Learn. This I-Pad app-based learning system is available for download from the *Apple App Store* for 99 cents. It boasts that it is “The First Selling Exercise Practising Fractions” and used “over 200,000 learners worldwide use it” (From *this app* window). The app also provides “links to the best content available directly via YouTube that is being constantly updated.” The first YouTube video that learners are linked to is from *Math Made Easy:*

http://www.youtube.com/watch?v=7e_JGthEE-Q which provides the first part of an “introduction to fractions.” At 4 minutes into this introduction, the narrator makes the following rule concerning numerator and denominator: “the numerator is always the smaller number in fractions that are correct. The denominator is always the larger number in fractions that are correct.” In referring to the fraction $\frac{1}{2}$, the narrator goes on to indicate that if you ever come across a fraction that looks like this: $\frac{2}{1}$ “it is incorrect – it is not O.K. It is breaking the rules. It has to turn around so that the larger number is on the bottom and the smaller number is on the top.” (While rewriting $\frac{2}{1}$ as $\frac{1}{2}$ see Figure 2.3).

Math Made Easy: Introduction to Fractions (part 1)

jediteacher2007

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114 videos

$$\frac{1}{2}$$

part of the whole (numerator)

the whole (denominator)

$$\frac{2}{1} \quad \frac{1}{2}$$



Like



Share



85,911



Figure 3: First screen shot from Introduction to Fractions (Part 1)

(Adapted from Margo, 2013, p. 20)

Some of you may feel that the video is not that bad at this point (even though the narrator just told the viewer to rewrite $2/1$ as $1/2$). What comes next, however, is an attempt to brainwash the young viewer so that they would NEVER regard an “improper fraction” as O.K. The narrator introduces “Arnold Schwarzenegger” holding a board over his head with a little baby sitting on top (see Figure

2.4). The narrator emphasises that the big guy (the denominator) has to be on the bottom in order to hold up the little baby on top (Margo, 2013).

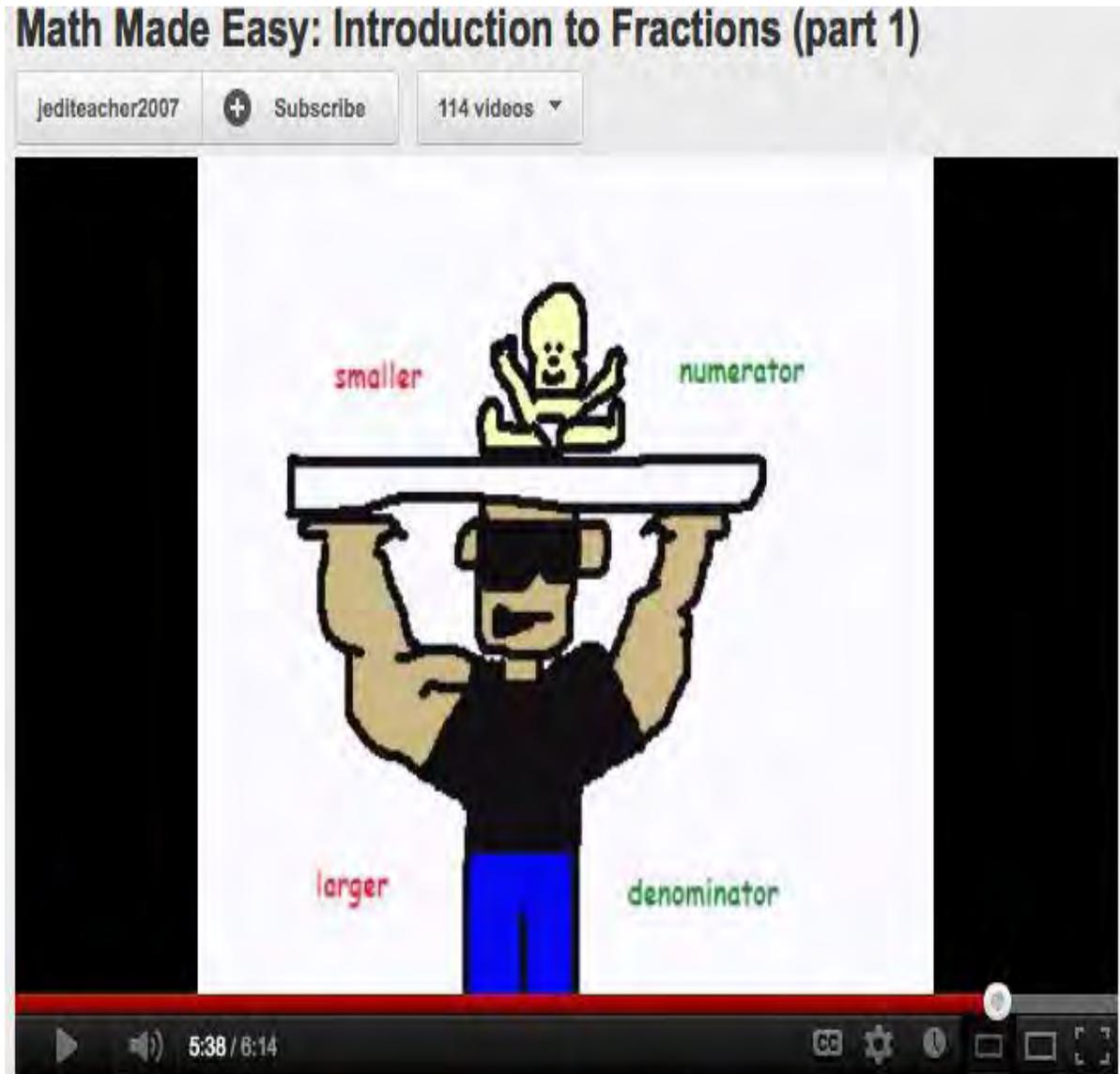


Figure 4: Second screen-shot from Introduction to Fractions (part 1)
Adapted from Margo (2013, p. 20)

2.8.4. With what are you learning mathematics with? (Resources)

Kurdziolek (2011) defines resource as a capability or determination to persevere. The word resource has got different faces it be can support or aid used when learning. Khoza (2013a) explains the three forms of resources namely: hard-ware (tool/machine/object) soft-ware (material used amidst kits to take/present) and ideological ware (invisible elements like a theory). Resources can be seen and touched, and include physical aids, learners' contextual understandings, teacher subject expertise, and structured organisation of materials, ideas, and activities. Khoza (2012, p. 75) defines a resource as "any person or anything that communicates learning" resources as an individual or equipment that facilitates learning. Resources are very important in achieving a positively attained curriculum. Teachers should be aware of all ideological-ware resources that drive the intended curriculum before the implementation. Identifying if the curriculum is underpinned by cognitivist, behaviourism and constructivism leads to a positively attained curriculum (Khoza, 2013b; Hoadley & Jansen, 2013). This suggests that if teachers chose the suitable ideological-ware to meet the learners' needs, it will help to enhance effective learning.

Suresh (2012) explains that audio-visual resources attract attention of learners and reduces boredom when learning mathematics. The audio-visual resource reduces boredom and gives true picture during the learning process. This suggests that it is crucial for mathematics classrooms to have appropriate resources which will make learning more interesting and concrete. "Within a learning structure, the accessibility of resources limits the level at which a new module can be implemented in the school curriculum" (Rao, 2010, p. 122). This suggests that for effective learning of some subjects, resources should be available in right the quantities and at the right time. If resources are not provided in some schools it will be hard for them to teach certain subjects like mathematics. Arulsamy (2010) agrees about the importance of resources by stating that the adequacy of learning resources at institution level contributes to quality curriculum being attained. This suggests that the availability of resources is important in enhancing effective learning. In addition, these studies (Arulsamy, 2010; Suresh, 2012; Roa, 2010) raise the same idea that availability of resources is crucial for effective learning.

Hoffer (1991) argues that for effective learning different resources such as text books, equipment and specialised rooms should be available for all learners. These suggest that different resources are needed to make learning interesting and concrete. Therefore, mathematics classroom should be well equipped with different resources for effective learning. Mathematic learning should take place through interesting learning activities and carried out in inspiring environments that provide adequate teaching and learning materials. According to the Department of Education (1997), a study revealed inadequate resources in terms of teaching aids, facilities and services in Limpopo province, Eastern Cape and KwaZulu Natal. The most under- resourced schools are the ones that were previously black only education systems (Zaaiman, 1998).

Van den Akker (2009) argues that resources are mainly thought of at the micro level of curriculum development where the school selects which materials to use and in what context to use them. This suggests that resources are not regarded crucial at national level. Fewer funds are put side for resources, leaving it for institutions to decide which resources to buy. This may be the reason why curriculum documents leave resources out. Byo (1999) agrees that in public schools place it's the role of teachers to decide which resources to use. This suggests that it is teachers who have the responsibility to select which materials to use and when to use them. Howie (2001) and Naidoo (2004) describe that unfair distribution of resources which was determined by race, the blacks were allocated a few and poor quality resources. The resources provided were westernised not relevant to learners particular the text books. Teaching was of much importance than learning. Olsen (1987) explains that learners fail mathematics because of a lack of access to cognitive tools. This suggests that lack of cognitive tools creates a gap in mathematics understanding there by leading to failure mathematics learning. The mathematics curriculum should offer opportunities to learners in a way that relates problem solving skills that are useful to learners.

Mosckovich (2005) conducted a study about the use of two languages when learning mathematics. The study emphasised that language is an important aspect in learning mathematics. Language is a key aspect in learning process of mathematics. This suggests that indigenous learners have their own home language yet mathematics is taught in a different language of instruction which is

sometimes confusing to learners. The learners come to mathematics classroom are multilingual English being the third or other language. Mathematics is mainly taught in English as the medium of instruction, yet some learners are not familiar with English. Understanding the techniques of the subject is important, as is the understanding the language of mathematics (Zevenbergen, 2000). This suggests that for the learners to understand mathematics they are supposed to understand the mathematical language which includes codes, procedures and techniques. Learning the code of mathematics is very crucial as learning the mathematics language. Failure to understand the language may sometimes lead to failure of mathematics. Teachers need to make sure the learners understand the mathematics language first in order to enhance a positively attained curriculum. Language is a crucial aspect when learning mathematics (Zevenbergen, Mousley & Sullivan, 2004). This suggests that language is a crucial resource when teaching mathematics. In addition to the above studies (Mosckovich, 2005; Zevenbergen, 2000; Zevenbergen, Mousley & Sullivan, 2004), language is an important resource which determines learning of mathematics.

Furthermore, Clarkson (2008) states that mathematics learning is taught in dominant language of the society hence the use of another language is prohibited. Mathematics teaching is like any teaching any other subject that is carried out in dominant language of the society. Language is an important aspect since learners come to class with a different background where by the dominant language is different from their home language. Early learning carried out before school is normally done in home language so emphasis on the societal language is very crucial to learners. This suggests that language is an important aspect for effective learning. The teachers have to first understand the dominant language of learning mathematics in order that they help learners to understand the language for effective learning. The study concludes that the need for learners to understand the language of instruction is very important. Abreu and Cline (2005) assert that it is very important for learners to understand the language of instruction. This suggests that effective learning of mathematics can be determined by the language. If the learners are not familiar with the language it can lead to failure of mathematics. Abreu and Cline (2005) and Clarkson (2008) share the same view that language is an important aspect of learning in mathematics. The studies suggest that the learners have to understand the language of instruction in order to understand mathematics, thereby enhancing a positively attained curriculum.

2.8.5. Where are you learning? (Learning environment)

Salomon (1991) defines a learning environment as a structure is composed of interconnected components that together affect learning relations, individuals and different cultures. This suggests that the learning environment consists of different components that include the learning space, the teachers and the learners. The learning environment should be conducive and suitable for learning. The learning environment should engage learners in meaningful and purposeful activities. The environment should be democratic in order to engage learners in different activities. Consequently, a mathematics improved learning system is essential to building an improved learning environment where learning can take place. In order to develop, design and implement an incorporated mathematics structure, the needs of learners have to be considered and should reflect learners learning.

Kolb (1984, p. 38) explains learning as an individual alteration procedure, that “is a procedure when knowledge is produced through alteration of experiences.” This suggests that learning can take place anywhere for example at home and, in the classroom. Knowledge is created through the exploration different experiences. Lewin (1951) discusses that learning starts with different experiences. Learning cycle theory begins with the learner in such way that human behaviour begins as function of a person and environment $\{B=F(p, E)\}$. This suggests that learning occurs when a learner with or motivated by the environment. Learning starts at birth thereby learned curriculum includes all types of curriculum such as null, hidden, written, political and societal. When learners learn through exploring they acquire important social and sentimental lessons. Jarvis (1987) asserts that “... the sense of any given circumstances doesn’t exist unless there is relationship with our own experiences” (p. 164). This suggests that experiences are a major aspect in the learning process. Boud (1989) asserts that the process of learning is a broad view. This suggests that learning encompasses different experiences.

“Although experiential or experience-based learning can be regard as the earliest approach to learning for the human race, the significance and potential of it has not been fully recognised until relatively recently. In the formal education system it has tended to be developed and regarded as somehow fundamentally inferior to those organised forms of

knowledge which have been constructed as subjects or disciplines. The practical and the applied do not tend to have the same status in educational institutions as the abstract” (Boud, 1989, p. xi).

Harre and Gillett (1994) explain that learning a language incorporates learning codes and symbols neglecting individual environment. “The learning of perceptions and motor-skills is determined by the environment” (p. 111). Learning is characterised with neutrality, biasness, and openness. In other words, learning is enhanced by exploring different avenues of nature through a trial and error procedure. This suggest that learners interacting with different resources, explore different events hence learning is achieved. Through the interaction with different resources makes learning interesting and exploring different events enables learners to discover their abilities. Pigeat (1980) asserts that learners learn by investigating and exploring different materials from Mother Nature. The use of westernised language of instruction made learning harder, hence affecting the attained curriculum (Moloi & Strauss, 2005).

According to Smith and Ragan (1993), a learning environment comprised of a teacher, instructional equipment, as well as an institutional and larger learner community. The learning environment is made up of different components such as the learners, resources, learning space and teacher. The school environment is a broader climate or context of the school that either facilitates or constrains the classroom instruction (Shields, 1993). This suggests that depending on different factors, the learning environment will either facilitate or restrain learning. Smith and Ragan (1993) and Shields (1993) share the same view that the learning environment consists of many components which are interrelated. A democratic learning environment has to be ensured in order for a positively attained curriculum to be enhanced. The learning environment was considered disadvantaged if a proportion of learners came from an environment which is associated with low capacity to take advantage of educational facilitates. These characteristics include; a high of percentage of persons with low status jobs or low income with a lack of formal educational qualifications. The homes of the disadvantaged learners tend to be more crowded, lacking magazines, newspapers and others objects that are likely to help in development of the

learner. Parents of the disadvantaged learner give little language encouragement to their children and give less interaction with them. For many reasons, learners from disadvantaged families come from the outskirts of the greater metropolitan areas known as townships and squatter camps. One can therefore say that learners who attend South African schools have been disadvantaged through lack of opportunities to access quality educational services.

