A comparison of grade 8 to10 urban and peri-urban learners' context preferences for mathematical literacy.

Christopher Blaauw

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Supervisors:

Prof. Cyril Julie (University of the Western Cape, South Africa)

Dr. Monde Mbekwa (University of the Western Cape, South Africa)

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KEYWORDS

Mathematical Literacy

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Relevance of Mathematics

Learners' interest in Mathematics

Urban

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ABSTRACT

A comparison between the contexts grade 8 to 10 urban and peri-urban learner's context preferences for Mathematical Literacy.

The study explored the comparison of grade 8 to 10 urban and peri-urban learners' contexts preferences in mathematical literacy. There is currently a strong emphasis on the use of contexts for school mathematics. This has been also the case for South Africa when grade 10 learners have to make a choice between mathematics and mathematical literacy as one of their compulsory subjects for grade 10.

This study focused more on the use of mathematics in real life situations. Data was collected by using questionnaires developed as part of the Relevance of School Mathematics Education (ROSME) project. The questionnaire dealt with contexts preferred by grade 10 learners from urban and peri-urban areas.

The data were analysed using non-parametric statistical techniques. The findings radicate that there were contexts highly preferred by learners from both urban and peri-urban areas; least preferred by learners from both areas, highly preferred by learners from peri-urban areas but not by learners from urban areas and least preferred by learners from urban areas but not by those from peri-urban areas and vice versa.

It is recommended that contexts highly preferred by learners should be incorporated in the learning experiences of learners.

DECLARATION

I declare that *A comparison of grade8 to 10 urban and peri-urban learners' context preferences for mathematical literacy* is my 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 indicated and acknowledge as complete references.

Christopher Blaauw September 2009

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Table of Contents

Contents

CHAPTER 1
Introduction

1.1 Purpose

This study focuses on the contexts learners in grade 8 to grade 10 prefer to deal with in Mathematical Literacy. Contexts within this study refer to identified clusters, for example mathematics, health relevant to the situation of these learners. Specifically the question on whether there are differences between the contexts preferred by learners from urban and peri-urban areas was investigated.

1.2 Motivation of the study

There is a need and call for the relevance (Matang, 2002; National research council, 2004; Wong, 1997) of school mathematics. Relevance in this case means providing learners with knowledge and skills to apply mathematics to real life situations or to mathematise contextual situations. Mathematical literacy primarily deals with contexts. This implies that mathematical problems are set within a context, for example finance. The notion of relevance of mathematics is thus closely linked to mathematical literacy.

Education authorities within the South African context are keen that the ideal of relevance should be dealt with in school mathematics. This was captured in the White Paper on Education and Training (Department of Education, 1995) making mathematics or mathematical literacy compulsory for all grade 10 to 12 learners from 2006. Consequently, that the first national examination for the grade 12 cohort was written in 2008 for the mathematics and mathematical literacy. On examining the stated aims of the new educational guidelines of South Africa, one can therefore clearly see congruence in terms of its stated goals to both the external and internal aims suggested by Niss (1996) .This study therefore leans heavily upon the ideas put forward by Niss (1996), since the emphasis placed on attaining equity in education, stimulating and emphasising interest in technology as well as the broader function that education is suppose to play He postulates the following aims, geared towards to mathematical literacy, under the headings of exterior and interior aims. Exterior refers to the aims within society, whilst interior refers to the aims within the classroom setting.

Exterior aims:

- To provide substantial mathematics 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 and 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 pupils' mathematical activity rather than their passive acquisition of knowledge;
- To emphasize mathematical processes (such as exploration, investigation, conjecturing, problem posing/solving/formulation, 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 analyze 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 mathematics. (Niss, 1996, pp. 32-33)

As mentioned earlier, all South African learners must complete their schooling with either mathematics or mathematical literacy as one of their school subjects. This requirement coincides with the very first aim of Niss (1996) which pleas for mathematics for all. He 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 social life, including active and considered citizenship in a democratic society. This idea leads up to this research in order to find out what the preferences for mathematical literacy contexts are of learners in urban and peri-urban environments.

I would like to mention at this stage that during my experience as a teacher for nearly 30 years, learners were interested in the value of mathematics in their daily lives. They would frequently ask “Where will we use this mathematics that we are doing?” In my opinion contextually-based mathematical problems driven to some extent by the interest of learners may contribute towards satisfying learners’ curiosity in this regard.

Contextually-embedded school mathematics is not unproblematic De Lange (1996, p. 87) as illustrated by the following scenario that played itself out in the Netherlands where context-driven school mathematics has been followed for some time:

> In the Netherlands a group was formed during the seventies to battle against the innovation called Realistic Mathematics Education. For a short period, it had considerable success in pointing out that basic skills were threatened. A report in the Netherlands seems to indicate that at the primary school level the "new" students performed equally well in basic skills as the students in the old curriculum, and that they outperformed students in the old curriculum in the field of problem solving.

The above description of De Lange (1996) highlights that at least at primary school level contextually-driven mathematics does not impact negatively on learner achievement. One of the key features of curriculum changes in South Africa with regard to the introduction of mathematical literacy, which is a new subject in the Further Education and Training (FET)-band, is that it will be to large extent context-driven. Obviously, no claims can be made that dealing with contexts in mathematical literacy will contribute towards the alleviation of difficulties learners experience with mathematics. On the contrary, it might introduce a different set of difficulties.

One of the difficulties might be the contexts that are used. In almost all cases the designers (policy makers, curriculum designers, educational authorities, text book writers, etc.) of mathematical learning resources are adults. They use contextual situations which they perceived to be of use for learners' individual, societal, current and "futuristic" needs. Of course, there is nothing wrong with such a process, since the expertise of adults place them in a position to determine the prospective demands. It could be of value to the designers of learning materials, examinations and tests to have some idea of the preferences learners have for contextual situations to be used in mathematical literacy. This study, therefore, focuses on the contexts which learners will find interesting to deal with in the pursuit to embrace the relevance of Mathematics.

Choike (2000) shared his teaching strategies and recommended that the teachers should mould lessons, whenever it is possible, around the interests of individual learners. He mentioned that the following situation which actually occurred in a ninth grade algebra class was 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 a 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 quickly 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 care less about sheep in a pen.
>
> The teacher discovered that the student liked flowers, in particular 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, p.560)

This extract confirms that contexts that interest learners, increase involvement or engagement into the problem and raises their chances to make meaning and mathematical problem solving possible.

Clarke and Helme (1996), however, draw attention to contexts not being a simple matter. They distinguish between figurative context and interactive context. The figurative context refers to the real scenario the task is embedded in and the interactive context describes how the task is encountered by a student. Stillman (1998) explores the connection between students' performances on application tasks and their engagement with the figurative context of the task. The findings showed that there was a link but that further factors must be considered in order to explain the results obtained.

