A Comparison between the Contexts learners in Grades 8, 9 and 10 prefer for Mathematical Literacy

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Abstract

The use of contexts in school mathematics is receiving much attention both nationally and internationally. This as well as the scarcity of research focusing on the topic stimulated me to research the contexts preferred by learners of mathematics. The large-scale project is called the Relevance of School Mathematics Education (ROSME) project. The current study essentially deals with that section of the larger project which investigates the issues and situations that learners in grades eight, nine and ten would prefer to deal with in mathematics.

Broadly, this study focuses on the contexts preferred by grade 8, 9 and 10 learners as a domain in which to embed school mathematics. This study aims then to explore if there are differences in the contexts preferred by grade 8, 9 and 10 learners. The data were subjected to nonparametric statistical analysis.

The analysis rendered that across the grades learners expressed a high preference for dealing with mathematics which would allow them access to mathematics at tertiary institutions and mathematically related careers. The analysis also show the mathematics cluster as the most preferred and the agriculture cluster as the least preferred contextual domain the learners in all the grades are interested in learning about in mathematics. There also seem to be agreement across the three grades with regard to their interest in the health cluster, political cluster as well as the cluster dealing with fiscal issues and social upliftment. The item dealing with the 'mathematics of a lottery and gambling' achieved the status across all three grades for being ranked the least preferred.

The significance of this study is that it provides some insight into what learners prefer as contexts for learning mathematics which might enhance mathematics teaching and learning.

DECLARATION

I declare that *A Comparison between the Contexts learners in Grades 8, 9 and 10 prefer for Mathematical Literacy* is my own work, that it has not been submitted before for any degree or examination in any other university, and that all the sources I have used or quoted have been acknowledged by complete references.

M.S. Barnes November 2006

Signed: ....

ACKNOWLEDGEMENTS

To be a responsible, respected and reflective citizen, particularly in this age of information technology explosion, one needs to be mathematically literate to be able to make informed decisions and judgements about the issues affecting our lives. I felt that I could contribute in a small way in helping learners become mathematically literate. This desire, as well as the lack of research dealing with relevance of mathematics to everyday contexts prompted me to pursue this study.

I thank God Almighty for inspiring me to pursue this study and to successfully complete it.

Many people deserve my sincere gratitude and appreciation for the assistance they provided in the completion of this study. Due to limited space, I can only mention a few.

Professor Cyril Julie, my supervisor, has nurtured and shaped my views about life in general, but more specifically about my practice as a high school mathematics educator. His patience and willingness to advise me whenever I requested assistance is admirable and speaks volumes about a man eager to make a difference to society as a whole, but more specifically to the socio-economic poorer sect of society. Without his concerns, advice and assistance, this study would not have been completed. I sincerely thank you Professor Cyril Julie.

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I also need to express my gratitude to my wife, and my three daughters for the support they offered me throughout this study.

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Soli Deo Gloria

TABLE OF CONTENTS

LIST OF TABLES

KEYWORDS

Mathematical Literacy

Contexts in Mathematics

Mathematical Modelling

Relevance of Mathematics

Learners' interest in Mathematics

CHAPTER ONE

INTRODUCTION

1.1 Background

The twenty-first century is fast becoming known as the century of information technology. To be a responsible, respected and reflective citizen, particularly in this age of information technology explosion, one needs to be mathematically literate to be able to make informed decisions and judgements about the issues affecting our lives.

I have been a high school mathematics teacher for eighteen years. Learners, teachers and parents have largely come to believe that mathematics is the most difficult school subject. I have seen how some learners, who are 'weak' in mathematics developed a low self esteem, became demotivated, lost interest in mathematics and in many cases opted out of mathematics. The most common question that many of my learners ask is: "Where or how do we use school mathematics in our daily lives?" I sensed the dissatisfaction of many of my learners with regard to the content of the subject of mathematics.

So, over the years I noticed negative attitudes from learners, parents and even fellow teachers towards the subject mathematics. The Times Educational Supplement (1997) reported that people have negative images of mathematics. For example mathematics is perceived to be difficult, cold, abstract and in many cultures, largely masculine. In this article, a female mathematics graduate commented that: "The school department was predominantly male and seemed to hold the opinion that female teachers shouldn't be teaching maths. These teachers were making my life unbearable".

Cockcroft (1982) states that half of the members of the public in the U.K. who were interviewed on the street immediately declined and walked away when they learnt it was about mathematics; indicating a negative reaction. Kloz (1996) claims that the mathematics profession is the most misunderstood in all of the academia. He also claims that the public have the perception that mathematicians ponder on ancient proofs and are isolated and have many of the characteristics associated with that of a scientist.

Reasons mentioned by my learners for disliking mathematics are:

1) Mathematics is very difficult:

   Many learners switched off from mathematics because they felt that the hurdle of "the difficulty of mathematics" was too high to cross. Hence they developed a low self esteem. Incidentally some learners enrolled for mathematics because they saw the issue of "difficulty" as a challenge whereby they could get complete satisfaction out of the mastery of the subject.

2) You must be clever to do mathematics:

   Many of the learners believe that one must be "clever" to do mathematics. They feel that you need to be clever to overcome the "difficulty" barrier.

3) Mathematics is for males:

   Many of my learners are male. There was a feeling amongst them that male learners are more able to overcome the "difficulty" barrier and achieve mastery of the subject than females. Many female learners therefore steer away from the subject. I am of the opinion that this view stems possibly from the notion that traditionally high school mathematics teachers and mathematicians are generally males.

4) Mathematics is "caged":

   Some learners feel there is no relevance in school mathematics. They feel that it is not applied in their daily lives and is left caged at school. Many learners feel that mathematics is a boring subject because the work done in class is devoid of real life contexts.

There are propositions and speculations about the causes leading to the negative and unpopular images of mathematics. Teachers' attitudes, the formal nature of most mathematics teaching, the seemingly lack of relevance of mathematics to everyday contexts, are some of the possible causes. It is because of this as well as the apparent dearth of research focussing on the contexts preferred by learners of mathematics that this study, the Relevance of School Mathematics Education (ROSME) project was embarked upon. The study essentially deals with the issues and situations that learners would prefer to deal with in mathematics. This appears to be a topic that is relatively under-researched. In this regard my study supervisor advised that we conduct web searches using key phrases like "learners and contexts in mathematics", "students and contexts in mathematics", "pupils and contexts in mathematics", "issues learners are interested about in mathematics", etc. to study and view literature related to this topic. These keywords rendered no hits. When the database MathDi was searched using general phrases like "mathematics and contexts" it rendered almost 700 hits. However those articles did not deal specifically with the learners' preferred contexts in mathematics. The study by De Bock, Verschaffel, Janssens, Van Doorn, and Claes (2003) refers to the effect of contexts on learner achievements in mathematics whereas the study of Edwards and Ruthven (2003) focuses on learners' identification of mathematics in everyday activities.

These studies and numerous others do not, in essence, capture the use of contexts in school mathematics. It is this lack of research dealing with relevance of mathematics to everyday contexts that prompted me to pursue this study.

1.2 Purpose

Broadly, this study focuses on the contexts preferred by grade 8, 9 and 10 learners as a domain in which to embed school mathematics. This study aims then to explore if there are significant differences in the contexts preferred by grade 8, 9 and 10 learners.

1.3 Motivation

Other studies in the literature focused on learner's interest in mathematics, but this study focuses on the contextual situations learners would find interesting to deal with in mathematics or mathematical literacy.

Worldwide the issue of relevance in mathematics, in an information technology-driven society, where human beings are more and more required to make informed judgements and decisions, is gaining momentum. Relevance in this sense refers to a kind of mathematics that empowers the general public to cope with life in this modern society. The notion of relevance of mathematics is closely linked to Mathematical Literacy. Mathematical Literacy deals primarily with contexts and there is a huge need for people to apply mathematical knowledge and skills to real life or to mathematise contextual situations.

The quest to improve the school mathematics curriculum by adding current contexts to make it more relevant and applicable to real-life situations is very high on the agenda of education authorities worldwide.

Niss (1996: 16) stated the following aims of mathematics education:

> Exterior aims:
>
> - to provide substantial mathematics education for all, and not only to the future members of society's intellectual or social elite, while emphasizing that mathematical competence, in some form or other, is available to everyone;
> - To provide opportunities for differentiated teaching and learning to the individual learner, while paying attention to his or her personal background;
> - To emphasize participation and co-operation amongst learners in dealing with collective tasks related to mathematics;
> - To assess pupils' mathematical potential, achievement and performance in ways which are in accordance with the higher order goals of mathematics teaching and learning.
>
> Interior aims:
>
> - To focus on the needs and interests of the individual learner, in order to prepare him or her for active participation in all aspects of private social life, including active and concerned citizenship in democratic society;
> - To develop pupils personalities by engendering or enriching self-respect and self-confidence, independent and autonomous thinking (including logical thinking), the development of explorative and research attitudes, linguistic capacities, aesthetic experience and pleasure, etc.
> - To emphasize pupil's mathematical activity rather than their passive acquisition of knowledge
> - To emphasize mathematical processes (such as exploration, investigation, conjecturing, problem posing/formulation/solving, representing, proving, modelling) and not only products (concepts, results, methods, skills);
> - To foster mathematical thinking and creativity, while emphasizing that mathematics is a living subject resulting from human activity and from continuing efforts of humankind over five millennia;
> - to enable pupils to identify, pose, formulate and solve mathematical problems, whether pure or applied, whether closed or open;
> - to enable pupils to understand and appreciate the special nature of mathematics;
> - to enable pupils to apply mathematics to extra-mathematical situations by means of models or modelling;
> - to enable learners to critically analyses and judge uses of mathematics (their own as well as others') in extra-mathematical contexts;
> - to provide students with an impression of and insight into the role of mathematics in society and culture;
> - to make pupils familiar with current information technology in relation to mathematics

If one analyses these aims carefully, one would notice that there is an attempt made at putting greater emphasis on a context-driven, socially relevant mathematics curriculum which promotes individuals who could function as critical and participating citizens. If one looks closely at the aims of the subjects Mathematics and Mathematical Literacy (in South Africa), nearly all of the above mentioned aims are embedded in the Revised National Curriculum Statement (2002). Niss (1996) also stated that there should be a focus on the needs and interests of learners in order to prepare them for active participation in all aspects of private social life, including active and concerned citizenship in a democratic society.

The twenty-first century demands a high level of mathematical literacy, which involves mathematics in context. An international mathematics test such as the Third International Mathematics and Science Study (TIMMS) have shown that South African learners performed poorly if compared to their counterparts from other countries. This indicates the need for the mathematics curriculum to be overhauled. A process in this direction was started in the early seventies which is known as Realistic Mathematics Education (RME). RME was developed by Freudenthal (1973, 1978) as a method of mathematics education that uses contexts from either the real or abstract world and emphasises that mathematics is relevant to society and thus has human value.

In a country like Japan, whose learners performed very well in international comparative mathematics tests, Nakagomi (2000, 746-751) reported the following:

> In the TIMSS, junior high school students in Japan were placed third among participating countries, yet 47 percent of the students reported that they dislike mathematics. That percent is much higher than the international average of 32 percent who claimed to dislike the subject. Even though comparative scores are very good in Japan, why do many students dislike mathematics? One reason could be that mathematics classes may not be taught in an interesting way. A second reason may involve students who have been unable to continue getting good grades. They may have fallen behind, and Japanese

> students are negative about their own grades dropping. As a junior high school mathematics teacher in a public school, I speculate that an additional problem may be students' inability to adequately express their opinions. Perhaps students are passive because lessons emphasize solution methods and recall of knowledge, whereas students are rarely asked to put their knowledge to use in creative ways.

A country like Japan, whose results in international mathematics tests is one of the best in the world still have many learners that dislike mathematics. It appears as if the issue of learners' interest is at the core of this state of affairs in Japan. It is also the case in South Africa.

A question that arises is what are the interests of learners and how can such interests be included in their school experiences? Hidi and Ainley (2002: 20) reported on the importance of academic interest and its relationship to academic achievement by stating that "individual interest is hypothesized to be a relatively enduring predisposition to attend to certain objects and activities, and is associated with positive effect, persistence and learning".

Interest is a person-object relationship that is characterized by value, commitment and positive emotional valences and thus the role of interest is particularly relevant in mathematics because it is perceived as a very difficult subject in which motivational factors are very important for enhancing academic achievement (Köller, *et al.*, 2001).

The overall correlation between interest and academic achievement according to Schiefele (1992: 151-182) was about 0.30. This indicates that there is a moderate correlation between interest in mathematics and achievement. However, we need to be vigilant of the fact that there is a very clear distinction between "interest in mathematics" and "interest in the contexts used in mathematics". This study therefore aims to explore learner's interest in the contexts used in mathematics. I think the need for such an exploration is critical given that South African learners performed very poorly in an international comparative mathematics test such as TIMMS (Mullis, *et al.*, 2004).

In South Africa and many other countries, including those countries whose learners achieved high scores in the international comparative mathematics tests such as TIMMS, learners express difficulty in translating their mathematical knowledge to real-life contexts. In highlighting the application of mathematics in Korean high schools, Kim (2006:12) speaks about this difficulty by stating the following:

> The application of mathematics to real-life contexts in the intended mathematics curriculum can be classified into four categories, depending on the amount of emphasis placed: "a lot of emphasis", "some emphasis", "very little emphasis" and "no emphasis". Under this classification system, Korea was placed in the "some emphasis" category. The results of TIMMS (Mullis, *et al*, 2004) shows that Korean learners' average for the application of mathematical knowledge in solving problem situations of everyday life is still very low (17%) in comparison with the international average of 44%. This implies that Korean mathematics education puts more emphasis on computation and algorithmic skills, and the lack of understanding of real-world situations has led Korean learners to have difficulties adapting their mathematical knowledge to real-world situations.