Liang and Qiong (2009) conducted a study on students' experiences of mathematics. The study concluded that it is a necessary to build the learning environment that involves learners in useful and crucial activities. This suggests that the learning environment should be conducive and allow learners to explore their abilities. During the class discussion, the learners can expand on the knowledge of the subject, improve on their listening skills and develop different ideas and tolerances (Davis, 1989; Goya & Schoereader, 1994). These suggest that a favourable learning environment will determine the effective learning of mathematics. Furthermore the mathematics class discussion establishes a foundation for significant discussion which helps in enhancing creativity and meaningful experiences. The dialogue allow learners to contribute "rightful and marginal contribution" (Lave & winger, 1991) in a challenging intellectual atmosphere. According to Robin and Steve (2007), learning mathematics has frequently been interpreted as a personal activity that takes place within the head of learner. The personal position has been challenged for many years. Learning is an activity that takes place through different factors. It is known when learning mathematics involves learning the techniques. This suggests that for learners to understand mathematics they have to understand the mathematics culture first. If learners fail to understand mathematics techniques and practises this in turn affects the attained curriculum.

2.8.6. How are the teachers facilitating teaching (Teacher's role)? Who are accessing mathematics curriculum (Accessibility)?

A teacher has four major duties at school; a superintendent, a supervisor, a planner and a controller (Shindu, 2012). Teachers are given additional duties apart from teaching in class. In terms of supervision, the teachers make sure that learners are doing the right thing at a right time and making sure everything runs smooth. Teachers control school activities and learners to make sure

everything is in order. In terms of planning, teachers' plan for school, classroom and extra mural activities. This suggests a teacher has different roles to play in the school. This makes the teacher invest less effort in teaching in order to attend other activities. Mathematics teaching needs a dedicated and committed teacher. Teachers have to invest the time and effort in teaching and attending to learners. Effective teaching of mathematics will be determined by the teacher and learners. Lamont (2002) indicates that the mathematics curriculum requires the teacher to have additional skills that are trained and God given skills. This suggests that a mathematics teacher should be gifted and creative when teaching mathematics. Byo (1999) states that mathematics curriculum needs a balanced teacher whereby a teacher is a specialist and generalist. This suggests that the teacher should be qualified to teach mathematics and be creative when delivering the content.

Durand and Guerrier (2012) suggest that the teaching approaches in mathematics involving experimentation require thoughtful design. This suggests that the teacher should engage with learners in order to experiment with what is being taught. Learners should be involved when learning mathematics and practical examples should be carried out in class rather than neglecting mathematics. " Involving learners in a circumstances which makes them conscious of the productive nature mathematics actions, particularly those linked to imagination and verification possessing difficulty challenges" (Durand & Guerrier, 2012, p. 364). This suggests that learners should be involved when learning mathematics. Practical exercises should be carried out to increase the learners' interest and abilities and learners should be involved in the representation of tasks. The selection of different tasks requires a firm mathematical foundation. Mathematics is too traditional, placing learners at the bottom and the teachers at the top of the hierarchy. Brousseau and Otte (1991, p. 18) explain that there is an autocratic contract involving educators and pupils "the educator is compelled teach and the learner is compelled to learn". This suggests that the educator is the manager of the class. Learners are given a small chance to participate and the learning space is not democratic. This agreement is not easily broken and cannot be neglected between educator and learner. For effective learning, the autocratic contract has to be broken since knowledge cannot be transmitted readymade. Due to the inherent contract, this has led to high failure rate of mathematics. The study recommends a reconceptualised mathematics curriculum

that will integrate theory and practice, encourage collaboration and enquiry, and be learner-centred and performance driven. This suggests that mathematics can operate well in an environment where the teacher is a facilitator of learning and not the source of knowledge. A positively attained curriculum is not about transmitting knowledge but the extent at which learner are motivated to explore the learning environment (Mihalica & Milea, 2007). This suggests that the learning environment should be democratic. The learner-centred approach should be carried out in a classroom since it gives chance to learners to explore their abilities. Brousseau and Otte (1991) and Mihalica and Milea (2007) share the view that the learning space should be democratic and learners given a chance to explore their abilities; and that a learner-centred approach should be used.

On the other, hand in terms of accessibility, Khoza (2015a) explains that accessibility is divided into physical, financial and cultural access. The research question is who or with whom are you learning with? Having enough teachers is a prerequisite for achieving attained curriculum and having professional teachers for mathematics is another. Only few nations are able to attract the best students into teacher training, while in many others teacher training is the next best and in some cases even the last alternative students apply for (Berkvens, van den Akker & Brugman, 2014). The best students should be selected for teacher training; teacher trainers should be viewed as top professionals and job prospects, including salaries, should be good. In-service teacher quality is yet another issue. The education levels of teachers differ widely between countries and within countries themselves. Sometime, having an unqualified or partially qualified teacher is the best that can be achieved. The teacher's gender is off balance in many countries. The issue differs from country to country. In many western countries, male teachers are poorly represented, while in other countries males are over presented. The other nations, the gender scales are more balanced in numbers, but females are not presented in higher staff positions.

Casey, Nuttall and Pezaris (1997) assert that gender differentiation in spatial abilities influences mathematical thinking. This suggests that mathematics reasoning and performance is determined by gender. It is a common belief that male learners perform better in mathematics than female

learners. Male learners are good when it comes to mathematics reasons and solving equations. Kerns and Berenbaum (1991); and Voyer and Bryden (1995) explain that male learners perform better than female learners in analysing graphic data. This suggests that boys were performing better in analysing and examining the graphic information. Campbell (1986) suggests that female learners perceive mathematics to be hard and lack interest in the subject. This suggests that the negative attitude toward the subject contributes to poor performance in mathematics. According to (Kerns & Berenbaum, 1999; Voyer & Bryden, 1995; Campbell, 1986; Casey, Nuttall & Pezaris 1997), gender differences contribute to the mathematics performance. These studies concluded that girls lack confidence and interest in mathematics which has contributed to poor performance in the mathematics.

2.8.7. How are they assessed in mathematics (assessment)?

Assessment is the process by which teachers or learners make judgements about teaching and learning (Bray, 2000). There are four different types of assessment activities in mathematics. “These activities are giving marks for grades, usually summative; observation of an activity, usually formative; questions and answer techniques, usually formative; and making comments to learners about targets for improvement, usually formative” (Bray, 2000, p. 36). Assessment helps to evaluate what learners have achieved in a particular subject. These assessment activities suggest the use of formative assessment for better achievement in mathematics. Formative “are those actions carried out by educators and the learners in evaluating themselves, which offers facts used as feedback in modifying the teaching and learning actions in which they are involved” (Kennedy, Hyland & Ryan, 2005, p. 12). This suggests that learners have to be given feedback in every particular task.

Berkvens, van den Akker and Brugman (2014) assert that assessment focuses on measurability. This suggests that assessment focuses on what the learner has achieved in a particular subject. Education has, in many cases, ignored the intended learning outcomes. The learners need to pass exams and tests which have been transformed into evaluative standards. Standards are set of goals to be attained following measurability and accountability, and are often if not always accompanied

with excessive testing and fierce inspection. Standards are found to have a negative impact on inclusiveness and progressive learning of many countries. A reconsideration of why standards are needed and what roles should be in quality assurance.

Kennedy, Hyland and Ryan (2005, p. 21) suggest that “continuous assessment is the frequency of repetitive summative assessments with results being recorded but small or no particular feedback is known to the learners.” This suggests that mathematics should not be continuously assessed because it does not improve learning. Another study describes formative assessment as, “work that a student carries out during a module, for which they get feedback to improve their learning, whether marked or not” (Higgins, Grant, Thompson & Montarzino, 2010, p. 5). These suggest that by giving feedback to learners it will help in the improvement of learners in mathematics. Khoza (2015b) asserts that formative assessment is when learners are evaluated for gathering important information, whereas continuous assessment is a set of different groups of summative assessment used for producing marks. This suggests that continuous assessment is not necessarily formative assessment.

McDonald and Boud (1999) suggest that self-assessment improves life skills in learners. This suggests that those who use it learn from their mistakes and improve their lives through self-assessing. McDonald and Boud (1999) suggest that self-assessment was important not only for examinations but it is also in everyday life. Sheridan and Byrne (2002) indicate that a learning environment should have balance between skills and challenge as well as setting tasks that balance the challenge of the activity with the children's skill levels. Such tasks must have clear goals and provide immediate feedback where there is instant success and no worry of failure. This suggests that assessment in mathematics should balance between skills and challenges. These conditions and tasks are in line with formative assessment because they suggest clarity of task (learning outcomes) and constant feedback which will help the learner and improve the process. If there is a balance between the skill and the challenge given, teachers would then have to employ differentiated methods therefore addressing domains and levels of Bloom's taxonomy. This will also assist in catering for mixed ability classes.

Christensen (2007) explains that there are learners who have a higher chance of passing mathematics than others. This suggests that there are learners who are not successful in mathematics and that there are reasons for their failure. The study concluded that passing and failing has been explained into main ways; the inherited intelligences passed on from the family helps learners to progress; and the hard work of learners and perseverance makes them to succeed. Apple (2003) asserts that there is a powerful relation between success and background. This suggests that success of mathematics is aligned with the back ground of the learners. Khoza (2015a) asserts that in South Africa, the Curriculum Assessment policy (CAPS) was implemented in 2012 by the Minister of Basic Education Department.

2.9. Extraneous variables (peers, family and community)

Apart from the ten components of the curricular spider web, other variables influence the learning of mathematics. Plummeridge (2002) suggest that family plays a significant role in developing the child skills and attitudes including motivation, personal delight, inventiveness, cooperation, imagination and self-confidence. The mathematics curriculum is more concerned with passing knowledge to the learners ignoring the attitudes and skills of the learners. Early learning starts at home before schooling this contributes useful experiences to a child before going mathematics classroom. This suggests that family play crucial role in building confidence and motivating a learner toward learning of mathematics. Peers and community also provide useful experiences towards learning mathematics. Sometimes peers can influence positively or negatively toward a learning mathematics (Hoadley & Jansen, 2012).

2.10. Conclusion

This chapter presents together the literature in relation to the experiences of grade nine learners in learning mathematics at secondary school. Most of the literature is from other countries and within South Africa, and mainly focuses on mathematics curriculum and learners experiences. The literature focused on the ten components of curricular spider web which include the following: rationale, aims and objectives, content, resources, teachers' role, grouping, time and assessment.

The literature will be used to improve mathematics education, making mathematical ideas accessible to the curriculum planners while preparing for further study in mathematics. The subsequent chapter will cover the research design and methodology.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1. Introduction

The literature review, which was discussed in the previous chapter, explored different experiences of the grade nine learners as they learned mathematics at a secondary school. The literature covered the curriculum, curriculum representations and the ten components of curricular spider web. This chapter is the core of the study as it presents the approach in which the study was conducted. It discusses the data generation methods, research paradigm, ethical issues considered, data analysis and limitations of the study. The research style/approach which is a case study, trustworthiness includes credibility, dependability, transferability, conformability, and interpretive research paradigm, guided analysis as analysing data, ethical issues and limitations of study. The sample was determined by the performance and gender of learners.

3.2. Research Paradigm

Thomas (1962) explains that the word paradigm was derived from the Greek word paradeigma which refers to a pattern to represent a conceptual framework for investigating problems and solutions. A paradigm refers to an incorporated collection of ideas, variables and problems as matched with methods and tools (Kuhn, 1977). The term paradigm refers to a model, organisation and framework of theories, principles and hypothesis (Olsen, Lodwick & Dunlop, 1992). A paradigm is what we think about the world but cannot prove (Lincoln & Guba, 1985). This suggests that the research paradigm guide a study by defining its nature determined by the dimensions of ontology and epistemology. Ontology refers to a natural reality to be studied and epistemology refers to the correlation involving the researcher and study. Collins and Hussey (2009) defined a paradigm as a particular world view for the researcher who carries the view. According to (Thomas, 1962; Kuhn 1977; Collins & Hussey, 2009), a paradigm is determined by the way data is generated and interpreted. Furthermore, the term paradigm can be referred to as suggestion of a certain ideas about the nature of the world; what can be recognised and, how can it be recognised?

Hennink, Hutter and Bailey (2011) explain the term paradigm as a reflection of truth and structures used to arrange observation and reasoning. This suggests that paradigms provide a foundation on which ideas are based. Furthermore, paradigm is a reflection of different views of the world, who holds the view and how the view is recognised (Christiansen, Bertram & Land, 2010). This suggests that a research paradigm is a reflection of different views which characterises the world. It is crucial for all studies to identify the most appropriate research paradigm. Christiansen *et al* (2010) identify three types of paradigms; interpretive, post-positivism and critical paradigm. Every paradigm includes a different approach to presenting and understanding the world. Post-positivist focuses on neutrality, certainty, model-making and regulations of actions. Interpretive paradigm aims to recognise and understand lived experiences and critical paradigm aims to change the political and ideological atmosphere.

Cantrell (2011) explains that different views of the interpretivists such as ontology, epistemology, and methodology. Ontology focuses on the nature of reality. Different experiences of grade nine mathematics learners can be explored and constructed through different interactions and meaningful actions. Ontology focuses on social realities that exist due to different human experience such as views, people's knowledge, experiences and interaction. Ontology seeks to discover how grade nine mathematics learners make sense of their social world while interacting with others around them. Epistemology explains the knowledge and relationship between the inquirer and the inquired into. Events are understood through interpretation process which is influenced by the interaction with social contexts. Knowledge is constructed through different experiences of real life or natural setting. Inquirer and the inquirer into are interlocked into interactive process of talking and listening, reading and writing. Methodology whereby data is collected through interviews, reflective sessions.

This study falls under the interpretive paradigm. Interpretive paradigm aims to understand and interpret the world (Christiansen *et al*, 2010). Willis (1995) asserts that interpretivists believe that

there is no one particular right or exact approach to knowledge. This suggests that there is no specific answer but answers are subject to people's experiences. Walsham (1993) asserts that interpretive paradigm there is no right or wrong hypothesis. This suggests that hypothesis is derived from constructs in the field by deeply examining the experiences of interest. The hypothesis is determined by people's experiences. Willis (1995) and Walsham (1993) share the idea that there is no correct or incorrect theory but that theories are derived from different experiences. Gephart (1999) asserts that the interpretive paradigm presumes that knowledge and meaning are actions of understandings where by objectivity in knowledge is independent of thinking and reasoning. This suggests that knowledge can be gained from different experiences through thinking and reasoning, therefore there is no particular route for acquiring knowledge. Myers (2009) asserts that the basis of research in the interpretive paradigm determined by societal construction from experiences, views and verbal construction. This suggests that reality can be achieved through lived experiences. Interpretive paradigm is driven by examination and explanation. Therefore, through examination, data is generated about events while explanation helps to understand the data (Aikenhead, 1997). Deetz (1996) asserts that the interpretive paradigm examines experiences and the meanings that people assign to them. People's reality can be discovered by interacting with them and listening to them (Terre Blanche & Durrheim, 1999). These suggest that the meaning that lies behind behaviour is explained and understood. This kind of research is aimed at discovering how the subject of study understands life (Babbie, 1998).