1.3 Research Question

The main research question for this study is whether there are differences between the context learners in grades 8 to 10 from urban and peri-urban areas prefer to deal with in mathematical literacy.

1.4 Conclusion

This chapter provides a rationale to pursue the focus question: What are grade 10 learners' contextual preferences and how do these preferences compare across urban and peri-urban areas. Chapter 2 deals with the literature review and in Chapter 3 the research methodology is presented. Chapter 4 deals with the findings from the analysis of the data. In Chapter 5 the conclusions and recommendations emanating from the study are discussed.

CHAPTER 2

Literature Review

2.1 Introduction

In this chapter the idea of relevance is discussed. Relevance is linked to contexts and since mathematical literacy deals primarily with contexts, mathematical literacy is explored. Mathematical literacy is embedded in mathematical modelling and the applications of mathematics and hence a discussion of mathematical modelling and the applications of mathematics are dealt with. The relevant literature related to these issues is explored.

2.2 Relevance of Mathematics

The debate about and search for relevance of mathematics (Matang, 2002; National research council, 2004; Wong, 1997) is prominent in many countries and has been pursued over a long period of time. This will always be the case since mathematics is one of the subjects that are a key and critical factor for careers related to economic and other forms of development. Ernest (1996) posits that mathematics is generally seen to fulfil social needs, to provide the skills relevant for everyday life and work in industrial and developing societies, as well as the basis for further study in mathematics, science and technology. The selection of content and the mode of teaching of mathematics is often claimed to be driven by relevance to these needs. This is widely agreed upon.

Ernest (1996) states that what is often overlooked, perhaps less so today, is that relevance and needs are not neutral objective judgments, but are based on the perspective of the judge, and the aims at which the judgment is directed. Any such judgment, however much integrity is involved, is determined by what the maker of judgments considers to be appropriate or right (Ernest, 1996). This means that if the judgment is based on the perspective of the judge, it is no longer objective. Relevance and needs will thus implicate different accentuations for different people.

The Compact Oxford English for Students (2006, p. 867) defines relevance as: “closely connected or appropriate to the matter current at hand.”

On the other hand relevance could also embrace the whole idea of interest. In this study I will frequently use the term interest as a notion that also embraces the concept of relevance.

Relevance could relate to every sphere of society. Human beings are by nature societal beings. Some of the different spheres of societal involvement could be open to quantitative, numerical or mathematical interpretation. It is thus expected that people should make some sense of the mathematically-based arguments or situations. It is expected that in schools the competence to deal with mathematically-based societal issues can be developed through mathematical literacy which is discussed in the next section.

2.3 Mathematical Literacy

The term literacy broadly refers to the use of human language. When human beings are able to read, write and listen but also able to use a language in a variety of situations at hand, they are regarded as literate. In this regard Romberg (2001, p.5) asserts that:

> A person to be literate in a language implies that he or she knows many of the desire sources of the language and is able to use those resources for several different social functions. When analogously considering mathematics as a language implies that students not only must learn the concepts and procedures of mathematics (its design features), but they must learn to use such ideas to solve non-routine problems and learn to mathematise in a variety of situations (its social functions).

This notion can be regarded as relevant mathematical literacy as learners have to show that they could apply what was learnt in the school classroom in different situations.

Generally to be literate means to have the appropriate skills to cope and make judgments pertaining to the issue at hand. In my opinion, specialists are those who possess specialist mathematical knowledge, design and apply their knowledge in the construction of models or devices. The users (general public) should be at ease to understand and use those models or devices to cope, criticize, and even redesign it to consider its benefits for society. In this sense one can describe such a person as literate or not.

In the FET band, there is a clear distinction between mathematics and mathematical literacy, as separate subjects. In The National Curriculum Statement (NCS) developed by the Department of Education (2003, p.7) Mathematics is defined as:

> … enabl[ing] creative and logical reasoning about problems in the physical and social world and in the context of mathematics itself. It is a distinctly human activity practiced by all cultures. Knowledge in the mathematical sciences is constructed through the establishment of descriptive, numerical and symbolic relationship. Mathematics is based on observing patterns; with rigorous logical thinking, this leads to theories of abstract relations. Mathematical problem solving enables us to understand the world and make use of that understanding in our daily lives. Mathematics is developed and contested over time through both languages and symbols by social interaction and is thus open to change.

On the other hand, mathematical literacy is defined in the NCS (Department of Education, 2003, p.9) as:

> … … provid[ing] learners with an awareness and understanding of the role that mathematics has 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 analyze everyday situations and to solve problems.

A difference, which is evident from these two definitions, is that in mathematical literacy the usage of mathematics in the real world is emphasized whereas in mathematics the very context should also be mathematical in nature. Mathematical structures and objects are thus of importance, although its application to the physical and the social world is not completely excluded.

The definition of mathematical literacy is also geared towards sensitizing individuals about the role and usage of mathematics whereas a deeper understanding of the underlying theory of mathematics and its use in real world situations is envisaged by mathematics. There will be common aspects in mathematics and mathematical literacy, since both disciplines have to do with some form of mathematics and are also applications-driven, especially where the mathematics could go beyond mathematics as a context. In fact, it is not easy to demarcate between the two since they are closely linked to each other. Mathematical literacy in turn deals primarily with real life situations. Table 2.1 captures the comparison between the learning outcomes of mathematical literacy.

Table 2.1: Learning Outcomes of Mathematical Literacy and Mathematics

MATHEMATICAL LITERACY	MATHEMATICS
LEARNING OUTCOME 1 **Number and Operations in Context:** The learner is able to **use** knowledge of numbers and their relationships to **investigate a range of different contexts** which include financial aspects of personal, business and national issues.	**LEARNING OUTCOME 1** **Number and number Relationships:** When solving problems, the learner is able to **recognise, describe, represent** and work confidently with numbers and their relationships to **estimate, calculate and check solutions**.
LEARNING OUTCOME 2 **Functional Relationships:** The learner is able to recognise, interpret, describe and represent various functional relationships to solve problems in real and simulated contexts.	**LEARNING OUTCOME 2** **Functions and Algebra:** The learner is able to investigate, analyse, describe and represent a wide range of functions and solve related problems.
LEARNING OUTCOME 3 **Space, Shape and Measurement:** The learner is able to measure using appropriate instruments, to estimate and calculate physical quantities, and to interpret, describe and represent properties of and relationships between 2-dimensional shapes and 3-dimensional objects in a variety of orientations and positions.	**LEARNING OUTCOME 3** **Space, Shape and Measurement:** The learner is able to describe, represent, analyse and explain properties of shapes in 2-dimensional and 3-dimensional space with justification.
LEARNING OUTCOME 4 **Data Handling:** The learner is able to collect, summarise, display and analyse data and to apply knowledge of statistics and probability to communicate, justify, predict and critically interrogate findings and draw conclusions**.**	**LEARNING OUTCOME 4** **Data Handling and Probability:** The learner is able to collect, organise, analyse and interpret data to establish statistical and probability models to solve related problems

Just by analyzing the first two learning outcomes within table 2.1, it is evident that mathematical literacy is to a large extent context-driven. Although the learning outcomes for mathematics and mathematical literacy are more or less the same and the focus in some cases overlaps, the difference points in the direction as indicated in the latter notion of mathematical literacy and mathematics.