The results of TIMMS (Mullis, *et al*, 2004: 25) in relation to South Africa show the following:

> The mathematics score profile for South Africa indicates that there are very few high performing mathematics learners at grade 8. The implication of this is that there would be very few learners graduating from the system with results in mathematics good enough to permit access to tertiary studies in the science and engineering fields. South Africa has committed itself to a science and technology pathway for the development of the individual and the social and economic development of the country. In order to achieve those goals, the country would have to achieve higher performance in mathematics at the lower levels of the schooling system.

In an attempt to address this problem, the South African National Education Department has introduced a subject called Mathematical Literacy in 2006 into the FET school curriculum. A key feature of this subject is that it is to a large extent context-driven. However, one cannot claim that dealing with contexts in Mathematical Literacy will completely remove or alleviate the difficulties learners experience with mathematics. On the contrary, it might just create a new and different set of challenges. In almost all cases the designers of mathematical learning resources (policy makers, curriculum designers, text book writers, etc.) are all adults and use contextual situations which they perceive to be beneficial for the learners' individual, societal, current and "futuristic' needs. There is nothing wrong with such a process, since the expertise of adults place them in a position to make those decisions. However, it will be extremely important and valuable for these designers of mathematical learning resources to have a sense of the contexts which learners will find interesting to deal with in the school mathematics curriculum.

1.4 The Structure of This Thesis

Chapter 2 deals with the literature review. It sets out the reasons why a study of this nature was undertaken against current ideas and developments in the subject field of mathematics education. It explains contexts in mathematics education by first defining relevance of mathematics. It then introduces the topic of mathematical literacy by first tracing its origin and then exploring current literature and trends on this topic. Chapter 2 then concludes by focusing on how relevance of mathematics and mathematical literacy is incorporated into mathematical modelling. Chapter 3 deals with Methods. It gives the reasons why a survey research format was used for this study and describes the sample. The method of data collection included a questionnaire. It gives the background and description of the learners and schools sampled. It goes on to provide the data that were needed for analysis. Chapter 4 explain data analyses, present the research data and provide, interpret and describe the data. In chapter 5 meaningful conclusions and suggestions are made. Chapter 5 also looks at the shortcomings of this study and concludes with recommendations for future exploration.

1.5 Conclusion

This chapter dealt with the background, purpose, motivation and structure of this thesis. In an international comparative mathematics test such as TIMMS, South African learners performed quite poorly. It appears as if learners' interests in mathematics are negatively affected because of a curriculum that is void of real-world contexts. It is with this in mind that an attempt is made at exploring literature related to the relevance of school mathematics, mathematical literacy and mathematical modelling, which is explored in the next chapter.

CHAPTER TWO

LITERATURE REVIEW

As mentioned in chapter one, this study focuses on the contexts which grades 8, 9 and 10 learners prefer to deal with in learning mathematics. In chapter one it was also described how applications of mathematics in real-life situations brings to the fore the notion of relevance. These are all issues which are in some way or the other linked or related to mathematical literacy. The concept of mathematical literacy that has its focus primarily on the application and modelling of mathematics has gained so much attention that international studies such as the TIMMS, which previously focused on the 'pure' testing of curricular bound knowledge are now aiming more and more to test the functional application of mathematics in the context of the real world. In this chapter an attempt is made at linking mathematical relevance, mathematical literacy and mathematical modelling in a structured and coherent way in order to draw evidence from it that could be useful in answering my research question. The focus of this chapter will therefore deal with relevance and how it links up with mathematical literacy and mathematical modelling.

2.1 Relevance of Mathematics

Over the 18 years that I have been a high school mathematics educator, I can single out one question most commonly asked by my learners and that is: "Where or how do we use school mathematics in our daily lives?" On careful reflection of this question, one gets a sense of learners begging teachers, government, industry, business, etc. to:

i) sit down and discuss with them their likes and dislikes of mathematics as it is taught in schools.

ii) hear from them what they would like to see in the school mathematics curriculum.

iii) introduce a school mathematics curriculum that is relevant

iv) introduce a school mathematics curriculum that would include contexts that learners prefer to deal with in mathematics.

Choike (2000) recommended that teachers should mould lessons, whenever it is possible, around the interest of individual learners. He describes the following situation which occurred in a grade9 algebra class in a high school in a suburb of the inner city in the USA. Learners in this class were presented with the following performance-based guided-exploration task:

> A farmer had 24 yards of fencing. What are the dimensions of a rectangular pen that gives his sheep maximum grazing area? All students were equipped with the necessary resources. Students were enthusiastically involved in this problem and were busily drawing sample rectangular pens on grid paper and noticing that the pens could be constructed in many ways. All students were engaged, that is, except for one young lady who had quietly detached herself from her group. She preferred, instead, to focus on her grooming. She fluffed her hair and checked her eye shadow and her nail polish. When asked why she was not interested in the problem, she commented respectfully, yet honestly, that she could not care less about sheep in a pen. The teacher discovered that the student liked flowers, in particular red roses. Homing in on this volunteered interest, the teacher restated the problem for Maria as follows:

> Maria has 24 yards of fencing, which she can use to make a rectangular garden for growing red roses. Each rosebush needs space to grow. A one-yard-one-yard square gives the rosebush sufficient growing room. What dimensions will allow her to plant the maximum number of rosebushes in this rectangular garden? With this new setting, tailored to Maria's interest in roses, Maria smiled delightedly at the teacher and became involved in the activity (Choike, 2000)

The quotation above clearly indicates the importance of relevance. The relevance of mathematics is topical in the literature on mathematics education. The Collins English Dictionary (1992) describes the word relevance as "having direct bearing on the matter at hand, pertinent". If we use this definition, then relevant school mathematics would mean: mathematics that has a bearing on the sector/area which the mathematical problem/question relates to. It would also embrace the idea of what learners' interests are, particularly in relation to the subject of mathematics. Cameron Dugmore (2005), the Minister of Education of the Western Cape Province of South Africa stated the following about mathematical relevance:

> The government's position pertaining to relevancy is to increase the number of learners to take Mathematics on the Higher Grade in order to live with the increasing demands of our increasingly globalised economy and technological nature of society. (Dugmore, 2005)

Government, learners, parents, teachers, industry, and business have expressed the need for mathematics to be relevant. Since all these stakeholders want the mathematics curriculum to be relevant, the focus questions to be answered must therefore be: Who decides what mathematics is relevant? When is school mathematics relevant? In trying to answer these questions, Carol Damian, in her article "It's About Relevancy" (2001), stated the following:

> Recently, I was chatting with 15 young people and asked them why a person should study math in school. They gave reasons as being well-rounded, getting into college, challenging oneself, being with friends in classes, and choosing courses taught by teachers they like. Then I probed further by paraphrasing the two big questions: "Do you think you'll ever use that stuff? Why should you have to learn all that maths?" Some of them mentioned things like balancing cheque books, converting litres to gallons at the gas pump and learning how to make slime.
> "Well", I asked, "do you suppose anything you're learning in maths and science will ever come up in your everyday lives or in your future jobs?"
> "Yes", one girl answered, "like when you change a bunch of stuff on your credit card and find you'll never be able to pay it off at the humongous interest rate." I asked them if any of their classes prepared them for that kind of real-life shock. They all said they were not sure because the lessons seemed disconnected from anything real.
> I asked the two big questions again, "When will you ever use that stuff? Why learn all that math and science?" They thought a while, talked among themselves, then started rattling off these "reasons": banking/borrowing money, product consumer, family planning, waste disposal, car purchases (and energy/pollution concerns), transportation systems, global warming, safety, medicines, genetic engineering, politics, defence, issues, earthquakes, usable water, food supplies, weather changes, materials for building and clothing, disabilities, understanding numbers and problem-solving, communication, computers, and information gathering.I was fascinated. These students were quite capable of answering their own questions. More than that, they were defining what it means to be literate in mathematics and science. They were closing in on what is relevant in maths and science in their lives now and in the future.
> When students ask you the two big questions, ask them to help you think through the answers. As they respond, they will realise how important mathematics and science literacy is to all of us. (Damian, 2001)

In the quotation above Damian aptly probed what learners perceived to be relevant in mathematics. Many of the answers given by students in Damian's study were used as items in the Relevance Of School Mathematics Education (ROSME, 2005) questionnaire which formed part of my study. More detail about this ROSME questionnaire will be given in chapter 3 which deals with the research methodology employed in this study. The use of arithmetic and the display of information by means of graphs are everyday practices. These are elementary aspects of the use of mathematics. Advanced mathematics is widely used, but often in a concealed way. In short, the relevance of mathematics involves both the various applications of mathematics and the position of mathematics in the spectrum of human values. It has been reported that learners have problems relating their well-developed manipulative skills to realistic context problems in real-world situations, as secondary mathematics lessons put much emphasis on computation and algorithmic skills (Boyce, 1994). According to Boaler (1993:14), there are two reasons for learning in contexts:

> …one concerning the motivation and interest of learners through an enriched and vivid curriculum, the other concerning the enhanced transfer of learning through a demonstration of the links between school and mathematics and real world problems.

How then do we start to address the issue of relevance? In an attempt to do this, Romberg asserts that the emphasis should be on "mathematical knowledge put into functional use in a multitude of different situations and contexts in varied, reflective and insightful ways" (2001: 5). If, according to Romberg, the emphasis should be on "mathematical knowledge" then by implication it means society must be mathematically literate. While literacy is the foundation of all learning, mathematical literacy would therefore be necessary if we are to understand fully the information that surrounds us in modern society. A fundamental aim of any country is to prepare its citizens for the future to fulfill various jobs and functions within that society. It is therefore important that decisions are made by taking into account the relevant contexts under which the country's needs are fulfilled. Because mathematical literacy is vital if we are to understand fully the information that surrounds us, my focus will now change to mathematical literacy.

2.2 Mathematical Literacy

Mathematical Literacy was introduced during the 1980's and is thus a fairly new term.It was introduced more than 20 years ago so although it is not a very old term, it only really surfaced in our schooling system as a school subject in the current year (2006). Hence it is topical as a result of its recent introduction into schools in South Africa.

Whilst numerous attempts were made to aptly define what mathematical literacy is, there is currently agreement that mathematical literacy cannot be defined in terms of mathematical knowledge alone and that it must also focus on individual competencies in using mathematical knowledge in a practical and functional way. The National Department of Education of South Africa (2005: 7) describes mathematical literacy as follows:

> Mathematical literacy is to provide learners with an awareness and understanding of the role that mathematics has to play in the modern world. Mathematical literacy is a subject driven by life-related applications of mathematics. It enables learners to develop the ability and confidence to think numerically and spatially in order to interpret and critically analyse everyday situations and solve problems.

The OECD Programme for International Student Assessment (PISA) (1999: 41) defines mathematical literacy as:

> …an individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded mathematical judgements and to engage in mathematics in ways that meet the needs of that individual's current and future life as a constructive, concerned and reflective citizen.

Mathematical literacy also implies the ability to pose and solve mathematical problems in a variety of situations, as well as the inclination to do so, which often relies on personal traits such as self confidence and curiosity (Bussiere, 2004: 86). On a daily basis, people are faced with demands which requires mathematical problem solving skills in order for them to handle the issue at hand with confidence and self-belief. Many times these demands relate to investments, hire-purchase, interpreting issues in newspapers, etc.

According to Doyle (1994: 23) mathematical literacy is driven by real-life contexts and should take a high priority in the learning and teaching of mathematics. He also asserts that teachers of mathematics need to change their teaching strategies to accommodate the interests of their learners. Jablonka (2003: 75-102) is of the opinion that mathematical literacy entails a broader approach of mathematics with the understanding that the target audience is a group of individuals with a sound educational background. The National Council of Teachers of Mathematics (NCTM) (1989: 5) is of the opinion that mathematical literacy should focus on the following five processes:

i) Valuing mathematics

ii) Becoming confident in one's ability to do mathematics

iii) Becoming problem solvers

iv) Communicating mathematically

v) Reasoning mathematically

The PISA-study describes mathematical literacy in terms of its application to real world contexts. The PISA-study also asserts that mathematical literacy is assessed by giving students 'authentic' tasks – based on a situation which while sometimes fictional, represent the kinds of problems encountered in real life (OECD 1999: 23). The National Curriculum Statement of South Africa (National Department of Education, 2005: 7) states that the purpose of mathematical literacy can be summarised as follows:

1) Mathematical literacy provides learners with opportunities to engage with real life problems in different contexts and so consolidate and extend basic mathematical skills.

2) Mathematical literacy will equip learners with the ability to understand mathematical terminology and make sense of numerical and spatial information communicated in tables, graphs, diagrams and texts.

3) Mathematical literacy will, furthermore, develop the use of basic mathematical skills in critically analysing situations and creatively solving everyday problems.

4) Mathematical literacy enables the learner to become a self-managing person, a contributing worker and a participating citizen in a developing democracy.

i) A self-managing person must be equipped with mathematical literacy for everyday life including financial issues, the efficient use of ratio and proportion in cooking and use of medicine.

ii) A contributing worker in the workplace requires the use of fundamental numerical and spatial skills to deal with work-related formulas, read statistical charts, deal with schedules and understand instructions involving numerical components.

iii) A participating citizen in a developing democracy must have the ability to understand mathematical arguments and statistics presented in the media and other platforms. In the information age the power of numbers and mathematical ways of thinking often shape policy.