Silverman (2013) asserts that interpretive paradigms like a functionalist paradigm, belongs to sociology of regulation. Interpretive paradigm aims to understand the learners' experiences from the individuals' point of view. This suggests that the interpretive paradigm illustrates the social world created by interactions of individuals therefore there is no fixed structure of society. The interpretive paradigm aims at description of events whereby the study questions "what" and "why" are used, so as to describe and explain experiences grade nine mathematics learners. This study will therefore use qualitative research methods to gain an understanding of the experiences of grade nine learners within a school context. This justifies why the interpretative perspective of the world fits with this researcher's view of the world.

Reeves and Hedberg (2003, p. 32) argue that the “interpretivists paradigm stresses the need to put analysis in context”. This suggests that the interpretive paradigm attempts to examine the world in a subjective way. Furthermore, the interpretive paradigm aims for significant approaches like one- to-one observation. The interpretive paradigm is neutral when it comes to examining different variables but focuses on understanding human experiences in a certain situation (Kaplan & Maxwell, 1994). This suggests that the interpretive attempts to understand personal reasons that depend on social actions. The interpretive paradigm does not construct a new theory but helps in the assessment of theories. The interpretive paradigm defines reality as created in that it is based on people’s subjective experiences of their internal world. The truths derived from grade nine learners’ subjective experiences are real and to be taken seriously. In short, reality is constructed in the minds of individuals (Terre Blanche & Durrheim, 1999; Guba & Lincoln, 1988). Following from this the perspective acknowledges multiple truths and multiple realities (Lincoln & Guba, 1985).

Walsham (1995) describes three principles in the interpretive paradigm; a principle of design and collection of data; a principle of data collection and analysing data of a case study; and findings of the case study. Burrell and Morgan (1979) explain that the interpretive is composed of different paradigms. According to Gadamer (1976, p. 117) “is constantly from the whole to the part and back to the whole.” This suggests that there is no specific route to understanding of data. Henning, VanRensburg and Smith (2004) explain that the main words to describe this approach are involvement, cooperation and commitment. This suggests that interpretive paradigm involves different methods like participation and collaboration when generating data on different experiences of grade nine mathematics learners. In the interpretive paradigm “ the researcher is not on top or outside although the participant is observing, involved in the events and distinguishes the importance of actions by expressing them in a particular societal environment” (Carr & Kemmis, 1986, p. 88). An interpretive perspective of case studies aims at examining the way participants interrelate with different experiences under study (Marcee, 2007). This suggests that the interpretive case study looks at understanding human actions and explores the experiences of grade nine learners as they learn mathematics. According to (Henning, VanRensburg & Smith,

2004; Carr & Kemmis, 1986; Marcee, 2007), interpretive paradigm involves understanding human actions and their interactions. Christiansen, Bertram and Land (2010) suggest that the interpretive paradigm the researchers do not aim to predict what the people will do, but rather to describe how people make sense of their worlds, and how they make meaning of their particular actions. The experiences of mathematics learners will therefore be explored to see how they make sense of the attained mathematics curriculum. This suggests that the interpretive paradigm believes that the social world is created by interactions of individuals; therefore there is no fixed structure of society. The interpretive paradigm includes the following advantages as discussed below.

The aim of the interpretive paradigm is that it helps to investigate the different experiences of grade nine learners when learning mathematics. Interpretive paradigm helps in investigating the findings from participant thereby making sense of the phenomena (Chapman & Smith, 2002; Smith, Flowers & Osborn 1997). The interpretive paradigm aims to explore different experiences of the participant (Reid, Flowers, & Larkin, 2005). This suggests that in interpretive paradigm presumes to understand and explore the grade nine learners' experiences in learning mathematics. Hart and Marriott (1999) suggest that the interpretive paradigm focuses on personal reports neglect common goals. It distinguishes research as an active process by investigating the findings from "the participant's personal world" (Smith, 1996, p. 218). This suggests that interpretive paradigm helps to understand the participants view on the personal level. Interpretive paradigm recognises the convenience and complex ideas of the participant's personal world. The interpretive paradigm is used as an indication and dual approach (Smith, Jamal & Osborn, 1999). This suggests that it recognises and interprets participants potential to clear their thoughts and experiences and this is determined by the researcher ability to replicate and examine (Baillie, Smith, Hewison, & Mason, 2000).

Linda (1981) suggests that the main aim of interpretive paradigm is that it helps in the formation of insight. This suggest that the formation of insight helps to build knowledge that is determined by the participants view and understanding. Smircich (2007) asserts that the main aim of the interpretive paradigm is that it helps to reveal the composition of structures and analyse the grouping of reality. The significance of insight is that it helps to understand and demonstrate the

critical level of common sense knowledge and scientific knowledge. Insights supply acquired knowledge which helps to create the level of awareness and understanding the characteristics of objects and procedures. This suggests that insights help to understand individual or particular situations relating to a societal and cultural environment.

Stanley (1982) conducted a study on critical interpretive research in organisational communication. The study concluded that the interpretive research helps in the creation of new theories which help to understand the different interest of the participants. This suggests that interpretive paradigm will help in understanding the organisation members' views and lived experiences. The interpretive paradigms help to overcome undesired outcomes and identify critical features of the study. Collins and Nicolson (2002, p. 627) argue that "the responsibility with interpretative commitment helps in deeper exploration of the participant's texts." This suggests that the interpretive paradigm will help to examine deeper information from the participants view. According to Smith *et al* (1999, p. 235) asserts that there is a chance that the "distinctive personality of every participants' experiences resurface." This suggests that each participant has different experiences which need to be understood. However, interpretive paradigm has the following disadvantages.

Stanely (1982) asserts that the insight of interpretive paradigm is inadequate in analysing the organisations. This suggests that the personal experiences explored provide insufficient data for change. The significance of interpretive research has been critical in order to enhance the goal aimed towards understanding different actions. Goldman, van and Nord (2002) explain that interpretive research fails to explore the economic, social and political aspect hence affecting the organisational problems, events and creation of ideas. This suggests that insufficient knowledge is caused by poor management. In interpretive research, data is indistinct and highlights an unequal distribution of power. Communication is blocked, repressed and unclear caused by the political, social and economic influence.

3.2.1 Research purpose or objective

This study explores five grade nine learners in learning mathematics at a secondary school. The study intends to achieve the following objectives:

- I. Identify and understand the experiences of grade nine learners in learning mathematics at a secondary school in Umzimkhulu.
- II. Understand the reasons why grade nine learners have particular experiences in learning mathematics.

3.2.2. Research Methodology

Research methods are the methods used by the researcher during the course of studying the research problem (Kothari, 2004). These include methods that are concerned with the generation, analysis and interpretation of data. There are many research methods and each research paradigm has methods that are most suitable for them to achieve their intended objectives. Within the interpretive paradigm, under which this study falls, there are some methods that can be used like an ethnographic study, naturalistic and a case study (Christiansen *et al*, 2010). I chose the case study approach because I explored the experiences of grade nine learners within their context and deeply examine why they have particular experiences. According to Myers (2009), the research method is an approach of analysis, shifting from the basis hypotheses to research design and data generation.

Schwardt (2007) defines research methodology as a theory of how an inquiry should proceed. This suggests that research methodology involves an analysis of assumptions, procedures, and principles in a particular approach of inquiry. According to (Schwardt, 2007; Creswell & Tashkorri, 2007; Teddie & Tashkorri; 2007), methodology define the kind of problems that are worthy investing and what constitutes a research problem. Fellows and Liu (1997) explain that methodology is a skill of examining how research is carried out and the different procedures researchers employ to carry out research processes. Kothari (2004) explains that research methodology consists of generating data and it's an important aspect in research. Methodologies

are the procedures of designing pre-arranged questions, taking measurements, explaining different experiences and carrying out experiments (Ololube, 2006). Methodology is a research approach that interprets rational and epistemological values into procedures that reflect how research is to be carried out (Sarantakos, 2005). Principles, procedures, and practices that govern research (Kazdin, 1992, DeMatteo & Festinger, 2005).

3.3. Research Approach (Qualitative Field of Research)

This study adopted qualitative field of research. Taylor (1977) urges that qualitative research is a natural investigation of day-to-day life. Direct observations are made of human behaviour in everyday life. Lofland (1976) indicates that naturalistic researchers gain knowledge from sources that have “intimate familiarity”. Domegan and Fleming (2007, p. 24) explain that qualitative research focuses on exploring and discovering the problems at stake. This suggests that quantitative research helps to identify uncertainties and the scope of the problem. Myers (2009) explains that qualitative research helps researchers to recognise the societal and cultural aspects in which people live. This suggests that qualitative research focuses on understanding and exploring human behaviour and their experiences; “This allows the complexities and differences of worlds-under-study to be explored and represented” (Philip, 1998, p. 267).

Babbie (1986) explains that qualitative research helps in examining of the phenomenon. During one-on-one interviews a researcher gets deeper information on the participant ideas, thoughts or context. The research being investigated aims to achieve knowledge and explore the experiences of grade nine mathematics learners. Qualitative research is concerned with developing explanations of social phenomena that inform understanding about the world in which people inhabit and why things exist the way they are (Hancock, 2002). Research in this field involves the opinions and experiences of grade nine learners when learning mathematics. This study adopts a case study approach or research style.

3.3.1. Justification for a Qualitative Research

According to (Domegan & Fleming, 2007; Henning, Van Rensburg & Smit, 2004; Denzin & Lincoln, 2003; Richardson, 1995), qualitative research is good for studying humans. Guba (1981, p. 76) explains that “it is proper to select that paradigm whose assumptions are best met by the phenomenon being investigated”. Qualitative research is about exploring human behaviour and understanding the experiences of grade nine mathematics learners.

3.4. Research design

Gay and Airasian (2000) indicate that a research design is referred to as a common plan for carrying out a research. This suggests that the characteristics of the theory, the participant included and the limitations of the world determine the choice of research design. Kothari (1988) asserts that deciding an approach or strategy comprises a research design. According to Kothari (2009, p. 31), a research design is the “preparation of circumstances for generating and analysing of data in way to emerge significant to research purpose.” This suggests that the research design refers to ways the data is generated and analysed in relation to research purpose. Leedy (1997) defines research design as a plan of study providing framework of collecting data. Macmillan and Schumacher (2001) define a research design as a map for choosing the subject matter, location and data generation procedures in order to respond to the research questions. Furthermore, the goal of sound research is to provide results that are judged to be credible. Durheim (2000) describes a research design as a planned structure for steps to be taken when carrying out research.

Christiansen *et al* (2010) describe the research design as a series of steps to experiential data in order revise the research questions and conclusions. This study aims to explore and understanding the experiences of grade nine mathematics learners. Qualitative research focuses on building different descriptions of societal phenomenon that inform and question the understandings about the world in which people live (Hancock, 2002). The study in this field involves the opinions, experiences and feelings of individuals producing subjective data, relative to the ideology of the interpretive paradigm. Henning, Gravert and Rensburg (2005) define the research design of a study is a logical sequence procedures which connects the empirical data to the research questions in the study and ultimately to its conclusions. Babie (1998) asserts that in this study, a qualitative,

theorising, examining and explanatory method was used. This suggests that the method was crucial because it focused on exploring the learners' experiences when learning mathematics.

Mouton (1996, p. 175) defines a research design as "map, organisation and execute" and "strength of the results". This suggests that a research design provides guidelines from the crucial theory to the research design and generation of data. Yin (2003, p. 13) defines a "research design as a map for getting from here to there whereby here is referred to a research questions and there is participants responses". Furthermore, research design is defined as a key plan that guides how the study should be conducted. This suggests that a research design indicates guidelines of the research study such as samples and research questions.

Christiansen *et al* (2010) describes a research design as ways of doing research. This study lies under the interpretive paradigm and adopted intrinsic case study as a research design. The case study helped me to deeply explore the experiences of grade nine learners as they learned mathematics. I intended to explore all kinds of aspects of school life, the learning process and the culture of the school.

3.4.1. Intrinsic case study

Silverman (2013) asserts that a case study scrutinises and gives insight into phenomenon. This study adopted a case study and five grade learners at a junior secondary school were suitable for this study as a research style. Cohen, Manion and Morrison (2011) define a case study as a study on individuals and context. This study can therefore assist other mathematics learners in other schools where this study was not conducted. This study is therefore using the case study because it sets to explore the experiences of grade nine mathematics learners a secondary school. This study aims to deeply explore the experiences of mathematics learners in a secondary school. In a case study, the results of study will not be generalised; the study helps to demonstrate the complexity and state of behaviour of the participants. A case study offers empathic, deep and compressive data from variety of sources (Cohen, Manion & Morrison, 2011). This study can therefore assist

the gap by other researchers in mathematics. The case study approach helped me to explore grade nine mathematics learners' experiences. Other research approaches may investigate issues and their contexts there by making the case study suitable for this research (Cohen, Manion & Morrison, 2011).

Gillham (2000) describes a case study as an inquiry to respond to a particular research question, seeking a variety of data from the case settings. This suggests that case studies help in getting answers to research problems. Yin (2003) explains the case study as a pragmatic examination which explores the current event within everyday situations and the borders linking the event and situations are not clearly distinct. This suggests that a case study is important where relative conditions of the phenomenon being examined. Cohen *et al* (2011) describe the case study a study of individuals and actual life conditions. This suggests that a case study covers participant's experiences and actual life situations. Even though its results cannot be generalised, a case study helps to show complexity and situations of behaviour and provides empathic, in depth and detailed data from a wide variety of data sources.

Ritchie and Lewis (2003) explain that case studies involve a diversity of perceptions which are embedded in particular situations. This suggests that a case study may be a plan, experience or an action that is restricted by timing and location. McMillan and Schumacher (2001) indicate that a case study investigates restricted system using different sources of data established location. The generated facts are gathered to get different responses to the research question. This suggests that a case study helps in exploring different events which are crucial. Mertens (1998, p. 145) asserts that a case is used to examine "specific instructional strategy". This suggests that a case study may help me to explore the specific learners' experiences when learning mathematics. This study adopted the interpretive paradigm and case study methodology which was suitable in that it offered an organised way to generate data, analyse information and report the findings.

Merriam (1998) recognises the four crucial characteristics of a case study; particularistic, descriptive, heuristic, and inductive. Particularistic refer to a particular experience, procedure or condition which is the aim of the study. Descriptive refers to the deep and wide group of particulars in relation to the event where as inductive refers to the type of analysis used to establish generalisations or theory that materialise from data. A case study does not represent, but stresses what is learned from a single case (Tellies, 1997). A case study is crucial in primary knowledge relating to important knowledge areas. The fundamental philosophy value of a case study is “not to prove but to improve” (Stufflebeam, Madaus & Kellaghan, 2000, p. 283). The case study research is criticised for not representing the larger population. The detailed and complicated data results into data being interpreted thereby leading to biasness (Cornford & Smithson, 1996). Denzin and Lincoln (2000, p. 193) assert that a case study can be comprehensive, arguing that “viewing numerous actors in several situations improves generalisability”. Yin (2003) explains that a case study is useful in analysing, generalisation, where by the researchers examines a set of findings in relation to a wider theoretical propositions. This suggests that different methodologies are used to obtain data. According to (Yin, 2003, Denzin & Lincoln, 2000), share the belief that case studies can be generalised.