According to the RNCS (2002) for the GET-band, mathematics is defined as:

> Mathematics is a human activity that involves observation, representing and investigating patterns and quantitative relationships in the physical and social phenomena and between mathematical objects themselves. Through this process, new mathematical ideas and insights are developed. Mathematics uses its own specialised language that involves symbols and notations to describe numerical, geometrical and graphical relationships. Mathematical ideas and concepts build on one another to create a coherent structure. Mathematics is a product of investigations by different cultures- a purposeful activity in the contexts of social, political and economical goals and constraints.

Although the wording of the two definitions within the FET and GET differs, both place strong emphasis on the social context, and emphasis on solving problems in everyday situations.

In terms of the South African Qualification Authority's regulations, mathematics and mathematical literacy are fundamental subjects. This means that all learners in FET-schools are compelled to do either one of the two as already explained.

On the other hand, in South Africa the term numeracy refers to the mathematics curriculum being taught in the GET- band and specifically at the Foundation and Intermediate phases (Grades R – 6) as well as at ABET levels 1 & 2. Despite the official recognition of only mathematics (Grades R – 12) and mathematical literacy (Grades 10 – 12) some government departmental officials and politicians refer to mathematics in Grades R – 3 as numeracy as articulated by Dugmore (2005) and Pandor (2005).

Another term that is used related to mathematical literacy is "quantitative literacy". In Canada the International Life Skills Survey (Policy Research Initiative, Statistics Canada, 2000) claims that quantitative literacy deals with quantitative situations arising in life and work. Porter (1997), a historian, asserts that quantitative literacy involves understanding the role of numbers in the world and how to critically analyze real-life issues. According to Steen (2001) the domain of quantitative literacy is concrete and contextual. There is thus agreement that the major source of quantitative literacy or mathematical literacy is imbedded in real world situations.

The term" real world" is not easy to define and very complex in nature. Real world or everyday life can be described a scenario constituted by so many factors and influences. This is a reflection of its multifaceted in nature.

The real-life situation encountered by humans on a daily basis and the interplay between mathematics and these daily occurrences are influenced by an array of elements. Critical elements could range from values, religion, socio-economic issues, political and even historical influences.

Mathematics is applied to complex real world situations. Quantitative data from real life is then called quantitative situations. Quantitative situations to a large extent reflect then in one way or another human involvement. This brings a social dimension to quantitative literacy. It is then expected that humans should be knowledgeable about these routine events which loaded with quantitative data. To deal with these quantitative situations, is regarded as quantitative literacy.

Steen (2001, p.8-9) identifies the following elements that are characteristic of quantitative literacy:

- confidence in mathematics;
- cultural appreciation;
- interpreting data;
- logical thinking;
- making decisions;
- mathematics in context;
- number sense;
- practical skills;
- prerequisite knowledge and
- symbol sense.

Evans (2000) in turn defines numeracy as the ability to process, interpret and communicate numerical, quantitative, spatial, statistical, even mathematical information in ways that are suitable for a variety of contexts that will enable a typical member of a culture or subculture to participate affectively and more effectively in activities that they value.

There are different meanings attached towards numeracy, but some coincide with the notion of mathematical literacy.

The South African perspective on numeracy leans more towards the numerical skills and aspects related to the Foundation Phase (grades R-3).The meaning of quantitative literacy goes further and aim to apply these "numerical" and mathematical skills to real life contexts. Real life situations thus provide a context that lends itself to be treated mathematically. By mathematising these real life situations, mathematical literacy is consequently introduced. Henceforth mathematical literacy will be used to embrace numeracy as well as quantitative literacy. The Organisation for Economic Co-operation and Development (OECD) (2003, p.55) defines mathematical literacy for the Programme for International Student Assessment (PISA) as:

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

Both definitions, the one of the Education Department and that of OECD, refer to the fact that an individual should have the ability to understand the role of mathematics in the world. The essential outcome of mathematical literacy is to create critical and reflective citizens in terms of the use of mathematics.

According to the definition of the Department of Education (2003), the emphasis is also on the application of mathematics in real life situations. These life-related applications differ from the normal "word problems". There should be awareness in application of mathematics to real life situations that the 'realistic' situations could become 'unrealistic'.

Romberg (2001, p.5) alerts to the application of mathematics by stating that:

> the emphasis is on mathematical knowledge put into functional use in a multitude of different situations and contexts in varied, reflective and insight-based ways. For this to be possible a great deal of fundamental knowledge and skills are needed.

A description of applications and modelling of mathematics where mathematical literacy is situated is presented by the ICMI Study 14 (2004:14):

> The term “application”, on the one hand, focuses on the opposite direction mathematics → reality and, on the other hand and more generally, 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 term “modeling”, on the one hand, focuses on the direction, reality → mathematics and, on the other hand and more generally, emphasizes the processes involved. These descriptions of application and modeling are widely accepted.

Terms that are not so prominent at this stage are (i) mathemacy (Skovsmose, 1996), which is regarded as critical mathematical literacy and (ii) matheracy (D’ Ambosio, 1985), which refers to culture and indigenous knowledge of mathematics. Both concepts are perceived as approaches to mathematical literacy.

Mathematical literacy for cultural identity is prevalent in developing countries, where there is a great discrepancy between the mathematics the pupils use in their everyday lives and that which they use to solve everyday problems. This approach serves as argument to give this informal mathematics a more important place in the curriculum. This informal mathematics can be seen as a form of mathematical literacy, and has been referred to as ‘ethnomathematics’. D’Ambrosio (1985) warns that the spontaneous matheracy that is common among the unschooled is often eliminated by the learned matheracy of the school.

He also states that the distinct formal approaches to mathematics presented in schools create a “psychological blockage” between the different modes of mathematical thought that on the one hand degrades the value of that which is “spontaneous” while at the same time it impedes the acquisition of that which would be “learned” in schools. D’Ambrosio (1985) asserts that the increasing technological presence in the Third World countries demands improved mathematical competence, but spontaneous abilities are “downgraded, repressed and forgotten”. He was lead to the conclusion that students become alienated from their reality, and thus the possibility for creativity through reflection and action on that reality is severely curtailed. D’Ambrosio (1985) argues for an approach that involves the informal and spontaneous matheracy which focuses on contextual situations which learners can identify with.