2.3.1 Realistic Mathematics Education

As a method to enhance mathematical literacy, 'Realistic Mathematics Education' (RME) have been developed. The focus of RME is mathematics in context. In the early seventies a method of mathematics using contexts from either the real or imaginary world was developed in the Netherlands. This is known as Realistic Mathematics Education (RME) and it was developed by Freudenthal (1973, 1978). RME was developed in reaction to the "New Math" movement (often labelled as mechanistic mathematics education) which was based on the theory of fundamental mathematical structures, but which ignored the application to social problems, the value of education and the individual's capacity. Freudenthal (1973, 1978) sees mathematics as a human activity which has a relationship with reality and which is relevant to society and thus has human value. Freudenthal (1973) also stresses that mathematics education is an activity called mathemitization which is a process of maximizing the understanding of the concepts of a mathematical model within the learner's mind. Mathemitization develops then further into two types of mathematical activity. On the one hand, horizontal mathemitization that involves moving from the context of the practical problem towards the mathematical context of articulating and solving the problem. On the other hand, vertical mathemitization that leads to the creation of new associations between the learning tools, and therefore also of new structures.RME, as was allude to earlier, focuses on solving problems in realistic contexts where learners develop strategies closely linked to the context. Certain aspects of the context situation can become more general, which means that context become more of a model and as such can give support for solving other related problems. According to Van den Heuvel-Panhuizen (1998) these models will eventually give learners access to more formal mathematical knowledge. In RME, learners are not just receivers of ready-made mathematics, but are active participants in the teaching-learning process, in which they develop mathematical tools and insights. Learners are also offered opportunities to share their experiences with others.

2.3.2 Mathematics in Context

Traditional mathematics education deals more with abstract strategies from memorising algorithms and rules to specific examples, and then to applications in context. As a method to enhance mathematical literacy, 'Mathematics in Context' (MiC) have been developed. MiC is highly contextual and use real-life situations as a starting point for learning. MiC, which was developed in America (Villarrubia, 2001: 8) is similar to RME in that it sees mathematics as a human activity. It sees mathematics not as pure rules and principles to be learnt in isolated pieces, but rather as an entity that must be learnt through contexts. The next topic I wish to engage in will focus on the position of mathematical literacy in the South African mathematics curriculum.

2.3.3 Mathematical Literacy in the Mathematics Curriculum in South Africa

Widespread concerns by teachers and mounting public pressure forced the South African government in 1999 to call for a review of curriculum 2005 (C2005). The review of C2005 led to the development of the Revised National Curriculum Statement (RNCS) for General Education and Training (GET) and the development of the National Curriculum Statement (NCS) for Further Education and Training (FET).

The introduction of the RNCS (GET) into schools was implemented in 2004 in the Foundation Phase and in 2005 in the intermediate Phase. The RNCS will be phased into the Senior Phase in GET during 2006 at grade 7 level, 2007 at grade 8 level and 2008 at grade 9 level. The NCS (FET) will be phased into high schools at grade 10 level in 2006, at grade 11 level in 2007 and in 2008 at grade 12 level. In the FET phase doing a course in mathematics is compulsory and covers two learning areas, viz. Mathematics and Mathematical Literacy. Learners are allowed to decide if they want to enrol for the Mathematics learning area or the Mathematical Literacy learning area. So, mathematical literacy, which was introduced in the 1980's as a mere topic for discussion and debate, has evolved in South Africa through many stages into a fully recognised subject/learning area known as Mathematical Literacy. Many studies on mathematical literacy conclude therefore that the theoretical approach of mathematical literacy focuses mainly on applications and modelling. My focus will now shift to mathematical modelling.

2.4.1 Mathematical Modelling

According to Aris (1979: 1), a mathematical model is any complete and consistent set of mathematical equations which is thought to correspond with some or other entity: its prototype. "Prototype" in this sense implies any physical or conceptual entity. It may even represent another mathematical model. Mathematical modelling represents therefore the process of using various mathematical structures – graphs, equations, diagrams, scatterplots, etc. – to represent real world situations.

According to Davis and Hersh (1986), three types of models can be classified on the basis of the purpose they serve:

1) Descriptive models: constructed to describe an existing reality as accurately as possible.
2) Predictive models: constructed to describe a section of reality, but in this case it is in a state that does not yet exist.
3) Prescriptive models: intended to give guidelines for the construction of a section of reality.

According to Kaiser (2005: 8), a modelling process consists of four steps viz:

1) A real world situation is the process' starting point. Then the situation is idealized, i.e. simplified or structured in order to get a real world model.
2) This real world model is mathematized: translated into mathematics so that it leads to a mathematical model of the original situation.
3) Mathematical considerations during the mathematical model produce mathematical results which must then be interpreted into the real situation.
4) The results' adequacy must be checked, i.e. validated. In case of an unsatisfactory problem solution, which happens quite frequently in practice, this process must be repeated.

2.4.2 The application of mathematics and mathematical modelling

The applications of mathematics and mathematical modelling are generally viewed as synonymous. However, recent discussions differentiate between the two constructs. According to Blum and Niss (1991:38) this differentiation can be explained as follows:

> The term "modelling", focuses on the relation reality to mathematics and more generally, emphasizes the processes involved. The term "application", on the other hand, focuses on the opposite direction mathematics to reality and emphasizes the objects involved – in particular those parts of the "real" world which are accessible to a mathematical treatment and to which corresponding mathematical models exist.

The use of mathematics to solve "real" world problems is often called applying mathematics, and a "real" world problem which can be solved by using or applying mathematics is called an application of mathematics. The idea of "applying" is sometimes used to connect the "real" world and mathematics.

According to Julie (1997) there are three domains involved in mathematical model making. These are the extra-mathematical reality, the consensus-generated reality domain and the intra-mathematical domains. He characterizes the domains as reflected in figure 1 below:

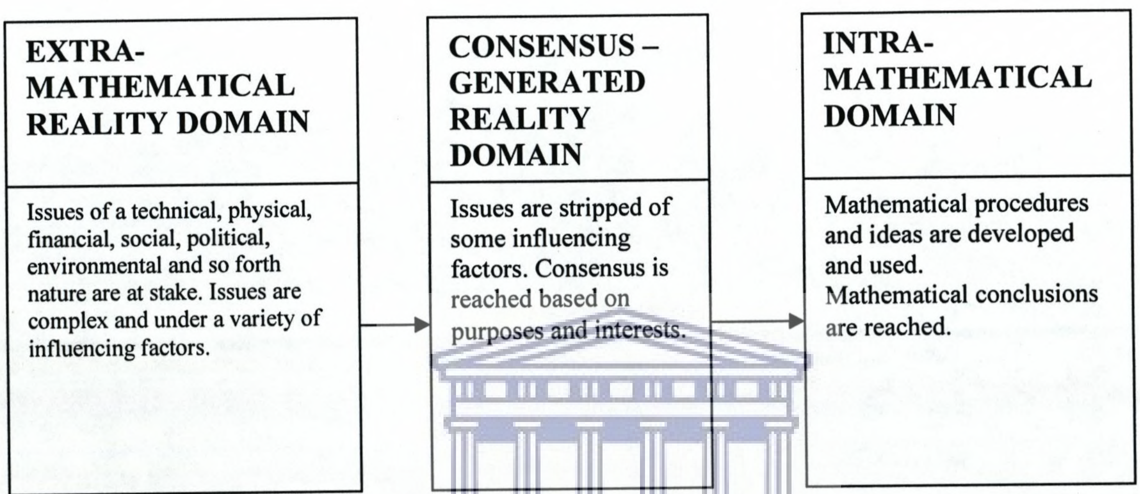

Fig 1: Domains in mathematical model making (From Julie (1997))

Niss (1989) describe mathematical modelling as the process of mapping a section of reality to mathematical objects and relations. He explains further that the result of this process is a construction of a model. He then asserts: “When a segment of reality is submitted to any kind of treatment by mathematical means, a mathematical model is necessarily involved”.

2.5 Summary and Conclusion

In this chapter I attempted to define, describe and discuss relevance. In my attempt to do so, I tried to link relevance to mathematical literacy, mathematical application and mathematical modelling. Relevance brought out the issues of interests and contexts.

Mathematical literacy, which first came to the fore in the eighties, needed to be defined since it was a fairly new term. What came out clearly from literature related to mathematical literacy is the fact that mathematical literacy cannot be defined in terms of mathematical knowledge alone and that it must also focus on individual interests in using mathematical knowledge in a practical and functional way. On a daily basis, people are faced with demands which requires mathematical problem solving skills in order for them to handle the issue at hand with confidence and self-belief. Many times these demands relate to investments, hire-purchase, interpreting issues in newspapers, etc. Mathematical literacy needs therefore to be driven by real-life contexts and should therefore take a high priority in enhancing the learning and teaching of mathematics. As methods to enhance mathematical literacy, 'Realistic Mathematics Education' (RME) and 'Mathematics in Context' (MiC) have been developed. The focus of both RME and MiC was mathematics in context.

The use of mathematics to solve "real" world problems is often called applying mathematics, and a "real" world problem which can be solved by using or applying mathematics is called an application of mathematics. The idea of "applying" is sometimes used to connect the "real" world and mathematics. "When a segment of reality is submitted to any kind of treatment by mathematical means, a mathematical model is necessarily involved" Niss (1989). A mathematical model is thus a representation or transformation of a real situation into mathematical terms, in order to understand more precisely, analyze and possibly predict what is going to happen. Mathematical modelling is therefore the art of building and working with mathematical models and it also serves as a powerful instrument of communication between the real world and the mathematical world. It is this art and skill that needs to be imparted to our learners when they frequent our mathematics classes and this is why a research project like the current one is so important because it will give insight into the contexts learners would prefer to deal with in mathematics and also how mathematics can be made more relevant.

In the next chapter the research methodology is explained. It gives the reasons why a survey research format was used for this study and describes the sample and the research instrument used. It gives the background and description of the learners and schools sampled. It goes on to provide the data that were needed for analysis.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

To determine the contextual preferences of grades 8, 9 and 10 mathematics learners the research methodology known as survey research was used. I will explain the research methodology used in this chapter under the following headings: background to the study, motivation for the use of ordinal data, the instrument, sampling, data collection and the data analysis procedures.

3.2 Background to the study

The use of contexts in school mathematics are receiving much attention both nationally and internationally. It is because of this new trend as well as the scarcity if not non-existence of research focussing on the contexts preferred by learners of mathematics that this study, the Relevance of School Mathematics Education (ROSME) project was embarked upon. The study essentially deals with the issues and situations that learners would prefer to deal with in mathematics.

3.3 Data Collection Method

Since this study essentially deal with the contexts preferred by mathematics learners the choice was made to survey the preferences of a fairly large number of learners using a questionnaire.

Preferences fall within the domain of what people like and not like. As such it cannot be directly measured, as say, one would measure someone's height or the competence on some mathematics test. Given this domain for preferences it is accepted that a choice is made on some scale given the degree of agreement with some statement. This is why the data in this study were ordinal; the learners expressed an order preference. The survey's intent was then to obtain a composite profile of the population.

There are basically two types of statistical processes and they are commonly known as parametric and nonparametric statistics. Since this study essentially deals with ordinal data it falls therefore under non-parametric statistics. According to Field (2005:521) many nonparametric procedures are based on ranked data by ordering from lowest to highest and then being assigned integer values in that order from 1 to some value decided by the researchers.

Nonparametric methods have a number of clear advantages in comparison to parametric methods (Levin, 1978:377-378); Stell and Torrie, 1980:533-534) which is elaborated on below.

1) They do not require us to make the assumption that a population is distributed in the shape of a normal curve or another specific shape.
2) Non-parametric procedures are easier to do and to understand and sometimes they can be used to get a quick answer with little calculation. Most non-parametric tests do not demand the kind of laborious computations often required, to calculate for example, the standard deviation. A non-parametric test may request

for the replacement of numerical values with the order in which those values occur in a list.

3) Sometimes even formal ordering or ranking is not required. Often, all that can be done is to describe one outcome as 'better' than another. In a case like this, or when measurements are not as accurate as is necessary for parametric tests, it becomes imperative that nonparametric methods are used.

There are also disadvantages to the use of non-parametric statistics (Levin, 1978:378).

1) In nonparametric techniques, there are no parameters to describe and it becomes more difficult to make quantitative statements about the actual difference between populations.
2) Nonparametric procedures throw away information. The sign test, for example, uses only the signs of the observations. Ranks preserve information about the order of the data but discard the actual values and because information is discarded in this way, non-parametric procedures can never be as powerful as their parametric counterparts in cases where parametric tests can be used.

3.3.1 Survey Method of Research

This study employs a method of research known as survey research. This method was decided upon because of the nature of this study as well as having considered the advantages and disadvantages of this method of research. I will now highlight some of its advantages and then also its disadvantages.

3.3.2 Advantages of the Survey Method of Research

The following represents a summary of the advantages of surveys as stated by Simon (1969:191).

1) With a survey, a researcher can get closer to the "real" hypothetical variables than with laboratory experiment. One can actually inspect the variables in their real-world setting. This is the pre-eminent advantage of a survey over an experiment in cases where one needs to investigate relationships, which are impossible in real-world experiments.
2) A survey is often quite cheap, especially if one can use already existing records and data.
3) Huge masses of data are often already available or can be culled from existing records. This is a major statistical advantage, because the large samples provide high internal reliability. Such huge samples are seldom available in experimentation.
4) Surveys can yield a very rich understanding of people both in breadth by collecting a wealth of information, and in depth by probing people's motives.

3.3.3 Disadvantages of the Survey Method of Research

Simon (1969:192) lists the major disadvantages of surveys as follows:

1) The crucial disadvantage of the survey method is the lack of manipulation of the independent variable.
2) One cannot progressively investigate one aspect after another of the independent variable to get close to the "real" cause.
3) Statistical devices are not always able to separate the effects of several independent variables when there is multivariable causation, especially when two independent variables are themselves highly associated.