Silverman (2013) explains the three types of case studies; intrinsic case study, collective case study and instrustmental case study. In intrinsic case study there is no effort to generalise beyond a single case; in instrustmental case study gives an insight into an issue; and collective case study examines a general phenomenon in different cases. This study adopted intrinsic case study because it explores the experiences of grade nine mathematics learners. The intrinsic study gives a sight of ways of achieving a positive attained curriculum. Since this study does not intends to generalise its findings this will help in understanding the different experiences when learning mathematics at a secondary school. Stake (1995, p. 5) assert that “a case study is a specific, a complex, functioning thing”.

3.5. Participants' Background

The sample for this study was taken at a junior secondary school in the District of Sisonke. The school is located in rural location and the learners are from poor families. The learners spend long hours working after school which affects their learning. The participants selected perform better in other subjects apart from mathematics. Consent to carry out the research was received from the management of the school. The convenient sample of five grade nine learners from a junior secondary was chosen. This sample was chosen according to performance and gender in the class. The data was gathered primarily from semi-structured observation, one-on-one semi-structured interviews and focus group discussion with five learners from grade nine these included three girls and two boys.

3.6. Sampling

Christiansen *et al* (2010) asserts that sampling is a process of deciding which group of people, location, actions or behaviours to observe or study. A sample can be referred to as a component of analysis and the sample is selected by the researcher which is dependent on the data generation methods, total population and style of the study. This suggests that the size of the sample of this study will depend on the research style and population size. Cohen, Manion and Morrison (2011) define sampling as the total population to be used in the research. To overcome barriers like expenses and time, researchers select a small group or set of the population to represent the total population. The sample is the five grades nine mathematics learners used in this study. There are two main methods of sampling which include probability sampling (random sampling) and non-probability sampling. Purposive sampling as one of the non-probability samples includes random, stratified sampling, cluster sampling, stage sampling and multi-phase sampling whereas non-probability sampling includes convenience sampling, quota sampling and purposive sampling (Cohen, Manion & Morrison, 2011). Purposive sampling was adopted in this study because the sample not representative of the bigger population.

3.6.1. Purposive sampling

This study adopted purposive sampling as one of non-probability sampling. Purposive sampling is making decision about which people to include in the sample. Purposive sampling method seeks to select information rich (experts) participants especially those who meet the objectives of the

study (Cohen, Manion & Marrison, 2011) I chose five grade nine learners knowing that the sample is not representative of the bigger population. The grade nine learners were selected purposefully because it simply presents itself and didn't intent to generalise the results beyond the group sampled. The sampling of five grade nine learners was based on performance and gender. The best performing and poorest performing learners have different experiences when learning mathematics at this level thereby giving different responses. In purposive sampling the researcher aims for a particular group, recognising that the group is not representative of the larger population (Collins & Hussey, 2009). This suggests that the researcher will not generalise the results beyond the group sampled. The five grade nine learners were able to reveal different experiences when learning mathematics in their grade. The school was chosen purposively because it is faced with poor standards in mathematics. Purposive sampling aims at exploring and examining different experiences of people (Hennink *et al*, 2011). The 3.1 table below shows the participants sampled for this study.

Participant	Grade	Age	Race	Gender
Participant A	Nine	15	African	Female
Participant B	Nine	15	African	Male
Participant C	Nine	15	African	Female
Participant D	Nine	16	African	Male
Participant E	Nine	16	African	Female

Table 3.1 Grade nine learners (participants)

Table 3.1 presents the participants' grade, age, gender and race. Cohen *et al* (2011) indicates that during purposive sampling, the researcher should decide on a sample with specific knowledge. Four of the participants were together for more than five years in the same junior secondary school and one was new to the school. All five participants take mathematics as a core subject which determines their graduation to the next class. The four participants were taught by same the teacher who had taught them for the past three years. The participants are performing better in other

subject apart from mathematics. The group had two male participants and three female participants. In terms of race, they were all black South Africans.

3.6.2 Convenient sampling

Christiansen, Bertram and Land (2010, p. 43) defines convenient sampling as “... selecting a sample that is easily accessed by the researcher”. Convenient sampling focuses on participants who are available and willing to participate in study. This suggests that the researcher will use the sample which is easily accessible. Convenience sampling participants are chosen from those who are within reach and can be accessed easily. The participants of this study will therefore be the five grade nine mathematic learners at a school that is easily accessible. The school that is chosen as a case study for this research is ease to access. The sample simply represents itself and I don’t wish to generalise the results beyond the group sampled. This sampling is not representative of a larger population but is relevant and effective for giving ideas and insight (Hennink *et al*, 2011). This suggests that the results will not be generalised beyond this sample. Cohen *et al* (2011) agree that sampling does not represent the larger population and therefore does not seek to generalise the results. Cohen *et al* (2011) and Hennink *et al* (2011) indicate that sampling may not be representative of a larger population. Convenience sampling was adopted in this study to save time and the participants were ease to access.

3.7. Data collection procedures

Three data generation collection procedures were used in this study. The unstructured observation was carried out for a week, then followed by one-on-one semi-structured interviews which were administered for 50 minutes, and lastly a focus group discussion was carried out once for 60 minutes.

3.7.1. Classroom unstructured observation

Observation, as a qualitative method can either be participant or non-participant in nature (Cohen & Manion, 1985; Worthen & Sanders, 1987). In participant observation, the researcher engages in activities that are designed to observe and become part of the group being observed. In non-

participant observation, the researcher does not participate in the activities. The researcher investigates and observes someone else's behaviour and records it. Generation of data in natural research involves observing the participants in real life situations. Babbie (1989) and Schwartz (1955) explained the four different roles a field researcher can play; full time participant, observing participant, observer as participant, and full time observer. This suggests multiple positions can be used in answering the research question. One main advantage "is that it provides here and now experience in depth" (Lincoln & Guba, 1985, p. 273). This suggests that unstructured observations can help in deeply understanding different experiences. Patton (1990) explains that observational data is used for describing the situations, actions and significance of phenomenon. A trained observer has skills for observing both verbal and non-verbal signals and uses actual, explicit, expressive language.

In this study, I adopted participant observation. I engaged in the activities that were set for observation and became part of the group that was being observed. My engagement in the activities enabled the learners to become used to my presences. Through it, I was able to observe the different aspects when learning mathematics rather than relying on what they said. I had a schedule that guided the classroom observations. The observation was carried out for one week. I carried out classroom observations for a sixty minute period per lesson. The first two days enabled learners and teachers to get used to my presence and during the remaining days I wrote down and recorded my observations. Through observation I was able to identify the body language, attitude, tone and context factors that helped me to understand why grade nine have different experiences. Data generated through observation is relevant when the participant's body language is consistent with the vocal feedback. Unstructured observation helped me to understand the different human activities rather than only focusing on the interviews, because it provided information of the situation in which actions occur when learning mathematics; and allowed me to observe events when the participants were unaware or unwilling to discuss them.

3.7.2. One-on-one semi-structured interview

This study adopted one-on-one semi-structured interview as a second method of data generation. Semi-structured interviews refer to understanding the participants' meanings and how they interpret crucial events in their lives through open questions (McMillan & Schumacher, 2006).

“The searching and clarification of answers is not allowed and it is a necessary to answer the prearranged questions by the participants” (Maree, 2010, p. 87). This suggests that interviewer get different responses to their research questions. Brown and Dowling (1998) explained that interviews would enable the researcher to explore issues in more detail and give an opportunity for probing and prompting further questions. This method involves data generation by direct verbal interaction with the participants. Interaction with the participants allowed them to open up to the interviewer. The interviewer makes some gestures making the participant more relaxed and likely to respond well. Whyte (1979, p. 56) suggest that it is the “different methods of data generation enables the researcher to compliment data generated from observation and interview method”. The flexible one-on-one semi-structured interview allows the researcher to identify statements, suggesting questions which are new for investigation” (p. 57).

One-on-one semi-structured interviews with the five participants involved first round interviews, which were conducted for 50 minutes, as well as follow up interviews. First round interviews allowed participants to orientate themselves to the interview process. I started by giving the participants the chance to express their opinions about mathematics as a subjects. This exercise enabled them to relax and freely give their responses. Cohen and Manion (1985, p. 271) assert that one-on-one semi-structured interviews give space to “modify the sequence of questions, change the wording, explain and add to them”. The processes were semi-structured; following a pre-determined sequence of questions related to the research questions. The questions gave the participants greater flexibility and helped interviews without reducing them to casual chat events (Cohen & Manion, 1985). The process provided further insights into learner’s experiences in terms of tasks and interactions when they learn mathematics. The follow-up interviews were written down and analysis was done. The follow-up interviews helped to achieve transparency on responses raised and to gather additional data to again deeper understanding.

Babrabra and Benjamin (2006) assert that one-on-one semi-structured interviews are the main source of data generation and are frequently pre-plan for designated times and settings. Semi-structured interviews generally include prearranged open-ended questions arising from the

interviews between participants and the researcher. The questions that were used emerged from the concepts of the curricular spider web and these include; Why are you learning mathematics? Which goals are you learning in mathematics? Which content are you learning in mathematics? When do learn mathematics? With what are you learning mathematics with? What is the learner's role in learning mathematics? When are you learning mathematics? Where do you learn mathematics? With whom are you learning mathematics? How are you assessed in mathematics?

3.7.3. Focus group discussion

Cohen *et al* (2011) explains that in a focus group discussion the researcher motivates participants to intermingle together to give answers to the research questions. Focus group discussion in this study was carried once with four participants since one of the participant dropped out. The Focus group discussion was held to gain an in depth understanding of experiences in learning mathematics. All the participants were brought together in one forum to share their experiences in learning mathematics. Barbara and Benjamin (2006) suggest that every focus group represents a particular unit in a sample group. Interviewing different people is not a shortcut for collecting data at same time. Vaughn *et al* (1996) argue that focus group interviews can be used along with other methods to bring an improved depth of understanding of the issue being researched. The focus group discussion helped me to explore issues that were not discussed in one-on -one semi- structure interview.

Hennink *et al* (2011) explains that focus group discussions help gain a deeper understanding of different issues because of the group environment. This focus group discussion was conducted for 60 minutes during the participants' free time from school. The environment provided the participants the space to think freely and feel relaxed. I used a co-researcher to help me to translate the language so that the participants were free to answer in the language they were most comfortable with. I wrote notes down during the discussion to ensure that nothing was missed. Furthermore, I tape recorded the discussion after getting the participants' consent and data was transcribed. During the focus group discussion, questions also emerged from the ten concepts of

curricular spider web: Why are you learning mathematics? With whom are you learning mathematics? Towards what goals are you learning mathematics? When do you learn mathematics? With what are you learning mathematics with? When do you learn mathematics? Where are you learning mathematics? How are you assessed in mathematics? Which activities are you learning in mathematics? What is the learner's role in learning mathematics? The table below illustrates how data was generated.

	Objective 1	Objective 2
Why was the data generated?	Identify and understand the experiences of grade nine mathematics learners at secondary school in Umzimkuulu	Understand the reasons why grade nine learners' have particular experiences in learning mathematics.
What is the research strategy?	Semi-structured observation, focus group discussion and one-on-one semi-structured interviews were used to generate data.	Semi-structured observation, focus group discussion and one-on-one semi-structured interviews were used to generate data.
Who were the sources of data?	Five grade nine mathematics learners.	Five grade nine mathematics learners
Where was the data generated?	At junior secondary school in Umzimkhulu.	At junior secondary school in Umzimkhulu.
How often data was be generated?	Firstly, semi-structured observations were carried out for a week.	Firstly, semi-structured observations were carried out for a week.

	<p>One-on-one semi-structured interviews which lasted 50 minutes for each participant.</p> <p>Focus group discussion was administered once for 60 minutes</p>	<p>One-on-one semi-structured interviews which lasted 50 minutes for each participant.</p> <p>Focus group discussion was administered once for 60 minutes</p>
<p>Why these methods were used?</p>	<p>Semi-structured observation was used to give the true picture of what happens in class when learning mathematics.</p> <p>The focus group discussion and one-on-one semi-structured interviews enabled me to get first-hand information from the participants themselves.</p>	<p>Semi structured observation was used to provide true picture of what happens in class when learning mathematics.</p> <p>The focus group discussion and one-on-one semi-structured interviews enabled me to get first-hand information from the participants themselves.</p>

Table: 3. 2. How data were generated

3.8. Data analysis

Kothari (2004) explains that there are two types of data; primary and secondary data. Primary data involves the researcher by generating data from the field, with analysis done to receive purposeful data. Miles and Huberman (1994) assert that analysing data involves three types of activity that takes place at the same time; data reduction, data display, conclusion drawing, and verification. Data reduction is the process of choosing, targeting, construction and alteration of the data that emerges from field notes or transcription. Data reduction happens throughout the process of a project. During the actually recording, the researcher decides the research boundaries of a conceptual framework, and the research question. Data reduction is not divided from analysing, it

is part of analysing. Data deduction involves organising and sorting data into codes or categories and then looking for patterns or relationship between categories.

Christiansen *et al* (2011) describes data reduction as a process of choosing, aiming, building and changing of the data. This suggests that data reduction engages the researcher in order to understand the crucial links between the phases of people's situations, mental processes, beliefs and actions. This reduction is an unbroken process that takes place during all stages of the research. The guided analysis method was driven by the components of the curricular spider web as the conceptual framework, which was used to help classify the data generated from this study. The generated data will be merged into categories. The categorised data was analysed in to thick descriptions hence describing behaviour (Hennink *et al*, 2011). Conclusions made were supported by the data to strengthen the quality of the findings. Gibbs (2007) explains that qualitative analysis is directed and enclosed by pre-existing ideas and concepts.

Analysing data entails “operating with data, categorising, splitting it into convenient units, building it, probing for patterns, identifying crucial patterns, what is learnt, and making a decision of what to tell others” (Bogdan & Biien, 1982, p. 145). Analysis starts with the classification of the themes arising from the raw data, a procedure called "open coding" (Strauss & Corbin, 1990). Throughout open coding, the researcher identifies the concepts and categories in which experiences observed must be grouped. Open coding helps to generate different categories which make the initial framework for analysing data. The grouping may be regularly adapted or restored throughout the successive stages of analysis that follow.