Jablonka (2003) sees mathematical literacy for social change from a critical pedagogical perspective. In other words mathematical literacy is the capacity to view reality differently and change it. Mathematical literacy needs to lead primarily to critical citizens with regards to socially and politically meaningful issues. This approach strongly criticizes school mathematics, which is viewed as only leading to continued inequality in knowledge, social class and sex.

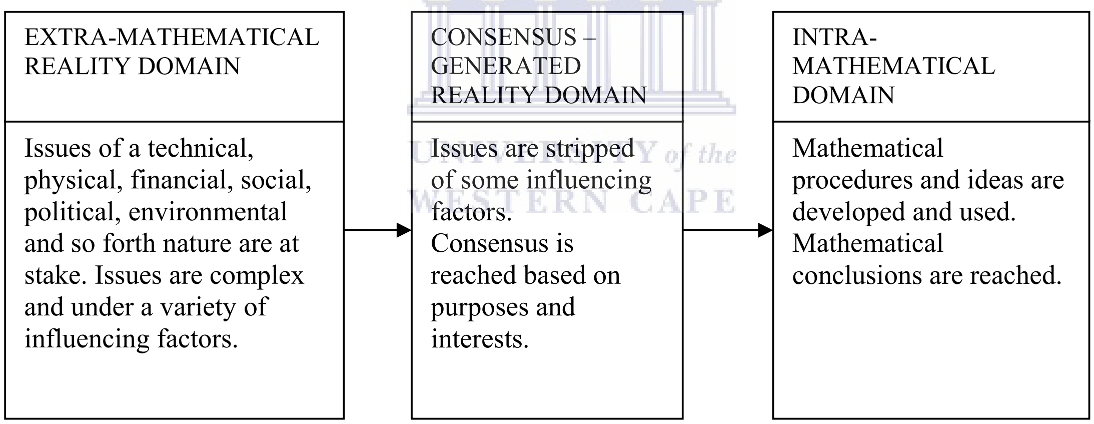
Skovsmose (1996) as cited by Ernest (1996) also argues from the point of view that the goal of critical mathematical literacy is the empowerment of learners both as individuals and as citizens-in-society. Skovsmose distinguishes between three competencies which together compose critical mathematical literacy, which he terms mathemacy. These are mathematical competence (mathematical knowledge and skills at all levels), technological competence (technology knowledge end know-how, especially in the application of mathematics) and reflective knowing. Mathemacy can be regarded as critical mathematical literacy with a strong focus on reflective knowing.

I regard mathematical literacy as the term that includes quantitative literacy, numeracy, matheracy and mathemacy (Ernest, 1996; Jablonka, 2003). Since mathematical literacy is also largely about using mathematics to deal with extra-mathematical situations, it is primarily about mathematical modelling and thus prioritizes contexts. Mathematical modelling is a process with the objective of developing mathematical representations for situations from outside of mathematics. Mathematical modelling shares characteristics with problem solving situations. Frequently, in a mathematical modelling situation, a phenomenon that is seemingly non-mathematical in context must be modelled. This may be an event in the realm of politics, such as predicting election results; of economics, such as finding the long-term behaviour of oil prices; or even of ecology, such as predicting the future growth patterns of a forest.

These situations can be regarded as quantitative situations, as labelled in the previous discussion on Mathematical Literacy. Important factors must be discerned, relationships must be determined, and these relationships must be mathematically interpreted. The mathematical interpretations of relationships allow for an analysis of the phenomenon so that conclusions (solutions) can be found. Thus, mathematical modelling is a systematic process that draws on many skills and employs the higher cognitive activities of interpretation, analysis and synthesis.

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. The characteristics of these domains are reflected in the figure 2.1 as outlined by Julie (2004, p.35).

Figure 2.2: The translation of reality issues through different domains



These three processes of mathematical modelling complement each other to build up a more comprehensive description of a complex process regarding mathematical modelling. As Julie (2003) points out, the reality situation is transformed through consensus where interests and purposes are settled and the resulting mathematisation relates to this consensus-generated reality.

Mathematical devices to control, organise, predict and manipulate nature and social life have penetrated every part of reality. The applications of and the modelling in mathematics is one of the ways to reflect this inter-relationship between reality and mathematics (Snyders, 2006, p.26). I am of the opinion that a great deal of emphasis should be placed on modelling in order to understand the effects of these mathematical models on our society.

Since the intention is to create critical and reflective citizens towards issues in society one of the most appropriate routes through which this outcome could be attain, is through mathematical modelling.

In the Mathematics Learning Programmes Guidelines (Department of education, 2004) it is stated that for “the purpose of developing learner’s ability to work with mathematical models, it is useful to subdivide the area of mathematical modeling into:

a. **Direct models**. These are models that can be directly generated from verbal representations. The model is an exact representation of the situation rather than an attempt to bring mathematics to bear on an imprecise real world problem. For example, functions created in linear programming problems are direct models.

b. **Physical models**. These models are produced by using objects or diagrams to physically model a situation. At times this may require building objects to act as models, thereby enabling us to produce a mathematical analysis of the situation. For example, using a jar of beans to physically model or represent the buffalo in the Kruger Transfrontier Park. Samples of ‘buffalo’ can then be drawn to test for disease or to calculate the entire population of buffalo in the park. In particular these models aid connections with content and processes evident in Learning Outcome 3(Shape, space and Measurement).

c. **Data models**. These models are generated as a line of best fit for a set of data. The model may not fit the data perfectly but is the best fit for the data. Data sets may be obtained from experiments conducted by the learners or it may be obtained from other sources (e.g. NGO’s; Statistics South Africa; Government departments).

The physical models as exemplified are viewed more as simulation experiments and not really mathematical models per sè. These are like teaching aids to assist the development of the models.

Mathematical Literacy involves a subset of mathematical applications and modelling revolves around situations in the real world. The phenomena which appear in reality should be the source of concept formation. According to De Lange, Keitel, Huntley & Niss (1993) the real world situation or problem is first explored intuitively, for the purpose of mathematising it. The initial exploration, with a strong intuitive component, should lead to the development, discovery or (re)invention of mathematical concepts.

2.4 Conclusion

In this chapter the notion of relevance was linked to mathematical literacy. Such relevance can be realised through contextualising situations. Since both mathematics and mathematical literacy envisage the enabling of critical citizenship, one of the routes to achieve this is the mathematisation of real life situations. In other words this can be accomplished through mathematical modelling.