3.4 The research instrument

The ROSME group came together early in 2002 to start work on the project. Discussions were entered into in terms of the type of research methodology that was needed to be employed in order to best capture and evaluate data that would reflect the contexts preferred by grades 8, 9 and 10 mathematics learners. After much deliberation and consultation the group finally concluded that the use of a questionnaire in a survey research methodology would best serve the purposes of the intended research since ordinal scales would be used which is commonly used in questionnaire responses.

The next issue the group had to confront was to develop a survey instrument around topics or clusters identified by the group. The group then discussed the test items that would make up these topics or clusters. Many hours and meetings ensued before we eventually agreed on the amount of clusters or topics. Thirteen clusters including two intra mathematical and eleven extra mathematical evolved through the identification process which consisted of sixty one closed response items as well as four open-ended items. The open-ended items do not form part of this study. The extra mathematical clusters were mainly informed by modules and learning materials developed by the Consortium for Mathematics and its Applications (Garfunkel, 2004) to ensure compliance with the possible mathematical treatment of the cluster items which were developed as indicators of the identified clusters. Table 3.1 identifies the clusters, number of items in a cluster and an exemplar item of the initial questionnaire.

Table 3.1: Clusters, number of items per cluster, and exemplar item

Cluster	Number of Items	Exemplar Indicator Item
mathematics	6	Mathematics that will help me to do mathematics at universities and technikons
Mathematicians' Practices	5	How mathematicians make their discoveries
Health	4	Mathematics involved in determining the state of a person
Physical Science	3	Mathematics involved in making complex structures such as bridges
Technology	5	Mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM
General	7	Mathematics involved in assigning people to tasks when a set of different tasks must be completed
Transport and Delivery	3	Mathematics involved in the sending of messages by SMS, cell phones and e-mails
Life Science	3	Mathematics to determine the number of fish in a lake, river or a certain section of the sea.
Crime	4	Mathematics involved in setting up a crime barometer for my area.
Sport	2	Mathematics involved in crowd control at a sport meeting
Youth Culture	4	Mathematics linked to music from the United States, Britain and other such countries
Politics	3	Mathematics used to calculate, the number of seats for parliament given to political parties after elections
Agriculture	4	Mathematics involved in working out the best arrangement for planting seeds

Another issue the ROSME group had to resolve was the development of a survey instrument that would meet the language competency levels of grades 8, 9 and 10 learners with backgrounds in English as a second language. To resolve this dilemma, all the grade 8, 9 and 10 teachers in the group had to be particularly vigilant and critical of the construction of each of the questions in the questionnaire so as to maintain the acceptable level of language usage. The aim was to keep the language usage understandable to the learners so that invalid answers could be kept to a bare minimum.

A third issue related to the construction of the questionnaire was highlighted by Julie and Mbekwa (2005:34) and it dealt with the use of the word "mathematics":

> The most daunting of these are whether in developed questionnaires to use the word "mathematics", as and when appropriate, with the contexts or to place the idea of treatment via mathematics at the start of the question and only name the contexts in the questionnaire items.
>
> The problem with the first-mentioned approach is that learners' experience related to the subject of mathematics might cloud their responses. If the second approach is followed the threat exists that learners might view contexts as just general and unrelated to forms of mathematical work.

The ROSME group adopted the first-mentioned approach believing that it is more likely to draw attention to both contexts and mathematical treatment of contexts. The instrument was constructed with careful attention given that learners make a personal response. Directions in the questionnaire were given where it was stated "what would you like to learn about in mathematics? There are no correct answers: we want you to tell us what you like". Words such as "me", "my" and "person" might appear to put some items personally closer to learners, but this appears not to have detracted overall from learners responding the way they did.

As previously mentioned the type of data were ordinal. The questionnaire therefore reflected clear ordering of variables: "not at all interested", "a bit interested", "quite interested" and "very interested". Scores of 1, 2, 3 and 4 were assigned to these four levels of interests giving "not at all interested" a score of 1 and the label 4 given to "very interested". The group therefore agreed on this four-point Likert-scale as the best possible method of getting the data needed for studying the contexts preferred by the learners. The questionnaire also captured demographic data: learners' grades, sex and age.

Julie and Mbekwa (2005) explains how a pilot project related to the research was started in the latter half of 2002 where in-depth work was done in developing and improving the instrument with learners in a secondary school from a squatter area . The findings of this preliminary work served as the basis to finalise the construction of the questionnaire. The final questionnaire is shown as Appendix A.

3.5 Sampling

In this study a group of 1177 learners from 20 schools across the Western Cape province of South Africa were sampled. The sample of learners was all from the lower socio-economic urban and peri-urban environments. Schools sampled represented the following regions: Urban: Cape Town, Peri-urban: West Coast Winelands (Vredenburg /Saldanha) and Boland (Worcester) and South Western Districts (Ladysmith).

The frequency table 3.2 below shows the demographic data of learners sampled across grades 8 to 10.

Table 3.2 : Demographics of cohort

		NUMBER	PERCENTAGE	TOTAL
GENDER	BOY	550	46.7	1177
	GIRL	627	53.3	
SCHOOL GRADE	8	260	22.2	1177
	9	526	44.6	
	10	391	33.2	
GEOGRAPHICAL LOCATION	URBAN	475	40.3	1177
	PERI-URBAN	702	59.7	
LANGUAGE	AFRIKAANS	497	42.2	1177
	ENGLISH	680	57.8	

3.6 Data Collection Procedures

Principals of the sample schools were approached by representatives of the ROSME group with regard to the project. About some research projects Hobbs (1988:56) asserts: "…there is often some deception. The researcher may conceal certain aspects of his/her identity, or exaggerate (perhaps even fabricate) others, in order to influence favourably subjects' perceptions". The ROSME group took these ethical issues very seriously and hence the principals were informed about the nature of the research, the background to the research and the aim of the research. In terms of the ethical considerations, principals were required to fully inform the learners and their parents about the impending research as well as gain permission from them to be sampled for this research project. In this regard principals were briefed by representatives of the ROSME research group concerning the ethical acceptability of deception, particularly when it involves gross misrepresentation of the purposes of the research. These concerns derive from the value of honesty and the view that subjects should be fully informed about the nature of any research in which they are involved. It also derives from a fear that subjects may be harmed by any deception and that the prospect of future research may be damaged if peoples' perceptions of research are adversely affected. The open, honest and frank way in which the ROSME group approached the principals lead to the implementation of the research project's introductory phases namely meeting the mathematics educators at the schools and having a thorough workshop on their role as facilitators in managing the questionnaires at their schools which entailed briefing learners about the filling in of the questionnaires and the issuing and collecting of the questionnaires from the learners. The ROSME research group saw this workshop (with the respective mathematics educators) as a critically important step so as to avoid compromising the validity of the data collected and also minimising mistakes made by learners when completing the questionnaires. Problems related to time tabling were also discussed and addressed. It was decided that a full period (about 30 to 40 minutes) would be needed to complete the questionnaire and that one week would be given to a school to complete its data collection procedures.

3.7 Data Analysis Procedures

The data used in this research project is known in statistics as subjective data and is not "directly measurable". It is also known as ordinal data as alluded to earlier, and cannot be subjected to parametric testing. The data was then subjected to what is known as nonparametric testing.The statistic used for ranking the data was the Kendall W test. It is also referred to as the coefficient of concordance which can be interpreted as a coefficient of agreement among raters. Each case (row-in SPSS language) is a rater and each variable (column) is an item being rated. The coefficient W ranges from 0 to 1, with 1 indicating complete inter-rater agreement, and 0 indicating complete disagreement among raters. The mechanical calculations were done by using the SPSS statistics software programme version 13.2. Using this SPSS programme, but more specific, the Kendall W statistic, the learners' responses were accorded mean ranks.

3.8 Summary and Conclusion

After many research meetings and discussions the ROSME group constructed a questionnaire which served as the instrument for this study. The questionnaire captured demographic data of the learners, 61 closed questions which represented 13 clusters and four open-ended questions. The four open-ended questions did not form part of the scope of this study. The nature of this study, with its ordinal data, required analysis to be done via nonparametric procedures. Data were collected from 20 schools comprising 1177 learners from grades 8, 9 and 10. Of these, 627 were girls and 550 were boys. All the learners came from the lower socio-economic environments. I used the Kendall W mean ranks to rank the 61 test items into order of the learners' preferred contexts.

Chapter 4 presents the research findings and interprets and describe these findings.

Chapter Four

Findings

This chapter deals with the findings and overall trends of the learner's responses. In order to investigate the research question 'What are the differences in the contexts preferred in mathematics by learners in grades 8, 9 and 10?" data were collected using the ROSME questionnaire as mentioned in the previous chapter.

4.1 General View on the Findings

The Kendall W mean ranking was used to rank preferences. The Kendall W mean ranking (ranked in order of highest to lowest) for items of individual grades, were determined and are given as appendices B, C and D. From these Kendall W mean rankings of the contexts preferred by grade 8, 9 and 10 learners the following emerged.

4.1.1 The Ten Most Preferred Items

Table 4.1.1 : Ten most preferred items for gr.8

Items	Mean Rank
Mathematics that will help me to do mathematics at universities and technikons	43.72
Numbers	41.62
Mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM	40.93
Mathematics involved in sending of messages by SMS, cell phones and e-mails	40.33
Mathematics that is relevant to professionals such as engineers, lawyers and accountants	39.91
Mathematics involved in making computer games such as play stations and TV games	38.04
The kind of work mathematicians do	37.95
Geometry	37.14
Mathematics involved in working out financial plans for profit-making	36.53
Mathematics for the storage of music on CD's	36.12

Table 4.1.2 : Ten most preferred items for gr.9

Items	Mean Rank
Mathematics that will help me to do mathematics at universities and technikons	46.67
Mathematics that is relevant to professionals such as engineers, lawyers and accountants	40.81
Mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM	40.56
Numbers	39.38
Mathematics involved in sending of messages by SMS, cell phones and e-mails	38.34
Geometry	36.8
Mathematics involved in working out financial plans for profit-making	36.67
Mathematics involved in making computer games such as play stations and TV games	36.37
Mathematics to prescribe the amount of medicine a sick person must take	36.1
The kind of work mathematicians do	35.9

Table 4.1.3 : Ten most preferred items for gr.10

Items	Mean Rank
Mathematics that will help me to do mathematics at universities and technikons	49.6
Mathematics that is relevant to professionals such as engineers, lawyers and accountants	45.58
Numbers	42.78
The kind of work mathematicians do	41.46
Mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM	41.32
Mathematics involved in working out financial plans for profit-making	41.02
Algebra	39.93
How mathematicians make their discoveries	38.21
Mathematics involved in sending of messages by SMS, cell phones and e-mails	37.73
Mathematics to prescribe the amount of medicine a sick person must take	37.6

Table 4.1.4 : Composite table of rankings for 10 most preferred items in each grade

ITEMS	RANKS GRADE 8	GRADE 9	GRADE 10
Mathematics that will help me to do mathematics at universities and technikons	1	1	1
Numbers	2	4	3
Mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM	3	3	5
Mathematics involved in sending of messages by SMS, cell phones and e-mails	4	5	9
Mathematics that is relevant to professionals such as engineers, lawyers and accountants	5	2	2
Mathematics involved in making computer games such as play stations and TV games	6	8	X
The kind of work mathematicians do	7	10	4
Geometry	8	6	X
Mathematics involved in working out financial plans for profit-making	9	7	6
Mathematics for the storage of music on CD's	10	X	X
Mathematics to prescribe the amount of medicine a sick person must take	X	9	10
Algebra	X	X	7
How mathematicians make their discoveries	X	X	8

X represents an item that does not appear amongst the ten highest ranked items for the particular grade

All three grades ranked "mathematics that will help me to do mathematics at universities and technikons" as the most preferred. This is in contrast to the grade 8 results of the TIMMS report (Mullis, I V S; Martin, M O; Gonzalez, E J and Chrostowski, S J, 2004). The results of this report show that only 34% of the grade 8's indicated that they want to study at tertiary institutions and the average TIMMS mathematics achievement scores for the two groups (either parent went to university and neither parent went to university) were 391 and 293 respectively. This is lower than those who indicated that they do not want to pursue tertiary studies where the average mathematics achievement scores were 240 (Not finish university- regardless of parent's education) and 232 (Do not know – regardless of parent's education). The group "Not finish university- regardless of parent's education" were the highest (54%) of the TIMMS cohort and this is contrary to the highest ranking the ROSME cohort assigned to "studies at university and technikons". It would be interesting to know how many of these learners would eventually end up doing a course in mathematics at a university or technikon. The Cape Argus news paper headline dated 24 July 2006 read as follows: 'Grade 10 crisis over new exam'(Cape Argus, 2006). This article, in essence, argues that whilst subjects like mathematics and mathematical literacy have become compulsory subjects, educators had not been adequately trained to deal with the demands of the new curricula and learners are subsequently failing the subjects in droves. In the same article Helen Sieborger of the National Union of Educators was quoted as saying: "It was obvious that pupils would not pass exams in grade 10 if they had not developed exam-writing skills in the lower grades and not all learners are mathematically inclined". If one considers the recent enrolment figures in mathematics courses at universities and technikons (Hanrahan, 2000: 2-3) in relation to learners passing their matric examination, the picture for these grade 8, 9 and 10 learners doesn't look too rosy. This state of affairs is however not unique to South Africa. Ronald Reagan (1986), the late ex-president of the United States of America said the following in a speech delivered at an occasion during America's National Mathematics Awareness Week:

> Despite the increasing importance of mathematics to the progress of our economy and society, enrolment in mathematics programmes has been declining at all levels of the American educational system. Yet the application of mathematics is indispensable in such diverse fields as medicine, computer sciences, space exploration, the skilled trades, business, defence and government. (Ronald Reagan, Proclamation 5461, 1986)

Nonetheless, there appears to be an indication that the learners from grades 8 to 10 coming from lower socio-economic environments assign a high priority to learning mathematics as a discipline as indicated in tables 4.1.1, 4.1.2 and 4.1.3 above. This result would surprise both curriculum developers of mathematics and educators of mathematics given that their general view according to Julie and Mbekwa (2005:38) is that "interest in mathematics as a discipline would develop through the embedding of mathematics in context due to learners' expression of requirements for how mathematics is applied".