In terms of data analysis, this study adopted guided analysis from the categories which emerged earlier (Freeman, 1996). Guided analysis is driven by two approaches; inductive and deductive reasoning. Christiansen *et al* (2010) assert that inductive reasoning begins from specific observation to broader generalisations and theories. I explored the learner's experiences by conducting semi-structured observation. Through observation, I generated raw data, then begun to

detect patterns and regularities in the data. The semi-structured observations helped me to understand and generate data. After generating the raw data, I detected patterns and regularities which helped me to develop some general conclusions. While on the other, inductive reasoning works from the general to the more specific (Christiansen *et al*, 2010). I began from the start of the project, focusing on grade nine learners' experiences as my main interest. The categories were developed from the curricular spider web. Themes derived from the data were structured by the curricular spider web and adapted through their relationship with the data (Samuel, 2009). Themes and categories that emerged from the process approach were modified through interaction with data (Khoza, 2013).

3.9. Trustworthiness

Lincoln and Guba (1994) define trustworthiness as the way a researcher is able to convince the readers that the findings of a study are accurate and are of high quality. Issues of trustworthiness have to be considered at the data generation, data analysis stage and data interpretation stages. This will ensure that the findings of the study reflect what is happening on the ground and readers will trust the findings of the study. Bassey (1999) explains that the concept of trustworthiness in qualitative research is concerned with meanings and personal experiences of individuals. Trustworthiness aims to describe and not to measure. Mertens and McLaughlin (2004); Christiansen *et al* (2010) agree that the concepts of credibility, transferability, dependability and conformability should be used to ensure the high quality of the study. I ensured trustworthiness in my study by attending to the concepts explained below.

3.9.1. Credibility

Guba and Lincoln (1994) describe credibility as do findings reflect reality and lived experiences of the participants and value information. Hall and Stevens (1991) explain that credibility is an honest explanation of participants' experiences and they should be able to identify them as their own. The study focuses on the different experiences of the participants neglect the reviewers. Credibility was ensured in this study through triangulation. Multiple methods of data generation were used in this study; unstructured observation; one-on-one semi-structured interviews; focus

group discussions. The credibility of the research was also enhanced by writing field notes; observation notes; and taking audio recordings of the interviews with the participants. The notes were also compared with the recordings to ensure accuracy. Posing the same questions to all the participants enhanced credibility. I double checked that no errors occurred in the research design and the appropriate methodology was used to carry out the study. I defended the proposal before the university panel after I attended to the corrections to make sure the research was in line.

3.9.2 Transferability

Transferability refers to the extent to which research can be transferred can to another context (Guba & Lincoln 1994). Cohen *et al* (2011) define transferability as an application of findings to a particular environment. Christensen *et al* (2010) explain the level at which findings are applicable to another situation. According to (Cohen *et al*, 2011; Christensen, 2010; Guba & Lincoln, 1994), transferability is the applicability of research finding to a particular context. Transferability was enhanced through the use of the ten components of the curricular spider web. The correct findings of the study were ensured where by the experiences of grade nine learners in learning mathematics can be transferred to another school. The findings were driven by curricular spider web components reflecting the CAPS in mathematics were presented clearly and can be applicable in another school.

3.9.3. Dependability

Dependability refers to the reliability of the research finding (Cohen *et al*, 2011). This suggests that dependability is about providing accurate information in the study. Dependability was enhanced through direct quotation of participant's responses, thereby allowing readers themselves to assess the findings. Christensen et al (2014) urge that education background and knowledge of the researcher can affect the data generation process. I made sure that my data generation process is not affected by not including my understanding in the study. I cited knowledge from the other studies in the same field. I was able to evaluate my findings from the study by hiding my understanding of the field being studied.

3.9.4. Conformability

Shenton (2004) describes conformability as the extent to which findings reflect participants' experiences and ideas, although findings should not be influenced by the researcher. Conformability was enhanced in this study by carrying out semi-structured observation. By describing each step in detail, I was able to ensure that my position did not influence the findings. Through the semi-structured observation I was able to get information that was not mentioned in the interview. Through observational methods, participants were able to get used to my presence which ensured that my presences did not affect the findings of the study.

3.10. Ethical Issues

Creswell (2009) emphasises the importance of all the studies to pursue ethical values like self-sufficiency, non-maleficence and beneficence. Because research involves humans, it is important for the rights of these individuals to be sheltered from any danger that can be caused by research. Participants must receive a clear explanation of what the research expects of them because this will allow them to make informed decisions through their voluntarily participation. Throughout the research process, try to ensure that the rights of the learners being studied are not comprised in any way. Permission was obtained from Department of Education as well as the school.

Obtaining permission from the parents of the learners was a long and difficult process, nevertheless, only those learners whose parents granted permission from the start were used in the study. Consent from participants was obtained by having them acknowledge the approval form by signing it. According to Cohen *et al* (2011), the approval form should have the following; the outline of the process to be followed; explanation of the participants inconveniences and dangers; advantages to the participants; that participation is voluntary; participants remain anonymous; respond to each question in a manner that will reflect own opinion; and that their answers are neither correct or incorrect. Burton and Bartlett (2005) agree that these ethical issues should be taken into consideration before embarking on a research project and also taken into account whilst the research is ongoing. The research proposal was taken for scrutiny through a selected panel by the university. The research proposal had to be screened by the panel before I proceeded to make

corrections and this process helped me to focus the study. After submitting the research proposal to the ethical office, the ethical certificate was issued which allowed the generation of data to be carried out.

3.11. Limitations

The limitations refer to those factors of methodology that affected the explanation of the findings of the study. The limitations are determined by the method used to collect data and restrict the findings of the study. It is anticipated that during interviews there could be dishonest responses from participants who trying to please the interviewer, and during observations untrue behaviour can be revealed. Cohen *et al* (2011) argue that a case study cannot be double checked which can lead to subjectivity and bias. This is possible because the researcher might seek answers that support their preconceived notions during interviews. Another limitation was the language barrier. Since English is not the learners' first language, and the interviews were conducted in English, it is anticipated that some participants may not have understood the questions properly and their responses may not be fully reflective of their experiences. Another problem was the availability of the participants; the interviews were carried out during their break times and most participants wanted to enjoy their school breaks.

This empirical research has its own limitations, as well as issues relating to the implementation of a case study. The results of this case study are not universal do not represent the experiences of all grade nine mathematics learners. This research is interested in the depth of the study in order to generate a greater understanding than just the issue of generalisation. There is also the problem of relying on interviews as major data generation methods because they rely on personal opinion and is open to bias. This is possible because the researcher might tend to seek answers that support their preconceived notions during interviews. Another limitation is the adequacy of sampling. Section 3.4.1 (Chapter 3) describes the samples used in the current research and indicates that these were purposive samples that were accessed within the South African contexts. Because of this,

they may not be representative of the wider population (McCall, 1990; Rosenthal & Rosnow, 1991).

3.12. Conclusion

Chapter 3 explained the research design and methodology. It described the research style, data generation methods, sampling, data generation plan, trustworthiness, data analysis, ethical issues and limitations. The methods gave the direction and the procedure in which to answer the research questions. The above explained methods were used to explore the experiences of grade nine mathematics learners. Transparency of the study was achieved through strengthening the reliability and trustworthiness. The next chapter will discuss the research findings and discussions.

CHAPTER FOUR

RESEACH FINDINGS AND DISCUSSIONS

4.1. Introduction

The previous chapter discussed research design and methodology whereas this chapter reveals the findings of the research through the three data generated methods; semi-structured observation, one-on-one semi-structured interview, and focus group discussion. Different sources of data were used with the purpose of achieving authenticity of data and achieving measures of trustworthiness (Khoza, 2013b). The findings are probing in nature and themes emerged from the ten components of curricular spider web. Five participants from junior secondary school were selected and ten questions as themes from the curricular spider web were presented. In presenting the data, I ensured that the participants' voices are not missed by directly quoting their responses.

4.2. Findings and Discussions

Cohen *et al* (2011) asserts the significance of developing up a particular plan for analysing data which helps in answering research questions. This suggests a plan will help in the analysis of data. Propositions derived from concepts of the curricular spider web are presented by the figure below.

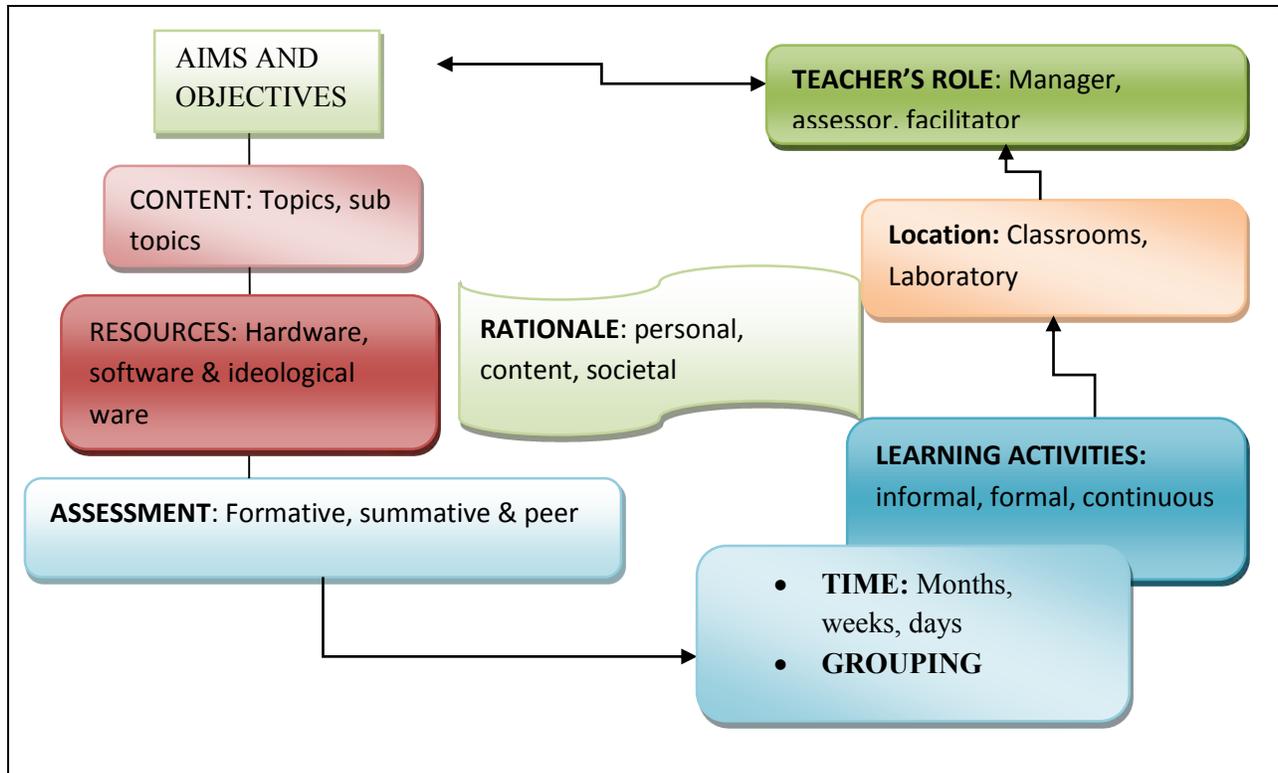


Figure 5: Concepts and Prepositions from curricular spider web. Redrawn from Khoza (2015a, p. 11)

4.2.1. Why are you learning mathematics (Rationale)?

Personal reasons

Participant A; “I learn mathematics because of the love I have got for it. I have so much interest in mathematics as subject. I learn it in that I possess mathematical knowledge and skills that are suitable for application in real life situations. Mathematics is core subject in determining for me to pass to the next grade.”

Participant B; “Mathematics enables me acquire problem solving skills. I learn mathematics for the sake of passing since it’s a determining subject. I have no interest in mathematics as a subject.”

Participant A's account suggests that he understands the subject, which is portrayed by his passion for learning mathematics. The findings reflect that the participant understands mathematics thereby achieving a positively attained curriculum. The understanding is reflected through a passion for mathematics. He was able to defend it by explaining that he was aware that other learners thought the subject was not easy, which according to him, was not true. He explained that every learner should have mathematics knowledge and skills in order solve problems in their lives. He indicated that he believes that every problem in life needs a mathematical solution even though some learners find mathematics challenging. Brown, Jones and Taylor (2004) explain that mathematics is about acquiring knowledge, understanding, and competence in using geometrical properties and theorems. This study reveals that mathematics will equip learners with knowledge that can be used for logical thinking. This suggests that mathematics, as a subject, should not just consider imparting skills but also attitudes and knowledge.

Participant B's account suggests that she did have a specific reason for learning mathematics. The findings indicate that she is learning mathematics because it is compulsory. The observation indicated that she takes mathematics because it is compulsory and is part of the curriculum. However, she was not aware of any negative attitude towards mathematics which may have resulted in her performing poorly. Campbell (1986) suggests that girls' lack confidence in mathematics as subject. This suggests that they perceive mathematics to be difficult and view the subject as male dominated subject. This can cause a negative attitude towards mathematics, which affects their performance and involvement in mathematics classroom. The negative attitude contributes to poor performance of mathematics. Casey, Nuttall and Pezaris (1997) assert that gender influences mathematics cognitive abilities. This suggests that performance of mathematics can in some cases depend on gender. It is believed that male learners perform better in mathematics than female learners. Sex influences the attitudes and beliefs towards mathematics, which in turn affects the performance of the subject. Mathematics is often believed to be too hard for females. Esahun (2004) concluded that gender differences determine the attitude of learners when learning mathematics. There is a common idea that mathematics is hard subject when it

comes to girls. It can make learners anxious and cause them to panic which results in them performing poorly in the subject.

Content reasons

Participant D; *“I want know more about mathematics. I read more about mathematics to expand on the knowledge of mathematics. I want get more knowledge about mathematics since it enables to acquire problem solving and critical thinking skills.”*

Participant D’s account suggests that he wants to expand his knowledge in mathematics. The participant wants to acquire problem solving and cognitive skills. He reads more to expand on his mathematics knowledge which leads to a positively enhanced curriculum. Blomoj (1999) explains that mathematics equips learners with decision making skills. Mathematics equips learners with problem solving skills, in situations in which they need to make a good decision and to think significantly about a particular issue. The application of mathematics numerical values and models helps in critical thinking processes about the situation. Mathematics is an important subject; whatever we do in our everyday lives involves mathematics. Bradford, Brown and Cocking (2000) assert that mathematics equips learners with skills which help them to deal with different problems. These suggest that mathematics equips learners with problem solving skills that will be used in their everyday lives. Furthermore, when learners understand mathematics, they acquire skills that are used in everyday life and problem solving skills are acquired

Societal reasons

Participant E; *“I learns it because I want to gain respect from other learners. Mathematics is a science connecting to different fields like doctors, engineer. It is believed mathematic to be a subject for clever learners and it’s hard...”*

Participant C; *“Mathematics is compulsory according to Department of Education. I learn mathematics in that I pass to the next grade. It is part of the curriculum so it is must for me to learn and mathematics is a compulsory subject...”*

From data generated through unstructured observation and one-on-one interviews the above participants (E and C) suggest that they learn mathematics for socially acceptable reasons. The participants learn mathematics because it is part of the curriculum and it is compulsory. Participant E learns mathematics to gain respect from other learners since it is believed mathematics is a hard subject. Vithal (1999) urges that learners learn mathematics to gain knowledge and earn respect from the others. Nabbie and Korara (2004) assert that mathematics contributes a significant role in different aspects of life. This suggests that mathematics equips learner with different skills and understanding, hence making them responsible citizens.