If relevance is perceived to be of interest for the learners, their preferences should also taken into consideration as far as contextual situations is concerned. In the following chapter the research methodology data collection as well as data analysis will be dealt with.

CHAPTER 3

Research methodology

3.1 Introduction

This study is part of a larger study, the Relevance of School Mathematics Education (ROSME). This project is an international comparative study on the contexts that learners in grade 8 to 10 would prefer to deal with in Mathematics and Mathematical Literacy. A fellow student, Cornellisen (2007), investigated the gender dimensions of the South African data set. Due to the similarity of this study and we being part of the ROSME research group at UWC, this chapter was done jointly with Cornellisen.

3.2 Survey Research

The research approach used in this study resorts under survey research. Survey research is normally used when the research interest is in gaining information about respondent's perceptions, preferences, interests in, and attitudes towards issues of importance to the researchers. Silverman (2000) classifies surveys as one of the approaches of quantitative research and mainly uses fixed–choice response formats to questions of importance to the issue being investigated. Survey research uses questionnaires as data-gathering technique.

As is the case with all research methods there are related advantages and disadvantages related to using a survey. The following, amongst others, can be seen as the main advantages:

- In general it is a quick process to obtain a lot of information covering a large area within a short period of time.
- The questionnaires can be administered, analyzed and reported on within a short time.

The major disadvantages of surveys are:

- There is always the risk that a certain percentage of the questionnaires are never returned if the questionnaires are send to respondents to complete on their own.
- When respondents experience problems with certain items on the questionnaire, it cannot be addressed due the fact that there is a lack of face to face contact. (Silverman, 2000, pp.53-57)

The study reported on here is concerned with the preference grade 8 to grade 10 learners have for contexts to be used in school mathematics. The preferences of learners from a particular socio-economic background and in particular grades were considered as important. For these reasons survey research was deemed appropriate for this study.

Survey research normally uses questionnaires as data collection technique and the construction of the questionnaire used in this study is discussed in the following section.

3.3 Instrumentation

The research instrument for ROSME was developed from 2003 to 2005 by a number of mathematics educators from Zimbabwe, Uganda, South Africa, Eritrea, Norway and a group of Mathematics teachers from South Africa (Julie and Mbekwa, 2005, p.33). I was part of the South African teacher cohort involved in this collective. Julie and Mbekwa (2005) give a comprehensive description of the process of development of the instrument. Basically various contextual issues of interest for learners were first identified and debated by the South African participants. Through competitive argumentation an initial set of contexts were decided upon. The South African participants tested some of the items in their classrooms in order to check whether learners understood the task and whether they had any difficulties with the language. After this the questionnaire was pilot-implemented in one school. The results were analyzed (Julie and Mbekwa, 2005). The questionnaire and the findings were deliberated upon by the entire cohort. A feature of the contexts selected was that it should be amenable to mathematical treatment.

To ensure this the units and modules on the application of mathematics developed by the Consortium for Mathematics and its Applications (Garfunkel, 2004) were studied to ascertain the mathematical amenability of the identified contexts. The final questionnaire, the Relevance of School Mathematics Education (ROSME) (Appendix A), was completed in January 2005.

The questionnaire contained sixty one fixed response items. For these items learners had to indicate their preference on a four-point Likert–type scale with response categories “not at all interested”, “a bit interested”, “quite interested” and “very interested”. The last four items required open responses and is not of relevance in this mini-thesis.

The questionnaire consists of 13 clusters of different contexts with each cluster consisting of a certain number of items. There are two intra–mathematical clusters—Mathematics and mathematicians’ practices—and eleven extra–mathematical clusters. The clusters, number of items in a cluster and an exemplar item are indicated in Table 3.1.

Table 3.1: Clusters

Cluster	Number of items	Exemplar Indicator Item
Mathematics	6	Mathematics that will help me to do mathematics at universities and technikons
Mathematicians' Practices	5	The kind of work mathematicians do
Health	5	Mathematics involved in determining the state of health of a person
Physical Sciences	2	Mathematics about renewable energy sources such as wind and solar power
Technology	4	Mathematics involved in sending of messages by sms, cell phones and e-mail
Sport	3	Mathematics involved in my favourite sport
Agriculture	4	Mathematics involved for deciding the number of cattle to graze in a field of a certain size
Finance	5	Mathematics involved in working out financial plans for profit- making
Politics	4	Mathematics used to calculate the number of seats for parliament given to political parties after elections
Youth Culture	5	Mathematics linked to rave and disco dance patterns
Life Science	5	How to predict the sex of a baby
Transport and Delivery	4	Mathematics involved in designing delivery routes of goods such as delivering bread from a bakery to the shops
General	9	Mathematics involved in military matters

3.4 Sampling

The sample used in the study was an opportunistic and convenient one. Data were collected from schools in urban and peri-urban areas. Teachers attending courses at the University of the Western Cape (UWC) were requested to administer the questionnaire (Appendix A) at their own and surrounding schools. In a particular school one Grade 8, one Grade 9 and one Grade 10 class were targeted to complete the questionnaire. The distribution in terms of urban and peri-urban regions of the Western Cape Province is indicated in Table 3.2 below:

Table 3.2: Regions of schools

Region Type	Urban	Peri - urban
District	Cape Peninsula	Klein Karoo, Southern Cape, West Coast and Boland

The age distribution of the sample is given in Table 3.3, the gender distribution in Table 3.4, regional distribution in Table 3.5 and grade distribution in Table 3.6.

Table 3.3: Age distribution of participating learners

Age	12	13	14	15	16	17	18	19	20	21	23
Number of learners	2	129	274	351	246	113	50	7	3	1	1

Table 3.4: Gender distribution of participating learners

	Gender	Frequency	Percent	Valid Percent	Cumulative
Valid	**Girl**	627	53.3	53.3	53.3
	Boy	550	46.7	46.7	100.0
	Total	**1177**	**100.0**	**100.0**	

Table 3.5: Distribution of learners per region

	Region	Frequency	Percent	Valid Percent	Cumulative
Valid	**Peri-Urban**	702	59.6	59.6	59.6
	Urban	475	40.4	40.4	100.0
	Total	**1177**	**100**	**100**	

Table 3.6: Grade Distribution of participating learners

Grade	Frequency	Percent	Valid Percent	Cumulative Percent
8	391	33.2	33.2	33.2
9	260	22.1	22.1	55.3
10	526	44.7	44.7	100
Total	1177	100	100	

Given that the data collectors taught in schools and environments situated in low socio-economic areas it can be reasonably assumed that the sample was fairly representative of learners in grades 8, 9 and 10 from LSES-areas in the Western Cape province.