However, this finding does not point in the direction that contextually embedded forms of school mathematics are not favoured by learners. The high preference accorded to disciplinary mathematics at institutions of higher learning rather point in the direction that learners across the three grades see good performances in school mathematics as entry into universities and technikons and hence better career opportunities.

The item "Mathematics that is relevant to professionals such as engineers, lawyers and accountants" was ranked as the second most preferred context in which to embed high school mathematics by both grade 9 and 10 learners. This same item was ranked fifth by the eighth graders. What comes out clearly from this are these learners' perceptions of mathematics being linked to the "elite" professions and careers and hence a better lifestyle than what they are currently used to.

The second most preferred item in which to embed high school mathematics for the grade 8 learners was "Numbers". This, one could argue, can be attributed to the fact that their school life experiences in the subject of mathematics had been one in which numbers were predominant. Their keen interest to be able to go to university or technikon and from there become prospering professional career people is driven by this great desire to be good in numbers and to understand it well. I posed the following question to a grade 8 class I taught: “When is a person good in mathematics?” Their overwhelming response was “when you are good with numbers”. I asked the same question to my daughter who is in grade 4 and her reply was “when you know your numbers well”. It is clear that at grade 8 level learners assign great value to the mastery and understanding of numbers, hence the high ranking they assign to it. This certainly does not mean that grade 9 and 10 learners do not assign high priority to ‘numbers’ as a preferred context in which to embed school mathematics. In fact the grade 9 learners ranked ‘numbers’ fourth where as the grade 10 learners ranked ‘numbers’ third.

‘Mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM’ was ranked very high by all three grades. Grade 8 and 9 learners ranked it as their third most preferred contextual item in which to embed school mathematics where as the grade 10 learners ranked it as their fourth most preferred contextual item in which to embed school mathematics. Together with the test item ‘mathematics involved in sending of messages by SMS, cell phones and e-mails’ which the grade 8 learners ranked fourth, the grade 9 learners ranked fifth and the grade 10 learners ranked ninth, it appears as if technology is one of the foremost phenomena driving the interest levels of our youth. Today, our modes of communication are highly dependent on technologies such as the internet, cell phones, computers, etc. These forms of communication have become part of our everyday life and reflect some new directions in the sphere of communications technology. It forms therefore an intricate part of our grade 8, 9 and 10 learners lives also and hence their high ranking of mathematics involved in technologies such as ATM’s and cell phones, etc. In a recent staff meeting at school the principal expressed his concern about the addiction that some of our learners show towards the sending of SMS's and how it negatively affects their sleep patterns at night and consequently their academic performance. It clearly shows why these learners assign a very high preference for technologies as a contextual domain for high school mathematics to be embedded in. 'Mathematics involved in making computer games such as play stations and TV games' was not ranked within the 10 most preferred items of the grade 10 group. This was a surprising result given the overall high rankings learners across the three grades accorded to contextual items dealing with the technology cluster. This prompted me to probe my grade 10 learners about this finding. I asked my grade 10 learners the following question: " Which of the three groups of learners, grade 8, grade 9 or grade 10 learners are more likely to play TV games and why?". They all agreed that the grade 8 and 9 learners would be more like play TV games. This answer seemed to correspond with the results of my study related to this issue. They provided the following reasons:

> Our parents do not buy TV games for us anymore… that is for children.
> We don't want TV games…we want cell phones now.
> We will only play if we have to show the little ones how to play some games.
> That's not challenging…to be on the internet for hours is…it's exciting.

'The kind of work mathematicians do' was also assigned high preference by learners from all three grades in that it ranked within the ten most preferred contextual domains within which to embed school mathematics. The grade 8 learners ranked 'the kind of work mathematicians do' at position number 7, the grade 9 learners ranked it at position number 10 and the grade 10 learners ranked it much higher at position number 4.

The grade 10 learners have ‘algebra’ amongst their 10 most preferred items but not the grade 8’s and 9’s. Grade 8’s and 9’s have ‘geometry’ in their 10 most preferred items. Since algebra form part of disciplinary mathematics, one would have expected that all three grades would accord a very high preference to it. As an educator of high school mathematics I am of the opinion that grade 8 and 9 learners struggle to deal with many introductory sections of algebra for example integers, negative numbers, graph work and graph interpretation, indices and surds, etc. By the time they have progressed to grade 10 those sections had been consolidated, revised and redone. Also, in grade 10 the learners write an examination consisting of two papers, an algebra paper and a geometry paper. At grade 10 level learners generally perform better in the algebra section than in the geometry section. Since algebra has somewhat of a negative image to grade 8 and 9 learners its value seem to increase as the learners progress to grade 10, 11 and 12 where they generally perform better in the algebra examination than in the geometry examination. Hence the grade 10 learners have ‘algebra’ amongst their 10 most preferred items but not the grade 8 and 9 learners.

4.2 Intra-mathematical and Extra-mathematical clusters

From the information above it appears as if learners across the three grades accorded high preferences to contextual issues related to the intra- mathematical cluster which include items such as ‘mathematics that will help me to do mathematics at universities and technikons’, ‘numbers’, ‘algebra’, ‘geometry’, ‘mathematics that is relevant to professionals such as engineers, lawyers and accountants’ and ‘the kind of work mathematicians do’.

Issues related to the extra-mathematical clusters such as technology, health, social services and fiscal and tax issues also received fairly high rankings as possible domains in which to embed high school mathematics. The Health cluster which include items such as 'mathematics involved in determining the state of health of a person', 'mathematics to prescribe the amount of medicine a sick person must take', 'mathematics involved in the placement of emergency services', 'how to predict the sex of a baby', 'mathematics used to predict the growth and decline of epidemics such as AIDS, tuberculosis and cholera', 'how mathematics is used to predict the spread of diseases caused by weapons of mass destruction' and 'mathematics to monitor the growth of a baby the first period of life', received fairly high rankings by learners from all three grades. Although grade 8's do not have items related to the health cluster in their 10 most preferred items, they still accorded very high rankings of 11th and 12th position to 'mathematics involved in the state of health of a person' and 'mathematics to prescribe the amount of medicine a sick person must take' respectively (Appendix B). Learners across grades 8 to 10 are generally interested in learning about how mathematics is applied to issues related to health with a very high interest in the mathematics involved in determining the health of a person. In discussing these questions with some of my grade 10 learners (they were not part of the sample group), they responded by giving these reasons:

i) Learners, in their low socio-economic environments are faced with a significant amount of sickness and illness.

ii) Learners, particularly at their schools, are exposed to many awareness programmes of the prevalence of HIV/AIDS. This is taken very seriously as it might have an effect on their health and their future.

iii) Violence and crime are also rife in their socio-economic environments and knowledge of mathematics involved in the strategic placement of ambulance services would rate high on their interests because ambulances are also linked to rushing violence related casualties to hospital. Learners also show a high interest in the mathematics involved in the placement of police stations because of the possibility of the quick reporting of crime to the police and the possibility of a swift and quick response from them (the police).

Strangely enough, the mathematics curriculum for both the General Education and Training (GET) and Further Education and Training (FET) phases emphasises only HIV/AIDS as the health-related context within which to embed school mathematics. This does not conform completely to these learners' high interests, but do perhaps indicate how HIV/AIDS could have an impact on their health and future seeing that they are fully aware of HIV/AIDS patients being terminally ill.

The items 'mathematics used to calculate the taxes people and companies must pay to the government', 'mathematics involved in working out financial plans for profit-making' and 'mathematics to assist in the determination of the level of development, education and poverty of my community' were accorded fairly high rankings by all three grades. This translates into a strong perception amongst learners across grades 8 to 10 that the efficient delivery of services from government is dependent upon the income attained by government through taxes. This high awareness of tax issues, one could argue, comes from their parents/guardians as well as their educators of accounting, business economics and economics subjects or learning areas in school. This also seem to correspond with the high preference they accord to the use of mathematics to alleviate poverty, generate employment and improve education; issues that require good governance and good fiscal practices. I would like to change the focus now to the ten least preferred items.

4.2.1 The Ten Least Preferred Items

Tables 4.2.1, 4.2.2 and 4.2.3 below represent the ten least preferred items in which school mathematics need to be embedded in according to the rankings accorded by grade 8, 9 and 10 learners.

Table 4.2.1: The Ten Least Preferred Items for gr.8 learners

Items	Mean Rank
Mathematics involved in making complex structures such as bridges	25.48
Strange results and paradoxes in mathematics	25.17
Mathematics involved in packing goods to use space efficiently	24.85
Mathematics to describe facts about diminishing rain forest and growing deserts	24.77
Blunders and mistakes some mathematicians have made	24.33
Mathematics involved in working out the best arrangement for planting seeds	24.07
Mathematics of inflation	23.98
Mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of a certain size	23.88
Mathematics used to calculate the number of seats for parliament given to political parties after elections	23.51
Mathematics of a lottery and gambling	20.05

Table 4.2.2 : The Ten Least Preferred Items for gr.9 learners

Items	Mean Rank
Mathematics used to calculate the number of seats for parliament given to political parties after elections	25.76
Mathematics linked to designer clothes and shoes	25.29
How to estimate and project crop production	24.5
Mathematics involved in designing delivery routes of goods such as delivering bread from a bakery to the shops	23.8
Mathematics involved in packing goods to use space efficiently	23.49
Mathematics involved in working out the best arrangement for planting seeds	22.25
Mathematics linked to decorations such as the house decorations made by Ndebele women	22.21
Mathematics needed to work out the amount of fertilizer needed to grow a certain crop	21.33
Mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of a certain size	20.53
Mathematics of a lottery and gambling	20.18

Table 4.2.3 : The Ten Least Preferred Items for gr.10 learners

Items	Mean Rank
Mathematics political parties use for election purposes	22.98
Mathematics used to calculate the number of seats for parliament given to political parties after elections	22.73
Mathematics involved in working out the best arrangement for planting seeds	21.61
Mathematics involved in packing goods to use space efficiently	21.56
Mathematics linked to designer clothes and shoes	21.39
Mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of a certain size	19.88
Mathematics needed to work out the amount of fertilizer needed to grow a certain crop	19.84
Mathematics involved in designing delivery routes of goods such as delivering bread from a bakery to the shops	18.7
Mathematics linked to decorations such as the house decorations made by Ndebele women	18.56
Mathematics of a lottery and gambling	17.6

Table 4.2.4 : Composite table of rankings for 10 least preferred items in each grade

ITEMS	RANKS GRADE 8	GRADE 9	GRADE 10
Mathematics involved in making complex structures such as bridges	52	X	X
Strange results and paradoxes in mathematics	53	X	X
Mathematics involved in packing goods to use space efficiently	54	56	55
Mathematics to describe facts about diminishing rain forest and growing deserts	55	X	X
Blunders and mistakes some mathematicians have made	56	X	X
Mathematics involved in working out the best arrangement for planting seeds	57	57	54
Mathematics of inflation	58	X	X
Mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of a certain size	59	60	57
Mathematics used to calculate the number of seats for parliament given to political parties after elections	60	52	53
Mathematics of a lottery and gambling	61	61	61
Mathematics linked to designer clothes and shoes	X	53	56
Mathematics involved in designing delivery routes of goods such as delivering bread from a bakery to the shops	X	55	59
How to estimate and project crop production	X	54	X
Mathematics linked to decorations such as the house decorations made by Ndebele women	X	58	60
Mathematics needed to work out the amount of fertilizer needed to grow a certain crop	X	59	58
Mathematics political parties use for election purposes	X	X	52

X represents an item that does not appear amongst the ten lowest ranked items for the particular grade

'Mathematics involved in making complex structures such as bridges' was ranked as the 10th least item by the grade 8's and fell outside the 10 least preferred items for grade 9's and 10's. 'Mathematics linked to designer clothes and shoes' was ranked as the 9th least preferred item for grade 9's and as the 6th least preferred item for the grade 10's. The grade 8's did not rank this item within its 10 least preferred. The political cluster which include items such as 'mathematics political parties use for election purposes' and ‘mathematics used to calculate the number of seats for parliament given to political parties after elections’ appear to have little appeal to the learners across the grades as preferred contexts in which to embed school mathematics. The grade 8 learners ranked the item ‘mathematics used to calculate the number of seats for parliament given to political parties after elections’ as their second least preferred item in which to embed school mathematics. Both the grade 9 as well as the grade 10 learners ranked the item ‘mathematics used to calculate the number of seats for parliament given to political parties after elections’ as their tenth least preferred contextual item in which to embed school mathematics. The print as well as the electronic media highlighted (and currently still do) a lot of corruption charges which implicate political personalities and their parties directly to those charges. Many political leaders have been jailed recently because of charges related to corruption, fraud and theft. The current spate of violence-related crimes has political leaders at each others throats in an attempt to shift blame on each other without really finding solutions to these problems. The lower ranking the participants (youth) in this study accorded to the items linked to the political cluster is indicative of what poor impressions they have of our political leaders and our political parties. I asked one of my grade10 learners about the possibility of making a career in politics and she responded negatively to this, with a frown.