From the focus group discussion, two learners (Participants A and B) showed passion and love for mathematics which contributed to effective learning. From the learners' experiences, it is clear that passion for the subjects goes hand-in-hand with the performance. Learners indicated that they learn mathematics to gain knowledge and acquire skills, such as problem solving which can be used in their everyday lives. According to participants' the more interest and passion they have got for mathematics the better they perform. The learners' interest and passion for the subject will determine their performance (Jansen & Hoadley, 2012). This suggests that if learners' are interested in learning mathematics, their overall performance in that subject improves.

Findings from unstructured observation, participant C's response indicates that the mathematics curriculum puts a lot of pressure on learners, regardless of whether or not they an interest in it. Mathematics puts an emphasis on knowledge and skills forgetting the attitudes and traits developed by the subject. Brousseau and Otte (1991, p. 18) describe the autocratic agreement between the educator and the learners: "the educator compelled to teach and the leaner is compelled to learn". This suggests the agreement is not negotiable; the agreement cannot be managed or neglected. Learning will not take place unless the agreement is respected. The contract has to be discontinued in order for learning to take place. The dictatorial contract which makes mathematics compulsory and a core subject for one to graduate to the next class. Mathematics as a subject emphasises on

knowledge and skills forgetting the attitudes and traits developed by the subject. From the focus group discussions, it reflects there is a misunderstanding of subject to be taken as male dominated subject. The female learners believe mathematics is meant to a male dominated subject. Campbell (1986) asserts that female learners perceive mathematics to be hard and subject meant for male. The female learners have a negative attitude toward mathematics which influences them to perform poorly. This suggests that female learners view mathematics as a male domain which is directly related to their achievement in the subject.

From responses of Participant E, mathematics is believed to be a very hard subject. She explains that mathematics has symbols, notations and language which need to be understood. Clarkson (2008) states that learning of mathematics is carried out in a particular language of instruction. The learners come from different backgrounds; they use a language different from the language of instruction. This suggests that it is crucial for the learners to understand the language of instruction which will help them to understand mathematics thereby enhancing a positively attained curriculum. All the participants were able to highlight the three rationale categories.

From the findings above, participants highlighted the personal reasons for learning mathematics and it was indicated as a motivating tool in learning mathematics. This suggests that mathematics CAPS is line in with the vertical/ performance curriculum. Van den Akker, de Boer, Folmer, Kuiper, Letschert, Nieveen and Thijs (2009, p. 9) define the curriculum as a “plan for learning.” Personal reasons are indicated as the most powerful, participants are taking the subject seriously since they are learning to acquire skills hence achieving positively attained curriculum. The reasons for their learning indicate that they are learning because it a core subject which determines them to get promoted to another grade. The generated data generated shows that mathematics curriculum is line with CAPS and the learners aim for attained curriculum. The participants learn the subject for the sake of acquiring the skills/knowledge and achieving a positively attained curriculum (Vithal, 1999). However, despite taking the subject seriously, the participants are learning mathematics with aim of getting promoted to another class. The participants indicted they are just following the mathematics curriculum not aim for better performance.

In addition to the above findings, all the participants ignored content reasons except for Participant D. This suggests that mathematics curriculum is not in line with the performance/vertical curriculum. The findings reflected that most of the participants ignored the content which affects the attained curriculum. Brenstein (1999) explains that content is hierarchically organised and coherent in a vertical/performance curriculum. This suggests that content aspect is crucial to achieving a positively attained curriculum. Since the findings indicated the content reasons is neglected this suggests that mathematics is not in line with the performance/vertical curriculum. However, only Participant D indicated content reasons which see learners reading further to acquire knowledge in mathematics. Van Mane (1977) explains the acquisition of knowledge in order to achieve the learning outcome. This suggests that when learners read extensively to acquire knowledge and cognitive skills. Hoadley and Jansen (2013) urge that it is vital to achieve the attained curriculum because it helps to standardise knowledge that is important to learners. This suggests that when learners acquire knowledge it helps them to become creative, artistic and productive, there by contributing to positive national development.

From the data generated, the findings reveal that the participants indicated learning mathematics for societal reasons. This suggests that the mathematics curriculum is in line with performance/vertical curriculum. Participant B findings reflect the she does not understand the curriculum. She is learning mathematics for a specific reason because it is compulsory. This suggests that the learner has to learn mathematics regardless of whether he or she has an interest in mathematics. The learners' interest in is related their performance. Cohen *et al* (2011) learners' attitude towards the subject determines the level of performance. This suggests that learners' interest in the subject is linked to performance. Participant A's response indicated the interest in the subject which determines his performance.

The data generated from unstructured observation, it reflects mathematics to be practical subject whereby gaining skills is critical in understanding the subject. The grade nine mathematics

learners' showed that educator is the sources of knowledge and learners are recipients of knowledge because they aim to acquire skills. Hoadley and Jansen (2012) urge that in performance approach the educator is consider to be the source of knowledge. Mathematics aims to impart skills implying learners are recipients of knowledge.

Furthermore, black learners are the most disadvantaged when it comes to the curriculum. The learning and teaching of mathematics was hindered in terms of race, especially blacks during the apartheid era (Moloi & Strauss, 2005). This suggests that black learners were given a different curriculum which prevented them from gaining critical skills. The curriculum designed the blacks was influenced politically which affected the school knowledge and their cognitive abilities (Hoadley & Jansen 2014). South Africa is faced with a challenge of poor performance mathematics learners. According to the findings released by the Department of Education, only 3% of the students register in colleges or university in subjects specialising in mathematics.

4.2.2 Towards which goals are you learning mathematics (outcomes)?

Outcomes

Participant C; “I can demonstrate different procedures, symbols, notations of mathematics. I want to acquire knowledge and skills...”

Participant A; “I can calculate and solve the problems in mathematics. Breakdown numbers and subtract them. I want to develop mathematical language...”

Participant B; “I don't know the term learning outcome. I confuse the learning outcome and aims”

Participant C and A responses indicated that, they can demonstrate different procedures, symbols and calculations. This indicates the level of understanding of learning outcomes. DOE (2011, p. 4) asserts that “This curriculum aims to ensure that children acquire, apply knowledge and skills in ways that are meaningful to their own lives. In this regard, the curriculum promotes knowledge in local contexts, while being sensitive to global imperatives”. This suggests that mathematics should not only impart knowledge but skills that are useful in everyday lives. The knowledge acquired from the mathematics curriculum should be relevant and usable in the local contexts.

Participant B's account indicates that she could not clearly explain the term learning outcome. The participants admitted, during the focus group discussions, that they cannot explain the term learning outcome. Donnelly and Fitzmaurice (2005) assert that learning outcomes are what learners are supposed to distinguish, comprehend and demonstrate by the end of the period. By the end of lessons, learners should be able to repeat what is taught. Khoza (2015b) explains that in South African curriculum; aims are referred to as curriculum aims; objectives are referred to as specific aims and outcomes are referred to as specific skills. Moon (2000) explains that learning is driven by identified content which is hierarchical from the lowest to highest level of knowledge. This suggests that the subject should focus on the learner's intention of learning rather than on aims and objective that are created by the facilitator.

From the generated data, the participants (A and C) indicated the understanding of learning outcomes. This suggests that the mathematics curriculum is in line with the vertical/performance curriculum. Hoadley and Jansen (2014) argue that in the performance curriculum learning outcomes help to develop a clearly defined behaviour or understanding rather than the more general competence. The understanding of learning outcomes leads to a positively attained curriculum within an appropriate time frame. Learning takes place when learners are able to demonstrate or repeat what is taught at the end of the lesson. The participants' responses indicated the understanding of outcomes thereby enhancing positively attained curriculum. Participant B did not clearly understand the learning outcomes that affect performance in the subject (Khoza, 2014b). Khoza (2015b); Kennedy, Hyland and Ryan (2006) assert that if learners are not able to demonstrate learning outcomes then the curriculum is affected. The learning outcomes are measured through learners' performance. Donnelly and Fitzmaurice (2005) assert that learners should be able to distinguish, comprehend and exhibit learning at the end of the lesson. The curriculum is affected if the participants do not clearly explain and understand learning outcomes. Adam (2006) and Khoza (2015b) explain that learning outcomes should come from Bloom's taxonomies of learning and these include: cognitive, skills and values. Moloi and Stray (2005)

assert that in South Africa the curriculum was restructured in with the aim of making it stronger and relevant to all the learners.

In addition to the above, findings from unstructured observation and one-on-one interview some of the participants revealed that they did not understand the learning outcomes. This suggests that if learners don't understand learning outcome in turn affects learning. Khoza (2015b) explains that according to Curriculum and Assessment Policy Statement (CAPS) aims, objectives and outcomes are part of the curriculum. Aims are presented as curriculum aims, objectives as specific aims and outcomes as skilled involved. In order for learners to achieve a positively attained curriculum they have to be able to understand the skills involved. This suggests that if learners do not understand the learning outcomes this affects the curriculum (Kennedy, Hyland & Ryan 2006).

4.2.3. What are you learning in mathematics (content)?

Subtopics

Participant B; *“I find it difficult to understand mathematical language because mathematics has got its own terminologies, concepts and procedures. Mathematics involves graphical, numerical and geometric. Most of the content is westernised not locally linked...”*

Participant B's account indicates that mathematics has its own language (terminologies) which can be difficult to understand. Zevenbergen (2000) explains that understanding the language of mathematics is crucial to learning. This suggests that for learners to understand mathematics they are supposed to understand the mathematics language. Failure to understand the language may sometimes lead to failure of mathematics understanding. The teachers need to make sure the learners understand the mathematics language first in order for them to understand the mathematics subject. Civil (2007) explains that there is a difficult to apply societal knowledge in to classroom environment. This suggests it is hard for mathematic knowledge to be applied in day-to-day life. In Civil (1996, p. 48) asserts that if “Can we develop learning experiences that tap on learners' areas of expertise and at the same time help them advance in their learning of mathematics?” This

suggests that the way mathematics content is delivered to learners seems irrelevant to the transformation of learners' day-to-day lives. The content taught in the mathematics curriculum seems to be boring to learners.

Topics

Participant A; *“I learn a lot of topics in theory. Sometimes I enjoy it but sometimes I don't because it seems to be hard. The practical part is left out and neglected...topics like geometry are theorised no practical are carried ...”*

Participant D; *“I don't understand topics like geometry, integers and angles. Certain topics seem to be hard and confusing to understand. I don't enjoy learning certain topics... seem to be irrelevant and not capturing my interest...”*

The accounts from two Participants A and D indicate that learners are not able to understand the some topics because the content is pitched highly for junior secondary. The participants explained that the content given to them is not understood which affected the attained curriculum. Hoadley and Jansen (2012) assert that if learners' do not understand the curriculum there by affecting the attained curriculum. This suggests that mathematics content is pitched highly which affected the performance of learners. In performance approach, knowledge provides learners with basic information that matches international standards.

From the findings from unstructured observation the participants indicated a problem of language when learning mathematics. Mathematics has its own language which learners sometimes don't understand, there by affecting thereby enhancement of positively attained curriculum. The findings indicate that the CAPS mathematics curriculum is not in line with performance/vertical curriculum. Khoza (2015a) suggests that vertical curriculum content is learnt hierarchically from the lowest to the highest. Performance curriculum is driven by identified content where all learners learn the same body of knowledge from the lowest to the highest levels. Performance curriculum is rich in content and controlled by the teacher. Mosckovich (2005) conducted a study on the use of two languages when learning mathematics. The study emphasised that language is an important factor in the mathematics learning process. This suggests that learners have to first understand the

language of mathematics such as terminologies, concepts and procedures before they can understand mathematics. Clarkson (2008) explains that teaching of mathematics is carried out in a particular language of instruction. This suggests that it is very important for learners to comprehend the language of mathematics for effective learning. The learners come from different backgrounds where by the language of instruction is second or third language and they are not familiar with the language of instruction. Early learning of learners which is influential is carried out in their home language so the teachers have to make sure the learners understand the language of instruction. The teachers and school have done little over the problem of language which has led to poor performance in mathematics. Vithal (2006) explains that mathematics is not the most prolific field to find such a language. This suggests that language in mathematics has to be first attended to in order for the learners to understand mathematics.

The generated data through one-on-one interviews indicate that applied mathematics is reduced to theory. Concentrating on theoretical mathematics is caused by certain factors like lack of resources and time. This suggests that the mathematics curriculum is not based performance/vertical curriculum. Bernstein (1999) suggests that content should be coherent and explicit. This suggest that neglecting the practical part makes curriculum not coherent and explicit affecting the attained curriculum. Mellin and Olsen (1993, p. 243) assert that “knowledge of possible applications of some mathematical knowledge and the application itself is not the same knowledge as the mathematical knowledge itself”. This suggests that learners deal with different kinds of mathematical content like statistics; and geometry but that “this variety is such that one form rarely can be reduced to another. Applied mathematics cannot be reduced to theoretical mathematics.” This suggests that applied mathematics is neglected concentrating on theoretical mathematics hence affecting attained curriculum.

Furthermore, the content learned is pitched highly and complex for the junior secondary since sometimes the learners do not understand. The content taught is complex and highly pitched not suitable for learners’ cognitive abilities. Briggs (2003) asserts that the placement of content, learning activities and learning outcome are crucial in the positively attained curriculum. Khoza (2015a) asserts that content learnt should be from lowest to highest order in the performance curriculum. In the performance/collection curriculum each subject is given its own identified content. When the content does not suit learners’ cognitive abilities sometimes the learners do not

understand the subject. This suggests that mathematics CAPS is not in line with vertical/performance curriculum which affects the attained curriculum.

4.2.4. How are you learning (learners' activities)? When are you learning mathematics (Time)?

All the participants were able to explain the learning activities in relation to time. They explained that each learning activity is allocated a specific time which is relevant and balanced.

Instructor

Participant A; "The teacher gives us instructions and tells us what to do. The teacher explains everything and just gives us the class work. Every day I learn mathematics ..."

Participant B; "I am always involved a bit when a teacher asks me to go search information for a project. Most times it is the teacher gives me instruction to follow. "

Both Participants A and B indicated that most mathematics lessons are teacher centred (instructor) and learner centred (facilitator). The teacher gives learners' instructions to follow and they are told what to do. The learners are, in most cases, considered passive recipients of knowledge in the classroom. While on the other hand, a learner centred approach is used when giving chance for them to explore their abilities.