3.5 Data Collection Processes

Data for the study were collected in the different school districts or regions of the Western Cape Education Department during March to June 2005. Student researchers visited to the different schools and in some cases steered this process in the class. Permission was obtained from the school principals to collect data after explaining to them what the purpose was and what would be done with the data. Learners were asked to participate voluntarily and could withdraw any time during the process.

The student researcher scrutinised each question with the participating learners to ensure that the learners understood the nature of each question. This was a lengthy process and due to logistics, student researchers in some instances could not finish the data collection process. It took more than an hour to complete the questionnaire whilst the length of a school period was on average fifty minutes. In such cases the particular mathematics teachers were asked to complete the process. Thus the teachers only did the outstanding cases that the student researchers could not complete.

3.6 Data Analysis

Before discussing the data analysis procedures used in this study, a brief description of the nature of the data is provided.

Data are categorized as nominal, ordinal, interval and ratio data. Nominal data are the lowest level of data and this type of data can be categorized and frequencies calculated in each category. Examples of nominal data are gender, marital status and age. Ordinal data are generated when observations are placed into order categories. This type of data is assessment or subjective data of something that cannot be measured, for example degree of satisfaction or interest. The distance between each scale step is not important the only requirement being that there is an order between them such as “ very bad”,” bad”,”good”and”very good”

Interval and ratio data are numerical data with consistent spacing. An example of interval data is test results obtained and an example of a ratio scale is age. It should be noticed that interval and ratio data are numeric if they are originally numeric values. Hence, re-coded nominal and ordinal data are not numeric and should not strictly be analyzed as numeric values.

Descriptive statistical presentation of continuous data, such as mean and standard deviation as well as parametric tests were not used for the analysis of the data because these methods make several underlying assumptions such as consistent spacing and normal distribution of the data. For the analysis of ordinal data medians, quartiles (or range) and non-parametric tests are preferable. The data in this study are ordinal and hence non-parametric procedures were used.

A common procedure to analyze ordinal data is to determine the mean rankings of the items under consideration. A procedure used to calculate mean rankings is the Kendall W- test which was chosen in this study. The Kendall W (coefficient of concordance) test is used for expressing inter-rater agreement among independent judges who are rating (ranking) the same stimuli. In this study the learners were the raters and the items the stimuli.

The Mann-Whitney test was chosen to test whether there were significant differences between the rankings provided by learners from urban and peri-urban areas. In essence the Mann-Whitney test uses medians to test for significant differences. All tests were performed by using SPSS version 13. Inevitably there are advantages and disadvantages to non-parametric methods.

Major advantages of non-parametric methods are:

- Non-parametric methods require no or very limited assumptions to be made about the format of data, and they therefore be preferable when the assumptions required for parametric methods are not valid. This was the case in this study.

- Non-parametric methods can be useful for dealing with unexpected observations that might be problematic.

Despite the advantages of non-parametric methods have the following disadvantages:

- Non-parametric methods may lack power as compared with more traditional approaches, particularly if the sample size is small
- Non-parametric methods are geared toward hypothesis testing rather than estimation;
- Tied values can be problematic when these are common; and
- Appropriate computer software for non-parametric methods can be limited, although improving. In addition, how a software package deals with tied values or how it obtains P values may not always be obvious.

(Whitley & Ball, 2002, p.513).

3.7 Issues of Reliability and Validity

The research instrument, namely the learners' questionnaire was a product of regular changes and improvement by the Relevance of School Mathematics Education (ROSME) group over a period of three years. The large number of Mathematics educators and researchers from a number of countries made it possible for constructing a well thought through learners' questionnaire and items dealing with a large variety of contextual situations and issues which could be dealt with in Mathematical Literacy and Mathematics.

Personal involvement of the student and principal researchers pertaining to data collection from the learners was the order of the day. The researchers were at the schools to give guidance and to clarify each item, making sure that uncertainty and the lack of understanding were to a large extent alleviated.

3.8 Conclusion

This chapter dealt with survey research as an appropriate methodological approach for this study. The data collection instrument, data collection procedures and the analysis procedures used were discussed. Furthermore the sampling procedure and the nature of the sample were provided. The next chapter focuses on the main research findings and a detailed discussion of these findings.

CHAPTER 4

Findings

4.1 Introduction

In this chapter the findings emanating from the analysis of the data are presented. In order to make the analysis manageable, 15 (approximately 25%) of the highest-ranked items and a similar number of the lowest ranked items are the focus of the findings. The highest ranked items for the two groups are presented first. This is followed by the presentation of the findings of the lowest ranked items. The findings emanating from the Mann-Whitney analysis then follows. Finally,the comparison across the urban and peri-urban learners is presented.

4.2 The most-preferred items

As mentioned in the previous chapter, the items were ranked using the Kendall procedure of SPSS 13. The overall ranking list for the urban and peri-urban cohorts is presented below in Appendix B. Table 4.1 gives the findings of the 15 most-preferred items of the learners from the urban and peri-urban areas.

Table 4.1: Fifteen highest ranked items by peri-urban and urban learners

Peri-urban			**Urban**		
Code	Item	Mean Ranking	Code	Item	Mean Ranking
C23	Mathematics that will help me to do mathematics at universities and technikons	47.97	C23	Mathematics that will help me to do mathematics at universities and technikons	45.31
C11	Mathematics that is relevant to professionals such as engineers, lawyers and accountants	43.67	C15	Mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM	40.57
C45	Numbers	41.78	C46	Mathematics involved in sending of messages by SMS, cell phones and e-mails	39.98
C15	Mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM	41.04	C11	Mathematics that is relevant to professionals such as engineers, lawyers and accountants	39.29
C47	Mathematics involved in working out financial plans for profit-making	39.14	C45	Numbers	39.21
C26	The kind of work mathematicians do	38.71	C3	Mathematics involved in making computer games such as play stations and TV games	37.29
C46	Mathematics involved in sending	37.8	C26	The kind of work	37.02

	of messages by SMS, cell phones and e-mails			mathematicians do	
C27	Geometry	37.75	C42	Mathematics of the storage of music on CD's	36.57
C34	Algebra	36.8	C47	Mathematics involved in working out financial plans for profit-making	35.97
C22	Mathematics to prescribe the amount of medicine a sick person must take	36.76	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	35.66
C16	Mathematics used to calculate the taxes people and companies must pay to the government	36.51	C22	Mathematics to prescribe the amount of medicine a sick person must take	35.38
C21	Mathematics to assist in the determination of the level of development regarding employment, education and poverty of my community	36.2	C27	Geometry	35.33
C29	How mathematicians make their discoveries	36.02	C20	Mathematics involved in determining the state of health of a person	35.32
C3	Mathematics involved in making computer games such as play stations and TV games	35.73	C21	Mathematics to assist in the determination of the level of development regarding employment, education and poverty of my community	33.62
C51	How to predict the sex of a baby	35.35	C29	How mathematicians make their discoveries	33.61

Of the 15 highest ranked items, 10 were selected by both peri-urban and urban. These are presented in table 4.2.