Agriculture is also one of the least preferred clusters as is indicated by the rankings the grade 8, 9 and 10 learners accorded to items related to it. ‘Crop estimation and projection’, ‘the best arrangement for the planting of seeds’, ‘fertilizers needed to grow crops’ and ‘the efficient use of grazing fields’ do not appeal much to learners across grades 8, 9 and 10. Grade 8 learners accorded ‘Mathematics involved in working out the best arrangement for planting seeds' the position of fifth least preferred item whilst they accorded 'mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of a certain size' the position of third least preferred item. Grade 9 learners accorded 'how to estimate and project crop production', 'mathematics involved in working out the best arrangement for planting seeds', 'mathematics needed to work out the amount of fertilizer needed to grow a certain crop' and 'mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of a certain size' positions of eighth least preferred, fifth least preferred, third least preferred and second least preferred items respectively. Grade 10 learners accorded 'mathematics involved in working out the best arrangement for planting seeds', 'mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of a certain size', and 'mathematics needed to work out the amount of fertilizer needed to grow a certain crop' positions of eighth least preferred, fifth least preferred and fourth least preferred items respectively. I think one could ascribe the urban nature of these learners' environment to this low interest in the agricultural cluster which is contrary to the hopes of the South African government. With regard to this Julie and Mbekwa (2005: 40) asserts:

> The policy for land reform and redistribution in South Africa is also aimed at providing the opportunity for agricultural production to be more equitably distributed across the country's population. If the low interest is indicative of a trend of young people's interest in agricultural matters then much motivational work at school level will have to be done to ensure a flow of new entrants into the agricultural sector to allow the South African government's policy to have the desired effects.

There is also not a high level of awareness in the low socio-economic environments (from where these learners come) of agricultural studies at tertiary level. The agricultural sector is actually more than just farming. It involves subjects like biotechnology, food sciences, horticulture, etc. which are components of agriculture and which is not too well known by many learners. Since the learners across grades 8 to 10 show a very high interest in the mathematics cluster, particularly about university or technikon mathematics, one can understand why they seem not to be interested in the mathematics linked to the agricultural sector. The learners' low interest for the agricultural sector is also echoed by the larger community. The Centre for Development and Enterprise (CDE) reported the following: "Far fewer black South Africans want to farm than is commonly supposed; most blacks regard jobs and housing in urban areas as more important priorities" (CDE, 2005). The CDE also commissioned a national survey which concluded that 9 percent of black people who are currently not farmers have clear farming aspirations.

'Mathematics of a lottery and gambling' received the lowest ranking by learners across the grades as a preferred context in which to embed school mathematics. Our South African society comes from a traumatic recent past of Apartheid policies where people were segregated along racial lines and were educated under the forced white supremist policy of Christian National Education. The parents of all the learners who are currently in grades 8, 9 and 10 grew up under Apartheid laws and were educated under the policy of National Christian Education. Gambling and lotteries were therefore seen to be sinful and have to be avoided. I suppose many of our learners' parents still hold those beliefs and naturally raise their children with those beliefs. Hence the lowest ranking accorded to it by all the grades.

Five percent of South African school goers gamble regularly, according to a report by Wits University, commissioned by the National Gambling Board, on youth gambling in South Africa:

> While participation in most forms of gambling has remained stable, the proportion of adolescents gambling on the lottery is increasing – because of the number of draws per month, the growing tendency of learners to dissociate the lottery from mainstream gambling, and the consolidation of lottery betting as a lifestyle.
> There has also been an increase in informal gambling and 'fight betting' that sometimes forms part of initiation procedures among adolescent males. This takes place near to schools or on specially designated and isolated portions of school property.
> The study found that 45.9% of the 4 000 learners (grades 10,11,12) surveyed in 2004/5 at 28 schools had previously gambled. The most common forms of gambling among the sample group were the national lottery (9.1%), sports betting (5%), scratch cards (4.5%), flipping coins (3.5%), and informally organised
> card games (2.7%). Cell phone gambling (2%), dice (1.9%), internet (1.4%), and casinos (1.4%) also featured.
> The study shows there is relatively extensive betting on the national lottery, which is both more accessible and inexpensive, but because of barriers to entry such as price, less frequent involvement in other forms of gambling. However, of concern to us is the fact that adolescents are finding it possible to lay bets in more controlled environments such as casinos, or horse racing, by agency or otherwise circumventing admission restrictions.
> The study additionally found that there was a significant correlation between computer access at home, and higher-end gambling by young people. Advocate Majake said that students in wealthier urban areas were more likely to engage in organised gambling than their poorer counterparts, who tended to play dice or engage in other gambling activities that offered lower barriers to entry.
> Race is also a significant predictor of behaviour, especially in terms of the amount of money spent on gambling. Of those students who spend R200 or more gambling on a regular basis, 26.8% come from the Indian community, 19.8% from the white community, 18.4% from the coloured community and 8.5% from the black community.
> The incidence of learners gambling on the national lottery is highest in the Northern Cape (15.6%) and lowest in Limpopo (2.5%). In respect of casino gambling, prevalence levels are highest in the North West (2.6%), and lowest in the Western Cape (0.3%), and in horse racing the highest is KZN (2.8%) and the lowest Mpumalanga (0.7%).
> The National Gambling Board, he said, had recognised the dangers of adolescent gambling, and it was co-operating in specific awareness projects in schools in two provinces so far to educate young people.

Through the National Responsible Gambling Programme (NRGP), together with the provincial governments of Gauteng and the Western Cape, two groundbreaking programmes have been operating since 2002 which have seen 55 200 learners at 177 schools receive education about the risks posed by gambling (Wits University, Report on Youth Gambling, 2005)

In a similar study on mathematical literacy which was undertaken by Kim (2006), a Korean educator, 'mathematics of a lottery and gambling' did not feature in the Ten Least Preferred Items ranked by Korean grade 8, 9 and 10 learners. In fact, in her findings none of the three grades ranked 'mathematics of a lottery and gambling' in their ten least preferred contextual domains in which to embed school mathematics. It would have been interesting to know what ranking they did accord to 'mathematics of a lottery and gambling', but that was beyond the scope of her study.

4.3 Conclusion

Overall, judging from the rankings the different grades accorded to the different items, there seemed to be no significant differences in the contexts preferred by the three grades. It appears as if all three grades accord almost similar rankings to items and accord almost similar rankings to clusters also.

The last chapter follows and focuses on conclusions that can be drawn from the study and proposed recommendations.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This study investigated the contexts preferred by learners of mathematics in their individual grades which comprised grade 8, 9 and 10 learners. The assumption is that these contexts would contribute in a comprehensive way to the improvement of an environment that is conducive to effective and constructive mathematics learning and teaching. This study also investigated the items and clusters which made up the ten most and the ten least preferred contexts which grade 8, 9 and 10 learners preferred to deal with in mathematics. Chapter 1 listed two questions that this research attempts to answer. They were:

1. What are the contexts preferred by grade 8, 9 and 10 learners for learning mathematics?
2. Are there differences in the contexts preferred by grade 8, 9 and 10 learners for learning mathematics?

A summary of the answers to those questions will be given in this chapter. The limitations and significance of this study will also be mentioned and recommendations made for further research.

5.2 Summary

5.2.1 What are the contexts preferred by grade 8, 9 and 10 learners for learning mathematics?

An international mathematics study, the Third International Mathematics and Science Study (TIMMS) which previously focused on the 'pure' testing of curricular bound knowledge and is now focusing more on the functional application of mathematics in the context of the real world, has shown that South African learners performed poorly when compared to their counterparts from other countries. This clearly indicates the need for the school mathematics curriculum to be overhauled.

Grade 8, 9 and 10 learners ranked "mathematics that will help me to do mathematics at universities and technikons" as the most preferred context in which to embed school mathematics. This is in contrast to the grade 8 results of the TIMMS (2004) report as was alluded to in chapter four. The high preference accorded to disciplinary mathematics at institutions of higher learning indicate that learners across the three grades regard good performances in school mathematics as facilitating access into universities and technikons and hence better career opportunities. The item "Mathematics that is relevant to professionals such as engineers, lawyers and accountants" was ranked as the second most preferred context in which to embed high school mathematics by both grade 9 and 10 learners. This same item was ranked fifth by the eighth graders. What emerges from this is that learners' perceptions of mathematics being linked to the acquisition of good professions and careers and hence a better lifestyle than what they are currently experiencing. The second most preferred contextual domain in which to embed high school mathematics for the grade 8 learners was "Numbers" (the grade 9 learners ranked 'numbers' as their fourth most preferred contextual item where as the grade 10 learners ranked 'numbers' as their third most preferred contextual item). This high ranking, one could argue, can be attributed to the fact that the learners' school life experiences in the subject of mathematics had been one in which numbers were predominant. Their keen interest in attaining access to higher education and from there become professional career people, is driven by this great desire to be good in numbers and to understand it well.

'Mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM' was ranked very high by all three grades. Together with the test item 'mathematics involved in sending of messages by SMS, cell phones and e-mails', it appears as if technology is one of the foremost phenomena driving the interest levels of our youth. Today, our modes of communication are highly dependent on technologies such as the Internet, cell phones, computers, etc. These forms of communication have become part of our everyday life and reflect some new directions in the sphere of communications technology. It therefore forms an integral part of our learners' lives and shows clearly in their high ranking of mathematics involved in technologies such as ATM's and cell phones, etc.

Learners across grades 8 to 10 are generally interested in learning about how mathematics is applied to issues related to health with a very high interest in the mathematics involved in determining the health of a person. They also accorded high preference to the items which focused on the use of mathematics to alleviate poverty, generate employment and improve education; issues that require good governance and good fiscal practices.

The political cluster which include items such as 'mathematics political parties use for election purposes' and 'mathematics used to calculate the number of seats for parliament given to political parties after elections' appear to have little appeal for the learners across the grades as preferred contexts in which to embed school mathematics. This could have been influenced by frequent media reports of political parties fighting and political leaders being involved in fraud, theft, sexual harassment and violence.

Agriculture is also one of the least preferred clusters. The learners' low interest for the agricultural sector is also echoed by the larger community. The Centre for Development and Enterprise (CDE, 2005) reported that far fewer black South Africans want to farm than is commonly supposed and that most blacks regard jobs and housing in urban areas as more important priorities and that only 9 percent of black people who are currently not farmers have clear farming aspirations (Julie and Mbekwa, 2005). They suggest that much advocacy work would have to be done to encourage young people to go into farming and other agricultural careers to ensure a critical mass into this sector. Failing this, land reform policy will be nothing other than just policy.

'Mathematics of a lottery and gambling' received the lowest ranking by learners across the grades as a preferred context in which to embed school mathematics. This low ranking seem to be in line with the results of a study conducted by Wits University on youth gambling which was commissioned by the South African National Gambling Board (2005).

5.2.2 Are there differences in the contexts preferred by grade 8, 9 and 10 learners for learning mathematics?

The grade 10 learners have 'algebra' amongst their 10 most preferred items but not the grade 8's and 9's. Grade 8's and 9's have 'geometry' in their 10 most preferred items and not the grade 10's. Since algebra form part of disciplinary mathematics, one would have expected that all three grades would accord a very high preference to it. 'Mathematics involved in making computer games such as play stations and TV games' was not ranked within the 10 most preferred items of the grade 10 group. This was a surprising result given the overall high rankings learners across the three grades accorded to contextual items dealing with the technology cluster. 'Mathematics involved in making complex structures such as bridges' was ranked as the 10^{th} least preferred item by the grade 8's and fell outside the 10 least preferred items for grade 9's and 10's. 'Mathematics linked to designer clothes and shoes' was ranked as the 9^{th} least preferred item for grade 9's and as the 6^{th} least preferred item for the grade 10's. The grade 8's did not rank this item within its 10 least preferred.

Judging from the overall rankings the different grades accorded to the different items, there seems to be no significant differences in the contexts preferred by the three grades. It appears as if learners in all three grades accord almost similar rankings to items and accord almost similar rankings to clusters as well. This translates into no significant differences in the different grades' ten most preferred and ten least preferred rankings and it also shows the mathematics cluster as the most preferred and the agriculture cluster as the least preferred contextual domain the learners in all the grades are interested in learning about in mathematics. There also seem to be agreement across the three grades with regard to their interest in the health cluster, political cluster as well as the cluster dealing with fiscal issues and social upliftment. The item dealing with the 'mathematics of a lottery and gambling' achieved the status across all three grades for being ranked the least preferred.

5.3 Limitations

Due to time constraints and the magnitude of this study, further probing of learners' responses were not possible. This prompted me to enquire from my own learners as to why learners from the sampled population ranked the items in the questionnaire the way they did. It would have been ideal to probe the sampled learners themselves on their reasons for choosing certain contexts or not. Twelve Masters level students participated in the large project, the Relevance of School Mathematics Education (ROSME). Each one focused on his or her own research topic drawing on the relevant data collected. It would have been ideal if we had shared and tapped into each other's work more often than we did, but because we lived across the wide expanse of our country, it was not possible to meet that frequently and we also had to consider the scope of the mini-thesis. In this way we would have had a better overall impression of the contexts the sampled learners would find interesting. This exercise will be carried out post-thesis stage as a follow up to the larger ROSME project.

5.4 Recommendations

In South Africa and many other countries, including those countries whose learners achieved high scores in international comparative mathematics tests such as TIMMS, learners express difficulty in translating their mathematical knowledge to real-life contexts (Kim, 2006; Howie, 2002). In this study the contexts which grade 8, 9 and 10 learners preferred to deal with in learning mathematics were identified and expounded upon. Government, mathematics curriculum designers, educators, learners, parents, industry, and business have expressed the need for mathematics to be relevant to real life contexts. Since all these stakeholders want the mathematics curriculum to be relevant, it is hoped that they look more carefully at what learners find interesting to deal with in mathematics, which is the focus of this study.