From the findings teacher-centred approach makes learners receivers of knowledge hence making mathematics curriculum CAPS is line with the performance/vertical curriculum. Teacher-centred approach learner is regarded as empty vessels to only receive knowledge. Bernstein (1999) suggests that the teacher-centred and content-centred approach should be used in performance/vertical curriculum. In a vertical/performance curriculum the learner has little or control over content or the pace of learning. However, the teacher-centred approach makes learning mathematics a one way flow of information resulting in to boredom. Teacher-centred approach limits the learners from exploring their abilities. When the learner-centred approach is

used, learners are told to do their own research for the project. This gives them chance to explore their abilities and learn in democratic environment. Khoza (2013b); Hoadley and Jansen (2013) assert that identifying whether the curriculum is teacher-centred, learner-centred or content-centred approach helps enhances the positively attained curriculum which ensures good alignment to the attained curriculum. It is important for teachers to choose the relevant approach toward learning; in the behaviourist (teacher- centred) approach the lessons are based on aims and objectives; cognitivist approach the lessons are based on content; and in the constructivist approach lessons are based on learning out comes (Khoza, 2015b; Anderson & Elloumi, 2004).

Furthermore, the learners were not aware that the content approach was being used. Khoza (2015a) indicates that in the teacher-centred approach a lesson is driven by aims or objectives; in the learner-centred approach the lesson is driven by learning outcome; and in the content-centred approach the lesson is driven by content. Georgii-Hemming and Westvall (2010) assert that learners should not be receivers of knowledge but they should be involved creating ideas and exploring different abilities. This suggests that there should be interaction between the learners and teachers in order for effective learning to take place. In addition, the findings reflected the time allocated is enough and relevant to each teaching approach. This suggests that enough time was allocated for content coverage whereby effective learning was attained.

4.2.5. With what are you learning mathematics (Resources)?

Hard- ware

Participant A; “We have limited resources available for us in the classroom. These include calculators, charts and mathematical sets. Sometimes we are told to share among ourselves so each individual give little time to use.”

Participant B; “There are only a few resources we normally use in class. The available resources are not enough for all of us. Sometimes I end up not using any of it, an example text books, and computers. The computers that are provided I can’t use them because there is no electricity at school and some of them are not working...”

All the participants agreed with Participant A when claiming that available resources are limited. Sometimes, the available resources are not enough for those in the classroom. Armory (2010) explains that learning is not about technology (hard-ware or soft-ware) but is instead about the content (ideological-ware). This suggests that the learner should be able to identify ideological-ware resources in order to enhance the effectively attained curriculum.

The above findings from unstructured observation and one-on-one interviews indicate that participants were able to identify the hard-ware (mathematical sets, calculators, and computers). The resources available are not adequate to facilitates effective learning. The shortage of resources hinders effective learning there by affecting the attained curriculum. The use of resources is crucial for learning in that they facilitate the learning process. Khoza (2013a) identifies the three types of resources; hard-ware (any tool/machine used), soft-ware (materials used to mirror information), ideological-ware (invisible elements like theories). Arulsamy (2010) explains the importance's of resources in enhancing an effective attained curriculum. This suggests that the availability of resources ensures successfully learning of mathematics. Mathematical learning is affected since there is a shortage of resources. This suggests that the mathematics curriculum is not in line with the performance curriculum which in turn affects the attained curriculum.

Khoza (2012, p.75) asserts that “anything or person that communicates learning is called a resource.” Hoffer (1991) argues that learners need text books, equipment and specialised classrooms in which to learn mathematics. Learners need resources to making learning more interesting. Schools should be well equipped with resources in order to facilitate active learning. The shortage of resources hinders effective learning which affects the attained curriculum. In addition to the above the participants would not identify the soft-ware resources like computers, CD players and ideological ware like theories. The participants indicated that they don't understand the other types of resources that would be used. This suggests that CAPS is not in line with performance/vertical curriculum.

In addition, the findings indicate that no local/ traditional resources were used. All the resources used are westernised and learners are not familiar with them. The resources also arrived at school late in the year and could only be used for the following year which is too late for many learners. This affects learning and in turn affected the attained curriculum. Wemys (1999) argues that the lack of local resources affects the attained curriculum and ignores the local context. This suggests that if local resources are neglected then learning becomes irrelevant. Khoza (2013) asserts that learners learn effectively when they have experiences with resources that promote positive attitudes. This suggests relevant learning theories are crucial in order to ensure a positively attained curriculum. Learning is not about hard-ware or soft ware but it is about ideological ware (Khoza, 2013; Amory, 2010).

4.2.6. How are you assessed in mathematics (Assessment)?

Formative and summative assessment

Participant A; “I am given class work every day, two assignments, and one project a term. Sometimes we are given group work, mental work and few practical activities. I don’t get a feedback on time.”

Participant B; “I am given a class work regularly, monthly test and a test every end of term. Sometimes the teacher marks my work and sometimes not.”

From the accounts of Participant A and B, the learners are assessed through both formative/informal and summative/formal methods. Khoza (2015b) asserts that the formative assessment, learners are assessed for gathering crucial information whereas summative is the summary of formative assessment when learners are given grades. Formative assessment takes place during the learning period and for summative assessment is carried out at end of the lesson. Formative assessment is crucial in gathering relevant information during the learning process. It is crucial for learners to be assessed in learning outcome. Hoardley and Jansen (2013) explain that formative assessment develops the learning process by giving learners a lot of tests, class work

and projects which help them to be on track when learning. The feedback given to learners makes assessment to be transparent.

The findings indicate that peer assessment and continuous assessment are neglected. Kennedy, Hyland and Ryan (2005, p. 21) suggest that “continuous assessment is the frequency of repetitive summative assessment with recorded marks yet small or no particular feedback is given”. This indicates that the mathematics curriculum is not in line with performance/vertical curriculum. Bernstein (1999) suggests that assessment should be planned and specific performance criteria be used. Assessment aims towards giving the learners grades. This suggests that improved assessments will become a motivating tool which can improve learners’ performances. However, when the participants are not given feedback on time, they are unable to improve. According to Hoadley and Jansen (2013), formative assessment is crucial to the improvement of learners’ performance. This suggests that learners should be given feedback in order to enable them to improve their performance. Harrison, Lebler, Carey, Hitchcock and O’Byryan (2013) explain that the lack of clarity in assessment tools may lead to dissatisfaction of learners because they might feel that the assessment is unfair. This suggests that learners have to be told how they are to be assessed which will help them to improve the next time they are assessed. Khoza (2015b) and Ramsden (2003) indicate that assessment takes place at the beginning and end of the learning process. This suggests learners can be assessed in anything and any situation.

In addition to the above, findings indicate that self-assessment is neglected. McDonald and Boud (2010) assert that self-assessment is crucial to improving the life skills. If learners use self-assessments they apply it in their everyday lives and improve their skills. This suggests that if learners are not encouraged to apply self-assessment it affects the enhancement of skills and how to deal with life situations. Furthermore, the findings indicate learners are assessed with intention for grading and recording of marks ignoring the acquired skills.

4.2.7. With whom were they learning (Grouping)? Where were they learning (Location)?

Grouping and location are combined because they work hand-in-hand, although they are two different aspects when learning. These are the different views from different participants.

Diverse abilities

Participant A; “*We are many learners in class and grouped in big groups. Sometimes we are told to help those who are not doing their work.*”

Participant C; “*We are many in a class. Sometimes our groups are chaotic.*”

From the focus group discussion both participants A and C indicated that little attention is given to each group. Learners with different abilities are put in the same groups. From the semi-structured observation learners sometimes use the time to be playful when they are put in their groups. Feichas (2010) believes that a balance between the official classroom methods and the unofficial methods can help bridge the gaps created by mixed abilities within the classroom. This suggests official and unofficial methods should be emphasised in order to improve the learning process.

The generated data through unstructured observation indicates that participants with different abilities are put in groups which affect learning. The participants come from different backgrounds; some are good with mathematics others are not. These groups are mixed with gifted learners and ungifted learners. The ungifted learners are left behind because they need more attention which can hinder a positively attained curriculum. A group is crowded with many learners which makes them to be more playful and chaotic which hinders positive learning. Hoffer (1991) explains that the number of learners in a group affects learning which is influenced by the availability of different factors; resources, time and teaching methods. This suggests that learners should be put in small manageable groups in order to enhance effective learning. Since learners are grouped randomly it is easy to leave some of the slow learners behind.

Classroom

Participant B; “*I normally learn from the classroom most of the time. No other place apart from the classroom.*”

Participant C; “The learning space in the classroom is not enough. We are crowded in the classroom.”

From the focus group discussion all the participants agreed with Participant B in that they only learn in the classroom which is sometimes boring and can become monotonous. Mathematics classrooms should be specialised for learning mathematics and all the required resources are available in the classroom (Hoffer, 1991). All participants agreed with Participant C that the learning space is not large enough. They are crowded within one classroom which affects the learning.

The generated data indicates that learning mathematics is restricted to the classroom which makes CAPS not in line with performance curriculum. Bernstein (1999) suggests that learning should also take place outside of classrooms. This suggests that, for a positively attained curriculum, learning should be carried outside the classrooms in to spaces such as laboratories and other specialised rooms. In this study the learning space is small and not large enough for mathematics learners which negatively affected learning. Effective learning is determined by the available learning space. If the classrooms are crowded, then the learning activities and some teaching methods cannot be used. Shields (1993) states that the school environment is wide which facilitates or constrains classroom instruction and learning. The learning environment should be conducive in order to enhance effective learning. The learning environment should be quiet and comfortable for learners. The learning space for mathematics should be well equipped with adequate resources and a large enough learning space to achieve a positively attained curriculum. Coetzee (2009) explains that the learning space and availability of furniture can facilitate effective learning. This suggests that learning space should be large enough in order to enhance effective learning.

4.3. Conclusion

In conclusion, this chapter focused on the findings and discussion from the data generation. The generated data was developed from the themes of the curricular spider web. The data was collected,

discussed and transcribed. Generated data merged from the ten components of curricula spider web and each strand is strong as it weakest point. All concepts of the curricular spider web work hand-in-hand in order to achieve positively attained curriculum. The links between each component affect each other. The short fall in one component affects other components and each concept should be given equal attention in order to enhance effective learning. The findings indicated that curricular spider web meets the four levels of education: contains the ten components of the curriculum (relevance); all learners can apply it at certain level and fit setting for which they are design (practicality); all the ten components are crucial and are aligned (consistency); and policies can be applied in both vertical curriculum and horizontal curriculum (sustainability). The findings indicated a gap in the attained curriculum since certain components like content, grouping and resources are not given enough attention. Barriers like time and inadequate resources have hindered the attained curriculum. The next chapter will cover the main conclusions and recommendations.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1. Introduction

The previous chapter covered findings and discussions that emerged from themes of the curricular spider web. Generated data will help in developing the summary, conclusion and recommendation. This chapter will cover the summary, conclusions and recommendations as stated below. The following recommendations are derived from the findings made in previous chapters.

5.2. Summary

This study focused on the experiences of grade nine learners while learning mathematics. The study explored different experiences when teaching and learning mathematics. The findings of the study were driven by the ten components of the curricular spider web. According to the findings, the rationale has got biggest percentage with 35%, followed by assessment with 20% , content 10%, resources 5%, time 5%, location 5%, teacher role 5% , leaner's activities 5%. The figure below illustrates findings from the literature and data from the ten curricular spider web components.

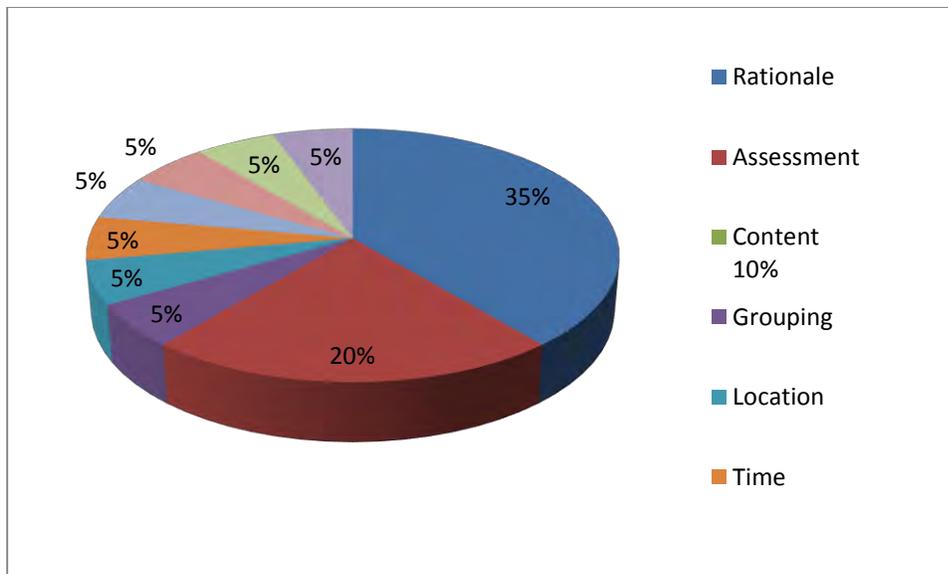


Figure: 6. Findings Coverage

Chapter one (introductory chapter)

Chapter one consists of the rationale behind the study. The study focused mainly on mathematics learning and learners' experiences. The study focused on the experiences of grade nine mathematics learners in junior secondary school. This chapter discusses the focus and the purpose of the study, objectives, research questions, literature review, research design methodology, data analysis, trustworthiness, ethical issues and the limitation of the study.

Chapter two (Literature review and conceptual framework)

Chapter two covered the literature review, focusing on mathematics within the related literature. It began with defining curriculum, curriculum representations, and competence curriculum versus performance curriculum. The curricular spider web and its concepts as the conceptual framework were discussed. The literature was driven by the ten concepts of the curricular spider web which include: rationale, aims and objectives, time, location, grouping, location, resources, teacher's role, teachers' activities and assessment. The literature illustrated how each component is crucial in the

attained curriculum. Each component is only as strong as the weakest point and neglect of any component affects the other components which create a gap in the attained curriculum.

Chapter three (Research design and Methodology)

Chapter three explained the research design and methodology. This study falls under the qualitative case study methodology and is framed by an interpretive paradigm. The case study as the research style was used at the junior secondary school. Three data generations methods were adopted in this study, that is to say; semi- structured observation, one-on-one semi- structured interview, and focus group discussion. Five participants (grade nine learners) were used in the study. Guided analysis was used to analyse data and trustworthiness was enhanced through credibility, dependability, transferability and conformability. Purposive sampling and convenience sampling was adopted in this study. Ethical issues and limitations of study were also discussed.

Chapter four (Findings and discussions)

This chapter presented the findings and discussions from the generated data. The findings were driven by the themes of the curricular spider web. Guided analysis was used to analyse the themes of the curricular spider web. The ten concepts were discussed in order to explore the experiences of grade nine learners as related to their learning of mathematics.

5.3. Conclusion

The conclusion was derived from the findings by following the concepts of curriculum spider web. The concepts are in line with the experiences of grade nine learners while learning mathematics at a secondary school.