Table 4.2: Common most-preferred items

Code	Item	Peri-urban Mean Ranking	Urban Mean Ranking
C23	Mathematics that will help me to do mathematics at universities and technikons	47.97	45.31
C45	Numbers	41.78	39.21
C26	The kind of work mathematicians do	38.71	37.02
C46	Mathematics involved in sending of messages by SMS, cell phones and e-mails	37.8	39.98
C27	Geometry	37.75	35.33
C22	Mathematics to prescribe the amount of medicine a sick person must take	36.76	35.38
C21	Mathematics to assist in the determination of the level of development regarding employment, education and poverty of my community	36.20	33.62
C29	How mathematicians make their discoveries	36.02	33.61
C3	Mathematics involved making computer games such as play stations and TV games	35.73	37.29
C11	Mathematics that is relevant to professionals such as engineers, lawyers and accountants	43.67	39.29

Six (C23, C45, C26, C27, C29 and C11) of the 10 items are directly linked to mathematics as it is currently practiced in schools. Although there are slight differences in the mean rankings, it does not necessarily mean there are differences in these preferences of mathematics as a discipline. C23, dealing with *mathematics that will help me to do mathematics at universities and technikons* is the highest preferred item for learners from both urban and peri-urban environments. One notes from this that learners from both urban and peri-urban areas thus seem to have a strong preference for further studies in mathematics-related subjects at Higher Education Institutions. The reason for this choice may be the fact that both sets of learners come from disadvantaged backgrounds and their aspiration for higher education is seen as a means to uplift themselves from their disadvantaged backgrounds.

Two of the items (C46 and C3) in the 15 highest ranked items deal with modern day technologies. This may be an indication that there are no real differences between preferences of urban and peri-urban learners to deal with modern technological issues in mathematics. Both groups of learners from urban and peri-urban find it interesting, challenging and explorative to work with modern technology such as cell phones and computer games.

Only one item (C22), dealing with *mathematics to prescribe the amount of medicine a sick person must take*, selected by both peri-urban and urban learners is related to health. This can be seen as an indication of young people's interest to deal with health issues in school mathematics for the mere reason that in disadvantaged areas sickness is endemic. These learners have equally seen people dying from diseases like TB and from HIV induced illnesses.

The 10 common most-preferred items selected by peri-urban and urban learners can be divided into three categories, namely: mathematics, technology and health. For the first three most-preferred items, C23, C45 and C26, learners from the peri-urban areas have a slight advantage in mean ranking of that over learners from the urban areas. This is also the case for C27, C29 and C11 on the list.

There appears to be an indication that learners in grades 8 to grade 10 from lower, socio-economic environments assign a higher priority to learning mathematics as a discipline as indicated above.

The item, C11, *mathematics that is relevant to professionals such as engineers, lawyers and accountants*, was ranked number ten on the common most preferred list. This may be an indication of the learners' desire to complete their schooling in order to pursue such high-status careers. This is probably an indication of learners' awareness of the importance of mathematics linked to professions that presumably leads to a better lifestyle.

4.3 The least-preferred items

The 15 least preferred items by peri-urban and urban learners are shown in table 4.3:

Table 4.3: The 15 least preferred items.

Peri-Urban			**Urban**		
Code	**Item**	**Mean Ranking**	**Item**	**Mean Ranking**	**Code**
C 41	Mathematics involved in making pension and retirement schemes	26.84	Mathematics to determine the number of fish in a lake, river or a certain section of the sea	27.12	C37
C59	Mathematics to describe movement of big groups of people in situations such as emigration and refugees fleeing from their countries.	26.15	Mathematics used to calculate the number of seats for parliament given to political parties after elections	26.91	C31
C8	How to estimate and project	26.14	Blunders and mistakes some	26.52	C33

	crop production		mathematicians have made		
C37	Mathematics to determine the number of fish in a lake, river or a certain section of the sea	25.44	Strange results and paradoxes in Mathematics	26.2	C53
C10	Mathematics political parties use for election purposes	25.32	Mathematics linked to designer clothes and shoes	25.68	C1
C56	Mathematics to describe facts about diminishing rain forest and growing deserts	25.1	Mathematics to describe facts about diminishing rain forest and growing deserts	25.66	C56
C1	Mathematics linked to designer clothes and shoes	24.22	Mathematics political parties use for election purposes	24.9	C10
C31	Mathematics used to calculate the number of seats for parliament given to political parties after elections	23.09	Mathematics involved in designing delivery routes of goods such as delivering bread from a bakery to the shops	24.59	C13
C28	Mathematics involved in packing goods to use space efficiently	22.72	Mathematics needed to work out the amount of fertilizer needed to grow a certain crop	23.9	C14
C36	Mathematics involved in working out the best arrangement for planting seeds	22.65	Mathematics involved in packing goods to use space efficiently	23.85	C28
C13	Mathematics involved in designing delivery routes of goods such as delivering bread from a bakery to the shops	21.76	Mathematics linked to decorations such as the house decorations made by Ndebele women	23.23	C43
C43	Mathematics linked to decorations such as the house decorations made by Ndebele women	21.16	How to estimate and project crop production	23.1	C8
C17	Mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of a certain size	20.91	Mathematics involved in working out the best arrangement for planting seeds	21.77	C36
C14	Mathematics needed to work out the amount of fertilizer needed to grow a certain crop	20.66	Mathematics of a lottery and gambling	21.09	C2
C2	Mathematics of a lottery and gambling	18.43	Mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of a certain size	20.97	C17

Of the fifteen lowest ranked items, twelve items are common to peri-urban and urban learners. These are indicated in table 4.4:

Table 4.4: Common least-preferred items

Code	Item	Peri-urban Mean Ranking	Urban Mean Ranking
C8	How to estimate and project crop production	26.14	23.10
C37	Mathematics to determine the number of fish in a lake, river or certain sector of the sea	25.44	27.12
C10	Mathematics political parties use for election purposes	25.32	24.90
C56	Mathematics to describe facts about diminishing rain forests and growing deserts	25.10	25.66
C1	Mathematics linked to designer clothes and shoes	24.22	25.68
C31	Mathematics used to calculate the number of seats for parliament given to political parties after elections	23.09	26.91
C28	Mathematics involved in packing goods to use space efficiently	22.72	23.85
C13	Mathematics involved in designing delivery routes of goods such as delivering bread from a bakery to the shops	21.76	24.59
C43	Mathematics linked to decorations such as the house decorations made by Ndebele women	21.16	23.23
C17	Mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of a certain size	20.91	20.97
C14	Mathematics needed to work out the amount of fertilizer needed to grow a certain crop	20.66	23.90
C2	Mathematics of a lottery and gamble	18.43	21.09

Of the twelve, three can be seen as directly linked to agriculture. Both peri-urban and urban learners ranked the items (C14, C17 and C8) as the least preferred. A lack of interest in agriculture through which to study mathematics or mathematical literacy could be learned is evident from learners' choices. This is contrary to the hopes of the South African government. In this regard to this Julie and Mbekwa (2005, p.40) assert:

> 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.