5.5 Conclusion

Finally, if the Revised National Curriculum Statement (2002), implementation of the mathematical literacy curriculum in schools and Outcomes-Based Education are to be more than just a political statement, the National Education Department needs to monitor if and when mathematics is made more relevant and contextualised. The implementation of the mathematical literacy school subject must be carefully monitored to see whether it makes some impact in terms of relevance and the DoE must be able to provide assistance where necessary. At the moment the implementation of the mathematical literacy curriculum and OBE depends on the teachers and it is not the policymakers who determine the outcomes of schooling but the teachers in the classrooms (Sebakwane, 1997). The significance of a study like the current study is that it provides some insights into what learners prefer as context for learning mathematics so that we as teachers can bring fun and creativity back into mathematics teaching and learning. Julie (2006) for example proposes Mathematics for action in which the “Teachers' interests for contexts related to issues of social import from the background of students provide a base for action orientedness in Mathematical Literacy” (Julie, 2006: 56). Examples he mentions include letter writing to the press and staging demonstrations aimed at for example poverty alleviation.

The greatest gain which can be achieved by incorporating at least some of the preferred contexts learners have identified in terms of school mathematics has to be the possibility of persuading them to have a better interest in schooling as a possible way in which to “move up and move out” as Julie and Mbekwa (2005) puts it. There is however a place too for the least preferred context especially if teachers and curriculum designers are forward looking enough to know what students could benefit from in the future.

REFERENCES

Aris, R 1979. *Mathematical modelling techniques*. San Fransisco: Pitman Publishing Limited

Blum, W and Niss, M 1991. Applied Mathematical Problem Solving, Modelling, Applications and Links to other subjects-state, trends and issues in mathematics instruction, educational studies in mathematics, 22.38-68

Boaler, J 1993. The Role of Contexts in the Mathematics Classroom: do they make mathematics more real? For the learning of Mathematics, 13 (2) 12-17

Boyce, W E 1994. New directions in elementary differential equations. *The College mathematics Journal* 25 (5), 364-371

Bussiere, P 2004. *Measuring up: Canadian Results of the OECD PISA Study-: The Performance of Canada's Youth in Mathematics, Reading, Science and Problem Solving.*
www.pisa.gc.ca/81-590-xie2004001.pdf

Cape Argus, 2006. Headline: *Grade 10 crisis over new exam*. 24 July 2004

Cockroft, W H 1982. Department of Education and Science (UK). *Mathematics counts.*

Choike, J R 2000. Teaching Strategies for "Algebra for All". *Mathematics Teacher*. Volume 93, 7, 556-560

Collins English Dictionary, 1992. 2 ed. Oxford Press. U.K

Damian, C 2001. It's About Relevancy
http://H:/ ENC Online It's About Relevancy (July 2006)

Davis, P and Hersh, R 1986. *Decartes'dream: The word according to mathematics.* London: Penguin Books.

De Bock D, Verschaffel l, Janssens D, Van Doorn W and Claes K 2003. Do realistic contexts and graphical representations always have a beneficial impact on students' performance? Negative evidence from a study on modelling non-linear geometry problems. Learning and instruction, 13(4), 441-463

Doyle, D P 1994. Reinventing education: Entrepreneurship in American schools. New York: Dutton

Dugmore, C. (2005). MEC speech to 200 exceptional grade 12 mathematics learners. Retrieved February 28, 2005 from http://intrawp.pgwc.gov.za/Content/Posting.aspx?contentid=3627

Edwards, E and Ruthven, K 2003. Young people's perceptions of the mathematics involved in everyday activities. Educational Research Journal, 45(3Winter), 249-260

Field, A 2005. Discovering statistics using SPSS. 2 ed. London: SAGE Publication

Freudenthal, H 1991. Revisiting mathematics education. Dordrecht: Reidel Publishing Company.

Freudenthal, H 1973. Mathematics as an education task. Dordrecht: Reidel Publishing Company.

Freudenthal, H 1978. Weeding and sowing: Preface to a science of mathematical education. Dordrecht: Reidel Publishing Company.

Garfunkel, S 2004. The good fight. The UMAP Journal, 25(3), 185-189

Hanharan, S A 2000. Widening access to a South African university: an approach used to redress inequality of the past education system. http://intl.concord.org/cbe/papers/Hanharan.htl (July 2006)

Hidi, S and Ainley, M 2002. Interest and Adolescence. In F. Pajares and T. Urdan (Eds.), *Academic motivation of adolescents*, pp. 247-275. Greenwich: Information Age.

Hobbs, D 1988. Doing the business: Entrepreneurship, the Working Class, and Detectives in East London, Oxford, Clarendon Press.

Howie, S 2002. Third International Mathematics and Science Study Repeat (TIMSS-R) Executive Summary. The Human Sciences Research Council. Pretoria

Jablonka, E 2003. Mathematical Literacy, in Bishop, A J, Clements, M A, Keitel, C, Kilpatric,K and Leung, F K S (Eds), *Second international handbook of mathematicseducation*, pp 77- 104. Dordrecht: kluwer Academic Publishers

Julie, C. 1997. An interpretation of the specific Outcomes of the learning area: Mathematical Literacy, Mathematics and Mathematical Sciences as artifacts of the Mathematical Sciences. Department of Didactics, School of Sciences and Mathematics Education, University of the Western Cape, Bellville.

Julie, C and Mbekwa, M 2005. What would grade 8 to 10 learners prefer as context for mathematical literacy? The case of Masilakele Secondary School. Perspective in Education, 23 (3), 31- 43

Julie, C. 2006. Teachers' preferred contexts for Mathematical Literacy as possible initiators. African Journal of Research in SMT Education, Vol.10(2) 2006, pp. 49-58

Kaiser, G 2005. Mathematical modelling in school: examples and experiences. Presented at the fourth Congress of the European society for Research in Mathematics Education (CERME 4), 17 – 21 February 2005 in Sant Feliu de Guixols, Spain, YERME day: 16-17 February.

Kim, S H 2006. Preferred Contexts for Mathematical Literacy of Korean Grade 8-10 Learners, p12

Kloz, G 1996. Public Understanding of Mathematics.

Köller, O, Baumert, J and Schnabel, K 2001. Does interest matter? The relationship between academic interest and achievement in mathematics. *Journal for Research in Mathematics Education*, 32, 448-470

Lehman, E L 1975. Nonparametrics: Statistical Methods Based on Ranks. San Francisco: Holden: Day, Inc.

Levin, R I 1978. Statistics for Management. Englewood Cliffs, N J: Prentice Hall

Mullis I V S, Martin M O, Gonzalez E J and Chrostowski S J 2004. TIMSS 2003 International Mathematics Report: Findings From IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades. TIMSS & PIRLS International Study Center: Boston.

Nakagomi, K 2000. Gathering Circles: An Experience in Creativity and Variety. *MathematicsTeacher*. December 2000.Volume 93, 9,746 -751.

National Council of Teachers of Mathematics, 1989. *Curriculum and evaluation standards for school mathematics*. Reston, Virginia

National Department of Education. 2002. Revised National Curriculum Statement Grades R - 9 (Schools) POLICY. Overview English. Cape Town: Government Printer.

National Department of Education, 2002. National Curriculum Statement Grades 10-12 (schools). Pretoria

National Department of Education, 2005. National curriculum statement grades 10-12: Learning programme guidelines mathematical literacy. Republic of South Africa.

National Gambling Board, 2005. A report by Wits University on youth gambling, July 2005

Niss, M. 1989. International Journal of mathematics, Science and Technology, 1987, vol18, no 4. P487 - 5050. Taylor & Francis Ltd. Philadelphia, Pennsylvania

Niss, M (1996). Goals of Mathematics Teaching. In A.J.Bishop, K. Clements, C. Keitel, J. Kilpatric & C. La-borde (eds). Second International Handbook of Mathematics Education p.16. The Netherlands, Dordecht: Kluwer Academic Publishers.

OECD, 2001. Measuring Student's knowledge and skills: A new framework for assessment.

Reagan, R 1986. Proclamation 5461- National Mathematics Awareness Week, 1986

Romberg, T A 2001. Mathematical Literacy: What does it mean for school mathematics? Wisconsin School News: October 2001, pp 5-8

Sebakwane, S. 1997. Controlling teachers' work: the South African state and curriculum control. *Qualitative Studies in Education 10 (2):191 - 206.*

Schiefele, U 1992. Topic interest and levels of text comprehension, in K A Renninger, S Hidi, and A Krapp (eds), The role of interest in learning and development. Hillsdale, NJ: Earlbaum.

Simon, J L 1969. Basic research methods in social science. 2 ed. N Y: Random House.

Stell, R G D and Torrie, H H 1980. Principles and Procedures of Statistics: A biometrical approach. 2 ed. Tokyo: McGraw – Hall Inc.

The Centre for Development and Enterprise. 2005. *Land reform in South Africa: A 21st century perspective*. Research report no. 14. Johannesburg

The Times Educational Supplement 1997. September 12, p3. United Kingdom

Van den Heuvel-Panhuizen, M 1998. Realistic Mathematics Education: work in progress. Presented at NORMA 98, The 2nd Nordic Conference on Mathematics Education, June 5-9, 1998, Kristiansand, Norway. (Retrieved from http://www.fi.uu.nl/en/rme/)

Villarrubia, B 2001. Mathematics in Context (MiC). Encyclopaedia Britannica

APPENDICES

Appendix A

CODE:…………………

RELEVANCE OF SCHOOL MATHEMATICS EDUCATION (ROSME)

January 2005

Things I'd like to learn about in Mathematics

I am: a female …… a male ….. I am ……. years old

I am in Grade …………….

What would you like to learn about in mathematics? Some possible things are in the list on the following pages. Beside each item in the list, circle only one of the numbers in the boxes to say how much you are interested. Please respond to all the items.

1 = Not at all interested
2 = A bit interested
3 = Quite interested
4 = Very interested

There are no correct answers: we want you to tell us what you like.
The items are not in any specific order of importance.

Thank you for your co-operation!

For office use	Things I'd like to learn about in Mathematics	Not at all interes-ted	A bit interes-ted	Quite interes-ted	Very interes-ted
C1	Mathematics linked to designer clothes and shoes	1	2	3	4
C2	Mathematics of a lottery and gambling	1	2	3	4
C3	Mathematics involved in making computer games such as play stations and TV games	1	2	3	4
C4	Why mathematicians sometimes disagree	1	2	3	4
C5	Mathematics used to predict the growth and decline of epidemics such as AIDS; tuberculosis and cholera	1	2	3	4
C6	The personal life stories of famous mathematicians	1	2	3	4
C7	Mathematics used in making aeroplanes and rockets.	1	2	3	4
C8	How to estimate and predict crop production	1	2	3	4
C9	Mathematics to predict whether certain species of animals are on the brink of extinction	1	2	3	4
C10	Mathematics political parties use for election purposes	1	2	3	4
C11	Mathematics that is relevant to professionals such as engineers, lawyers and accountants	1	2	3	4
C12	How mathematics is used to predict the spread of diseases caused by weapons of mass destruction such as chemical, biological and nuclear weapons	1	2	3	4
C13	Mathematics involved in designing delivery routes of goods such as delivering bread from a bakery to the shops.	1	2	3	4

C14	Mathematics needed to work out the amount of fertilizer needed to grow a certain crop	1	2	3	4
C15	Mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM	1	2	3	3
C16	Mathematics used to calculate the taxes people and companies must pay to the government	1	2	3	4
C17	Mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of a certain size	1	2	3	4
C18	Mathematics of inflation	1	2	3	4
C19	Mathematics about renewable energy sources such as wind and solar power	1	2	3	4
C20	Mathematics involved in determining the state of health of a person	1	2	3	4
C21	Mathematics to assist in the determination of the level of development regarding employment, education and poverty of my community	1	2	3	4
C22	Mathematics to prescribe the amount of medicine a sick person must take	1	2	3	4
C23	Mathematics that will help me to do mathematics at universities and technikons	1	2	3	4
C24	Mathematics involved in the placement of emergency services such as police stations, fire brigades and ambulance stations so that they can reach emergency spots in the shortest possible time	1	2	3	4

C25	Mathematics involved in making complex structures such as bridges	1	2	3	4
C26	The kind of work mathematicians do	1	2	3	3
C27	Geometry	1	2	3	4
C28	Mathematics involved in packing goods to use space efficiently	1	2	3	4
C29	How mathematicians make their discoveries	1	2	3	4
C30	Mathematics linked to South African pop music	1	2	3	4
C31	Mathematics used to calculate the number of seats for parliament given to political parties after elections	1	2	3	4
C32	Mathematics involved in assigning people to tasks when a set of different tasks must be completed	1	2	3	4
C33	Blunders and mistakes some mathematicians have made	1	2	3	4
C34	Algebra	1	2	3	4
C35	Mathematics about the age of the universe	1	2	3	4
C36	Mathematics involved in working out the best arrangement for planting seeds	1	2	3	4
C37	Mathematics to determine the number of fish in a lake, river or a certain section of the sea	1	2	3	4
C38	Mathematics linked to music from the United States, Britain and other such countries	1	2	3	4
C39	Mathematics that air traffic controllers use for sending off and landing planes	1	2	3	4
C40	Mathematics linked to rave and disco dance patterns	1	2	3	4
C41	Mathematics involved in making pension and retirement schemes	1	2	3	4

C42	Mathematics of the storage of music on CD's	1	2	3	4
C43	Mathematics linked to decorations such as the house decorations made by Mdebele women	1	2	3	3
C44	Mathematical ideas that have had a major influence in world affairs	1	2	3	4
C45	Numbers	1	2	3	4
C46	Mathematics involved in sending of messages by SMS, cellphones and e-mails	1	2	3	4
C47	Mathematics involved in working out financial plans for profit-making	1	2	3	4
C48	Mathematics involved in my favourite sport	1	2	3	4
C49	Mathematics involved in dispatching a helicopter for rescuing people	1	2	3	4
C50	Mathematics used to work out the repayments (instalment) for things bought on credit are worked out	1	2	3	4
C51	How to predict the sex of a baby	1	2	3	4
C52	How mathematics can be used by setting up a physical training program, and measure fitness	1	2	3	4
C53	Strange results and paradoxes in Mathematics	1	2	3	4
C54	Mathematics to monitor the growth of a baby the first period of life	1	2	3	4
C55	Mathematics that entertain and surprise us	1	2	3	4
C56	Mathematics to describe facts about diminishing rain forest and growing deserts	1	2	3	4

C57	How mathematics can be used in planning a journey	1	2	3	4
C58	How mathematics can be used in sport competitions like ski jumping, athletics, aerobics, swimming, gymnastics and soccer	1	2	3	3
C59	Mathematics to describe movement of big groups of people in situations such as emigration and refugees fleeing from their countries	1	2	3	4
C60	Mathematics involved in determining levels of pollution	1	2	3	4
C61	Mathematics involved in military matters	1	2	3	4

C62 Please write down 3 issues that you are very interested in learning about the use of mathematics in these issues.