5.3.1. Rationale

According to the findings, the rationale should be given more attention and made stronger to ensure positive attained curriculum. According to Berkvens, van den Akker and Brugman (2014) the rationale is divided into three main prepositions; personal development (personal reasons), knowledge development (content reason), and social skills development (societal reasons). The personal reasons should be emphasised this will enhance the passion and enthusiasm to improve the performance of mathematics. Furthermore, if societal reasons are encouraged this will increase the number of people with critical skills. In addition, content reasons will equip learners with the necessary knowledge, hence become professionals. The rationale should be given a stronger emphasis to effectively enhance attained curriculum. Hoadley and Jansen (2013) assert that school knowledge is important in performance curriculum. This suggests that learners should be encouraged and motivated to specialise in mathematics related subjects. Since South Africa is need of professionals like doctors and engineers, mathematics contributes to the holistic development of the learner by inculcating certain attributes and traits (Vithal, 1999).

5.3.2. Teacher's role

From the findings, the participants indicated that a mainly teacher-centred approach was used during lessons. The learning environment is not democratic enough to give learners a chance to participate. The learning is mainly dictated by the teacher. This has made learning not enjoyable and limits the learner's ability. According to Kidding (2014), teachers need to focus on their personal experiences, social experiences and the political dimensions of their school experiences in order to improve their teaching practises. This suggests that by focusing on their relevant theories it will help improve teaching methods, thereby achieving a positively attained curriculum. The teachers practised competence curriculum which has been driven by an outcomes based approach since 1998 (Khoza, 2015a). In the competence curriculum outcomes were more important than content which ultimately promotes more general knowledge than school knowledge.

5.3.3. Goals

The participants were unable to explain the intended learning outcomes. The learners' failure to interpret the intended learning outcomes is an obstacle in learning mathematics. The learners should be able to demonstrate, understand what to do at end of the lesson. Clarity of the learning outcomes should be made stronger in order to achieve effective learning (Donnelly & Fitzmaurice, 2005). The findings also indicate that the outcomes should be clearly stated to learners in order to enable them to understand what they are supposed to know at the end of the lesson. The learning outcome should be clearly stated so that the learners know what is expected of them at the end of the lesson. Khoza (2015b) urges that it is crucial for teachers to know Bloom's taxonomies of learning in order to ensure that the learning outcomes are generated effectively.

5.3.4. Content

It is crucial for a teacher to understand the content before teaching (Kelly, 2009; Hoadley & Jansen, 2013). This suggests that for an effectively attained curriculum, it is crucial for the teacher to be well versed with the content before delivering it to the learners. Content is divided into three prepositions; topics, experiment and subject knowledge. The findings reflected that the scope of content is too large and pitched highly for the grade nine learners. This has resulted in teachers not achieving learning out comes. The content of mathematics curriculum is more theoretical than practical which can make learning insignificant to learners. This type of curriculum allows more space for everyday/general knowledge than scientific/school knowledge. According to Hoadley and Jansen (2013), general knowledge acquired unplanned as it usually comes either from social conversations overheard or different hard-ware/soft-ware resources. It is usually based on people's opinions within a particular local context.

5.3.5. Assessment

The findings indicate that few assessment tasks are conducted, with the bulky being summative assessments since learners are assessed only at the end of the month, quarter or year. Hoadley and Jansen (2013) explain that there are three types of assessment; formative, summative and continuous assessment. Assessment is a crucial concept of learning and it needs to be strongly

attended to and carried out correctly. Kennedy, Hyland and Ryan (2006) indicate that in continuous assessment the process becomes a collection of different sets of summative assessment used in generating marks for grading learners without any feedback which helps the learners. There is small evidence of formative assessment carried out to achieve the intended learning outcomes. Monthly tests and term marks are continuous assessment and form part of summative assessment. Ramsden (2003) indicates that assessment is carried out when teaching and learning process is finished for teachers, while it takes place at the beginning of the teaching and learning processes for learners. This means that learners are tested by anything that is given to them while their teachers are sometimes not aware of this situation.

5.3.6. Resources

The findings indicated that there is a shortage of resources. The resources that are available are inadequate, implying that there are not enough for the learners. There is shortage of learners' text books and teacher's reference books which has hindered effective learning. The mathematical instruments are few or broken. Sometimes resources like textbooks are not delivered on time. The resources are often brought towards at the end of year which made them irrelevant for learning during the course of the year. Khoza (2015a) suggest that it is crucial for teachers to understand the ideological- ware before teaching and resources are crucial for an effectively attained curriculum. Resources provided are westernised and don't meet the learners needs. The resources can't be reduced to the local level which makes too abstract and uninteresting. The qualities of mathematical resources and instruments provided are of poor quality in that they don't last long enough to be useful. The computers that are provided can't be used since the school doesn't have electricity. The shortage of furniture results in some learners sitting on the floor, which makes learning uncomfortable.

5.4. Recommendations

Recommendation 1

The mathematics curriculum needs to be revised by redefining the rationale of the subject. The rationale should be relevant, practical, sustainable and consistent with all spheres of the subject. A revised rationale will help to enhance a positively attained curriculum. When the rationale is relevant, all the ten components of curriculum will be relevant and consistent at all levels of curriculum implementation. A comprehensible rationale will help determine the learning outcomes which in turn results in a sustainable learning process.

Recommendation 2

Teacher should be more involved in curriculum planning because it is the teachers who go to the classroom to deliver the content. The teachers will help in identifying the challenges they find in the subject. Teacher involvement will help in finding solutions to the challenges that are hindering effective curriculum attainment. Refresher courses and workshops for mathematics teachers should be conducted. This will help update teacher's on how to deliver the content to the learners and improve their assessment skills. From the findings, the learners are given less assessment tasks and feedback from tasks is not given on time. The workshops will help equip teachers with assessment skills by apply Blooms taxonomy when assessing learners. Employing qualified teachers for the mathematics subject will help in enhancing a positively attained curriculum.

Recommendation 3

Improved infrastructure, like enough learning space and furniture, will help to enhance effective teaching and learning. Some classrooms lack furniture like tables and chairs which makes it hard for some activities to be carried out. Creation of mathematics specialised rooms with proper storage facilities and fixed equipment will help institutionalise the subject and strengthen its position in the curriculum. This will also help preserve the little teaching time which is allocated to the subject.

Recommendation 4

There is need to redefine the content that suits the learners' cognitive levels. The content should be made relevant to learner interests and reduced to a local context. The taught content should emphasis practical skills than instead theory. This will only be successful if teachers are involved in curriculum planning. A department of education intervention is needed to supervise teachers more often in order to ensure there is good coverage of the content. Employing subject advisers to help teachers in areas they are not comfortable with is also recommended.

Recommendation 5

There is a need to change in the teaching approach to enhance effective learning. Content-centred and teacher-centred approaches should be made stronger in that learner involvement in the lesson is encouraged. The learner should have some control over content and the pace of learning. Learner involvement makes learning more interesting and increases the acquisition of skills. The study recommends grouping learners into small groups, according to their abilities. Grouping learners in big numbers sometimes disrupts learning and can lead to chaos. Big groups are hard for one teacher to manage and less attention is given to a group. Sometimes learners with different abilities are put together which affects effective learning. The teachers end up moving with the pace of fast learners which leaves the slow learners behind.

Recommendation 6

There is need for proper budget allocation for the resources for the mathematics curriculum. The resources should be properly budgeted for and delivered at right time. Learners' and teachers' text books will help enhance positively attained curriculum. A proper procurement method for mathematics books should be considered to ensure that the subject has enough text books. The text books should be secured on time whereby they can be used during the course of the year. Mathematical materials should be available in the right quantities so that there are enough material for the entire class. Sometimes, the mathematical instruments available are not enough for the whole class and the existing ones are broken. This hinders effective learning since some learners don't get the chance to use the mathematical instruments and are left behind when the teacher is teaching. There are no learners' text books and teacher's reference books provided that is relevant

to the proper context for learning. The lack of mathematical text books affects the attained curriculum which in turn affects other concepts of the curricular spider web like the teacher role, content and teaching activities. This affects the learning of the subject which leads to poor performance. The types of resources available are exotic which sometimes seems irrelevant to the everyday lives of learners. An increase in the indigenous resources can make learning easy and concrete for learners which bridge a big gap in mathematics learning. It also affects other curricular spider web elements such as time, grouping and content relevance.

5.5. Conclusion

This study focused on exploring the experiences of grade nine learners while learning mathematics. From the findings it is revealed that if one of the ten concepts of curricular spider web is neglected other concepts are in turn affected (Van Den Akker, 2009). The findings indicated that learning content should be given more attention in order to achieve a positively attained curriculum. The content should be reasonable and not pitched highly in order for learning outcomes to be achieved. The content of mathematics incorporates a specific language and teachers should make sure learners understand the language first, in order to achieve the learning outcomes (Zevenbergen, 2000). Another constraint from the findings is that inadequate resources hinder the achievement of effective attained curriculum. Resources are vital in the learning process in order to achieve an attained curriculum. Resources help to make learning more interesting and authentic. Khoza (2015b) asserts that a teacher should be able to understand the ideological-ware that drives the lesson. The mathematics curriculum meets four quality criteria such as: sustainability, relevance, consistency, practicality (Berkvens, van den Akker & Brugman, 2014). All in all, the mathematics curriculums can be improved if all the curricular concepts are taken seriously and worked upon. The curriculum should work from peripheral structure involving significant curriculum planners and promoting approach to curriculum growth. During curriculum planning the active participation of the curriculum planners, community and teachers will help in enhance a sustainable and improved curriculum.

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Appendix 1

White city,
P. o. box 148,
Umzimkulu,
3297.

16 February 2015

Dear sir/madam,

REQUEST TO CONDUCT RESEARCH

I am undertaking a research project on “**Experiences of grade nine mathematics learners in learning mathematics at a secondary school in Umzimkhulu**”. I kindly request to carry out research in vumanzonke combined school therefore, it will be highly appreciated if you could this document, sign the declaration below and email it as an attachment to my email address mutesireen@yahoo.com.

The research is influencing the ways in which people are being educated and trained. South Africa, like any other developing countries, is forced to conduct studies of this nature in order to critically evaluate and improve educators’ methods. Therefore, this study aims at providing valuable information on experiences of grade nine learners in learning mathematics.

Please take note of the following issues

1. There will be no limit on any benefit that the participant may receive as part of their participation in this research project.
2. Answer all the questions
3. Respond to each question in a manner that will reflect your own personal opinion;
4. Your indentify will be not be divulged under any circumstances;

5. All your responses to will treated with strict confidentiality;
6. There will be no right or wrong answer;
7. No audio or video recording will be made.
8. If they are willing to be interviewed, they will indicate whether or not they are willing to allow the interview to be recorded by the following equipment:

:	Willing	Not willing
Audio equipment		
Video equipment		
Photographic		

I can be contacted by:

Email: mutesireen@yahoo.com

Cell: +2778 82 1148

My supervisor is Dr. SB Khoza who is located at the School of Education, Edgewood campus of the University of KwaZulu-Natal.

Contact details:

Phone number: +2731 260 7595

Email: khozas@ukzn.ac.za

Discipline Co-ordinator is Dr. LR Maharajah, Curriculum Studies, School of Education, Edgewood College, University of KwaZulu-Natal Tel (031) 260 2470 Cell: 082 202 2524

Email: maharajhrlr@ukzn.ac.za

You may also contact the Research Office through:

P. Ximba

HSSREC Research Office,

Tel: 031 260 3587

E-mail: ximbap@ukzn.ac.za

Thank you for your contribution to this research.

DECLARATION

I (Full names of principal) hereby
confirm that I understand the contents of this document and the nature of the research project, and
I consent the researcher to undertake the research project in my institution.

SIGNATURE

DATE

.....

Appendix 2

White city,
P. o. box 148,
Umzimkulu,
3297.
16 February 2015

Dear Participant,

INFORMED CONSENT LETTER

My name is Mutesi Maureen. I am a Curriculum MEd candidate studying at the University of KwaZulu-Natal, Edgewood campus, South Africa. I am undertaking a research project on **“Experiences of grade nine mathematics learners in learning mathematics at a secondary school in Umzimkhulu”**. I kindly ask if you would take part in this project by answer some questions. It will be highly appreciated if you could this document, sign the declaration below and email it as an attachment to my email address mutesireen@yahoo.com.

The research is influencing the ways in which people are being educated and trained. South Africa, like any other developing countries, is forced to conduct studies of this nature in order to critically evaluate and improve educators’ methods. Therefore, this study aims at providing valuable information on experiences of grade nine learners in learning mathematics.

Please take note of the following issues

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2. Answer all the questions
3. Respond to each question in a manner that will reflect your own personal opinion;
4. Your indentify will be not be divulged under any circumstances;

5. All your responses to will treated with strict confidentiality;
6. There will be no right or wrong answer;
7. No audio or video recording will be made.
8. If they are willing to be interviewed, they will indicate whether or not they are willing to allow the interview to be recorded by the following equipment:

:	Willing	Not willing
Audio equipment		
Video equipment		
Photographic		

I can be contacted by:

Email: mutesireen@yahoo.com

Cell: +2778 82 1148

My supervisor is Dr. SB Khoza who is located at the School of Education, Edgewood campus of the University of KwaZulu-Natal.

Contact details:

Phone number: +2731 260 7595

Email: khozas@ukzn.ac.za

Discipline Co-ordinator is Dr. LR Maharajah, Curriculum Studies, School of Education, Edgewood College, University of KwaZulu-Natal Tel (031) 260 2470 Cell: 082 202 2524

Email: maharajhlr@ukzn.ac.za

You may also contact the Research Office through:

P. Ximba

HSSREC Research Office,

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Thank you for your contribution to this research.

DECLARATION

I (Full names of principal) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent the researcher to undertake the research project in my institution.

SIGNATURE

DATE

.....

Appendix Three

Interview questions

The following are the interview questions to be answered in order to explore the experiences of grade nine mathematics learners. The study will help to check if the grade nine learners understand mathematics curriculum (CAPS). The questions were driven by ten component of the curricular spider thereby helping to explore different experiences of grade nine mathematics learners. The participants (learners) will be answering the questions following the concepts of the curricular spider. The participant views will help to clarify if the mathematics curriculum is in line with Curriculum Assessment Policy. The interview interviews will be driven by the ten components of the curricular spider web as listed below;

1. Why are you learning mathematics (Rationale)?
2. Towards which goals are learning mathematics (Aims and Objectives)
3. What are you learning in mathematics (content)?
3. When are you learning mathematics (Time)?
4. How are you learning mathematics (learners' Activities)?
5. With what is learning mathematics (Resources)?
6. With whom are you learning mathematics With (Grouping)?
7. Where are you learning mathematics (Location)?
8. How are you assessed in mathematics (Assessment)?

Appendix Four

Semi- structured Observation Schedule

Information

Name of the participant: _____ Time: _____

Date of Observation: ____/____/2015 Place: _____

Subject/Lesson: _____

Main scheduled observation aspects

1. Do the learners understand the mathematics content (content)?
2. Are the learners involved in mathematics activity (learners' Activities)?
3. Are the resources enough and utilised (Resources)?
4. Which teaching method is used when learning mathematics (Teachers' Role)?
5. Which method of assessment is used in mathematics (Assessment)?

Extra information from Observation

Appendix Five

University Ethical Clearance