(a) ....

(b) ....

(c) ....

Why are you interested in these issues?

....

....

C63 Are you interested in learning something on mathematics that arises while you are learning other school subjects?

YES ....

Why? ....

....

....

....

NO ....

Why not?..

....

....

C64 Are you interested in learning something on mathematics related to issues that have been in the newspaper or radio or TV recently?

YES ....

Why? ....

....

NO ....

Why not?..

....

C65 Make a sketch or drawing of a mathematician working.

Appendix B: Kendall W ranking of grade 8 items

Ranks(a)

Mean Rank	Items
43.72	Mathematics that will help me to do mathematics at universities and technikons
41.62	Numbers
40.93	Mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM
40.33	Mathematics involved in sending of messages by SMS, cellphones and e-mails
39.91	Mathematics that is relevant to professionals such as engineers, lawyers and accountants
38.04	Mathematics involved in making computer games such as play stations and TV games
37.95	The kind of work mathematicians do
37.14	Geometry
36.53	Mathematics involved in working out financial plans for profit-making
36.12	Mathematics of the storage of music on CD's
35.33	Mathematics involved in determining the state of health of a person
34.53	Mathematics to prescribe the amount of medicine a sick person must take
34.52	Mathematics used to calculate the taxes people and companies must pay to the government
33.94	The personal life stories of famous mathematicians
33.89	Mathematics involved in the placement of emergency services such as police stations, fire brigades and ambulance stations so that they can reach emergency spots in the shortest possible time
33.84	Mathematics that entertain and surprise us
33.70	How to predict the sex of a baby
33.69	How mathematics can be used in sport competitions like ski jumping, athletics, aerobic, swimming, gymnastics and soccer
33.65	Mathematics used to predict the growth and decline of epidemics such as AIDS; tuberculosis and cholera
33.36	How mathematics is used to predict the spread of diseases caused by weapons of mass destruction such as chemical, biological and nuclear weapons
33.04	Mathematics linked to music from the United States, Britain and other such countries
32.96	Mathematics linked to South African pop music
32.87	How mathematicians make their discoveries

Appendix B: Kendall W ranking of grade 8 items (continued)

32.76	Mathematics involved in my favourite sport
32.47	How mathematics can be used by setting up a physical training program, and measure fitness
31.69	Mathematics used to work out the repayments (instalment) for things bought on credit are worked out
31.61	Mathematics to assist in the determination of the level of development regarding employment, education and poverty of my community
31.29	Mathematics linked to rave and disco dance patterns
31.09	Mathematical ideas that have had a major influence in world affairs
30.80	Mathematics to monitor the growth of a baby the first period of life
30.44	How mathematics can be used in planning a journey
30.08	Algebra
29.94	Mathematics involved in military matters
29.88	Mathematics that air traffic controllers use for sending off and landing planes
29.83	Mathematics involved in assigning people to tasks when a set of different tasks must be completed
29.80	Mathematics about renewable energy sources such as wind and solar power
29.52	Mathematics to describe movement of big groups of people in situations such as emigration and refugees fleeing from their countries
29.46	Mathematics about the age of the universe
29.41	Mathematics used in making aeroplanes and rockets.
29.19	Mathematics linked to designer clothes and shoes
29.11	Mathematics involved in dispatching a helicopter for rescuing people
28.94	Why mathematicians sometimes disagree
28.36	Mathematics involved in determining levels of pollution
27.26	Mathematics to determine the number of fish in a lake, river or a certain section of the sea
27.05	Mathematics political parties use for election purposes
27.04	Mathematics involved in designing delivery routes of goods such as delivering bread from a bakery to the shops
26.98	Mathematics involved in making pension and retirement schemes
26.08	Mathematics needed to work out the amount of fertilizer needed to grow a certain crop
25.54	Mathematics to predict whether certain species of animals are on the brink of extinction
25.48	Mathematics involved in making complex structures such as bridges
25.17	Strange results and paradoxes in Mathematics
24.85	Mathematics involved in packing goods to use space efficiently
24.77	Mathematics to describe facts about diminishing rain forest and growing deserts

Appendix B: Kendall W ranking of grade 8 items (continued)

24.33	Blunders and mistakes some mathematicians have made
24.07	Mathematics involved in working out the best arrangement for planting seeds
23.98	Mathematics of inflation
23.88	Mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of a certain size
23.51	Mathematics used to calculate the number of seats for parliament given to political parties after elections
20.05	Mathematics of a lottery and gambling

Appendix C : Kendall W ranking of grade 9 items

Ranks(a)

Mean Rank	Items
46.67	Mathematics that will help me to do mathematics at universities and technikons
40.81	Mathematics that is relevant to professionals such as engineers, lawyers and accountants
40.56	Mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM
39.38	Numbers
38.34	Mathematics involved in sending of messages by SMS, cellphones and e-mails
36.80	Geometry
36.67	Mathematics involved in working out financial plans for profit-making
36.37	Mathematics involved in making computer games such as play stations and TV games
36.10	Mathematics to prescribe the amount of medicine a sick person must take
35.90	The kind of work mathematicians do
35.85	Mathematics involved in the placement of emergency services such as police stations, fire brigades and ambulance stations so that they can reach emergency spots in the shortest possible time
35.33	Mathematics to assist in the determination of the level of development regarding employment, education and poverty of my community
35.13	Mathematics of the storage of music on CD's
34.50	How to predict the sex of a baby
34.35	Mathematics involved in determining the state of health of a person
34.26	Mathematics used to calculate the taxes people and companies must pay to the government
34.15	Mathematics involved in my favourite sport
34.14	Algebra
34.10	Mathematics about the age of the universe
34.05	How mathematicians make their discoveries
34.03	How mathematics can be used in sport competitions like ski jumping, athletics, aerobic, swimming, gymnastics and soccer
33.58	How mathematics can be used by setting up a physical training program, and measure fitness
33.49	Mathematics to monitor the growth of a baby the first period of life
33.06	Mathematics linked to music from the United States, Britain and other such countries

Appendix C : Kendall W ranking of grade 9 items (continued)

32.76	Mathematics that entertain and surprise us
32.55	Mathematics used to predict the growth and decline of epidemics such as AIDS; tuberculosis and cholera
32.34	Mathematics involved in dispatching a helicopter for rescuing people
32.21	How mathematics is used to predict the spread of diseases caused by weapons of mass destruction such as chemical, biological and nuclear weapons
31.80	Mathematics used to work out the repayments (instalment) for things bought on credit are worked out
31.62	Mathematics that air traffic controllers use for sending off and landing planes
31.51	Mathematics linked to rave and disco dance patterns
31.41	How mathematics can be used in planning a journey
30.68	Mathematics about renewable energy sources such as wind and solar power
30.67	Mathematics linked to South African pop music
30.67	Mathematical ideas that have had a major influence in world affairs
30.30	Mathematics used in making aeroplanes and rockets.
30.24	Why mathematicians sometimes disagree
29.75	Mathematics involved in military matters
29.43	Mathematics to predict whether certain species of animals are on the brink of extinction
28.63	Mathematics involved in assigning people to tasks when a set of different tasks must be completed
28.53	The personal life stories of famous mathematicians
28.42	Mathematics involved in making pension and retirement schemes
27.71	Blunders and mistakes some mathematicians have made
27.56	Mathematics of inflation
27.38	Mathematics involved in making complex structures such as bridges
26.82	Strange results and paradoxes in Mathematics
26.70	Mathematics involved in determining levels of pollution
26.21	Mathematics to describe facts about diminishing rain forest and growing deserts
26.07	Mathematics to determine the number of fish in a lake, river or a certain section of the sea
26.07	Mathematics to describe movement of big groups of people in situations such as emigration and refugees fleeing from their countries
26.02	Mathematics political parties use for election purposes
25.76	Mathematics used to calculate the number of seats for parliament given to political parties after elections
25.29	Mathematics linked to designer clothes and shoes

Appendix C : Kendall W ranking of grade 9 items (continued)

24.50	How to estimate and project crop production
23.80	Mathematics involved in designing delivery routes of goods such as delivering bread from a bakery to the shops
23.49	Mathematics involved in packing goods to use space efficiently
22.25	Mathematics involved in working out the best arrangement for planting seeds
22.21	Mathematics linked to decorations such as the house decorations made by Ndebele women
21.33	Mathematics needed to work out the amount of fertilizer needed to grow a certain crop
20.53	Mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of a certain size
20.18	Mathematics of a lottery and gambling

Appendix D : Kendall W ranking of grade 10 items

Ranks(a)

Mean Rank	Items
49.60	Mathematics that will help me to do mathematics at universities and technikons
45.58	Mathematics that is relevant to professionals such as engineers, lawyers and accountants
42.78	Numbers
41.46	The kind of work mathematicians do
41.32	Mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM
41.02	Mathematics involved in working out financial plans for profit-making
39.93	Algebra
38.21	How mathematicians make their discoveries
37.74	Mathematics involved in sending of messages by SMS, cellphones and e-mails
37.60	Mathematics to prescribe the amount of medicine a sick person must take
37.48	Mathematics to assist in the determination of the level of development regarding employment, education and poverty of my community
37.32	Mathematics used to calculate the taxes people and companies must pay to the government
37.12	Geometry
36.41	How mathematics is used to predict the spread of diseases caused by weapons of mass destruction such as chemical, biological and nuclear weapons
35.81	Mathematics involved in determining the state of health of a person
35.77	Why mathematicians sometimes disagree
35.56	Mathematics that entertain and surprise us
35.10	Mathematical ideas that have had a major influence in world affairs
35.04	Mathematics involved in making computer games such as play stations and TV games
34.91	Mathematics used to predict the growth and decline of epidemics such as AIDS; tuberculosis and cholera
34.75	How to predict the sex of a baby
34.62	Mathematics involved in the placement of emergency services such as police stations, fire brigades and ambulance stations so that they can reach emergency spots in the shortest possible time

Appendix D : Kendall W ranking of grade 10 items (continued)

33.95	Mathematics used to work out the repayments (instalment) for things bought on credit are worked out
33.07	Mathematics to monitor the growth of a baby the first period of life
32.99	Mathematics about the age of the universe
32.79	Blunders and mistakes some mathematicians have made
32.74	Mathematics of the storage of music on CD's
31.68	Mathematics used in making aeroplanes and rockets.
31.61	Mathematics that air traffic controllers use for sending off and landing planes
31.59	How mathematics can be used by setting up a physical training program, and measure fitness
31.30	Mathematics about renewable energy sources such as wind and solar power
31.19	Mathematics to predict whether certain species of animals are on the brink of extinction
30.75	Mathematics involved in dispatching a helicopter for rescuing people
30.36	Mathematics involved in military matters
29.19	Mathematics involved in my favourite sport
29.13	How mathematics can be used in sport competitions like ski jumping, athletics, aerobic, swimming, gymnastics and soccer
28.96	Mathematics of inflation
28.34	Mathematics involved in making complex structures such as bridges
28.08	The personal life stories of famous mathematicians
27.94	Mathematics involved in determining levels of pollution
27.34	Mathematics linked to music from the United States, Britain and other such countries
27.31	Strange results and paradoxes in Mathematics
27.25	Mathematics involved in making pension and retirement schemes
26.12	Mathematics involved in assigning people to tasks when a set of different tasks must be completed
26.01	Mathematics linked to South African pop music
25.64	How mathematics can be used in planning a journey
25.62	Mathematics linked to rave and disco dance patterns
25.51	Mathematics to describe movement of big groups of people in situations such as emigration and refugees fleeing from their countries
25.16	How to estimate and project crop production
25.16	Mathematics to determine the number of fish in a lake, river or a certain section of the sea
24.26	Mathematics to describe facts about diminishing rain forest and growing deserts
22.98	Mathematics political parties use for election purposes
22.73	Mathematics used to calculate the number of seats for parliament given to political parties after elections

Appendix D : Kendall W ranking of grade 10 items (continued)

21.61	Mathematics involved in working out the best arrangement for planting seeds
21.56	Mathematics involved in packing goods to use space efficiently
21.39	Mathematics linked to designer clothes and shoes
19.88	Mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of a certain size
19.84	Mathematics needed to work out the amount of fertilizer needed to grow a certain crop
18.70	Mathematics involved in designing delivery routes of goods such as delivering bread from a bakery to the shops
18.56	Mathematics linked to decorations such as the house decorations made by Ndebele women
17.60	Mathematics of a lottery and gambling