The item, C43, was ranked as one of the least preferred items. Mathematics linked to decorations such as the house decorations made by Ndebele women deals with the mathematical analysis of cultural art which links to indigenous knowledge. The reason may be the fact that both learners from urban and peri-urban do not have any interest in happenings in rural environments like the paintings and decorations of the Ndebele women.

Politics C10 and C31 are items amongst the least-preferred items ranked by both peri-urban and urban learners. This seems to be in line with a general perception that young people in South Africa are not as interested in political matters as was the case during the Apartheid era

Mathematics dealing with lottery and gambling, C2, is the fourth least preferred item. The lack of interest can be seen as an age-factor which does not allow the learners from urban and peri-urban areas to participate in lottery and gambling which is against the law in terms of the South African Gambling Act.

4.4 Comparison of rankings of items between learners from urban and peri-urban areas.

The Mann-Whitney test was used to evaluate the differences between the rankings of learners from urban and peri-urban areas. The null hypothesis is that the populations from which the two samples have been drawn are identical. The Mann-Whitney test rendered the results as given in tables 4.5 and 4.6 (see below) in which the mean rankings of the contexts preferred by learners from urban and peri-urban areas emerged. The rules for decision for the Mann-Whitney test are:

(a) If $-1.96 < z < 1.96$, do not reject H_O.

(b) If $z \leq -1.96$ or $z \geq 1.96$, reject H_O. (McCall; 331)

Table 4.5: The 10 common most-preferred items: Mann-Whitney test

Code	Item	Z
C3	Mathematics involved in making computer games such as play stations and TV games	-3.046
C11	Mathematics that is relevant to professionals such as engineers, lawyers and accountants	-3.561
C15	Mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM	-2.214
C16	Mathematics used to calculate the taxes people and companies must pay to the government	-0.299
C21	Mathematics to assist in the determination of the level of development regarding employment education and poverty of my community	-0.240
C26	The kind of work mathematicians do	-1.473
C27	Geometry	-0.218
C29	How mathematicians make their discoveries	-0.579
C45	Numbers	-0.338
C46	Mathematics involved in sending of messages by SMS, cell phones and e-mails	-3.721

From the above table it is clear that for 4 of the of the items— C3, C11, C46 and C15— that appear amongst the common most preferred 10 most preferred items, the difference between the rankings of these items are significant according to the Mann-Whitney test. This implies that the preferences for these items are ranked significantly higher by one of the two groups.

Table 4.6 presents the Mann-Whitney test for the common items of the 15 least preferred items. Of these, the Mann-Whitney test rendered significant differences between the rankings for items C1, C2, C13, C14, C17, C28 and C31. As is the case with the most-preferred items, the preference rankings for these items differ significantly for one of the two groups.

Table 4.6: The 10 common least-preferred items: Mann-Whitney test

Code	Item	Z
C1	Mathematics linked to designer clothes and shoes	-3.094
C2	Mathematics of a lottery and gambling	-4.498
C8	How to estimate and project crop production	-0.753
C10	Mathematics political parties use for election purposes	-1.516
C13	Mathematics involved in designing delivery routes of goods such as delivering bread from the bakery to the shops	-3.929
C14	Mathematics needed to work out the amount of fertilizer needed to grow a certain crop	-5.185
C17	Mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of a certain size	-3.961
C28	Mathematics involved in packing goods to use space efficiently	-2.447
C31	Mathematics used to calculate the number of seats for parliament given to political parties after election	-5.315
C36	Mathematics involved in working out the best arrangement for planting seeds	-1.425

4.5 Conclusion

Generally learners from urban and peri-urban areas prefer to deal with the same contexts in school mathematics.

There are, however, items for which the ranking preferences for particular items are significantly different between the two groups of learners. The discussion, conclusions and recommendation follow in the next chapter.

CHAPTER 5
Conclusions and Recommendations

5.1 Introduction

The main aim of this study was to determine whether differences existed in the contexts preferred by urban and peri-urban learners for mathematical literacy in grade 10. This chapter gives an interpretation of the findings of this study with reference to the main research question and makes recommendations based on these findings.

5.2 Findings

The discussion of the findings is done under the following headings:

- Contexts highly preferred by learners from both urban and peri-urban areas;
- Contexts least preferred by learners from both urban and peri-urban areas.
- Contexts highly preferred by learners from urban areas and not from peri-urban areas;
- Contexts highly preferred by learners from peri-urban areas and not from urban areas;
- Contexts least preferred by learners from urban areas and not from peri-urban areas and
- Contexts least preferred by learners from peri-urban areas and not from urban areas.

5.2.1 Contexts highly selected by both learners from urban and peri-urban areas.

The highest preferred context for learners from urban and peri-urban areas is C 23 (*mathematics that will help them to do mathematics at universities and technikons*). This preference indicates an ambition by these learners to further their studies at Higher Education Institutions. It is a known fact that students who have tertiary qualifications especially in mathematics have greater career opportunities than those who are not similarly qualified. It makes sense therefore for these students to aspire for tertiary qualifications in mathematics, which will open up career opportunities, which were denied to the majority of black students in the past.

Perhaps the reason for these strong preferences for further studies in mathematics related subjects at Higher Education Institutions is the fact that both sets of learners come from disadvantaged backgrounds and their desire for higher education should be seen as a means to uplift themselves from their disadvantaged backgrounds.

Urban and peri-urban learners' choice of the item C11, (*mathematics that is relevant to professionals such as engineers, lawyers and accountants*) supports the notion discussed above with respect to mathematics linked to a career choice. A major topic of discussion in Life Orientation classes is that South Africa has a shortage of skilled workers in the disciplines of accountancy and engineering. This could be a possible reason for the high preference of this item.

The item C45, *numbers*, figures quite prominently in choices for urban and peri-urban learners. An attributing factor for this choice could be that numbers are part of learning outcome 1 in the National Curriculum Statement for grades 4 to 12.

Both sets of learners also preferred item C46 (*mathematics involved in sending of messages by sms, cell phones and e-mails*) and C3 (*mathematics involved in making computer games such as play stations and TV games*). These items deal with modern day technology in mathematics. Both groups found it interesting and this is indicative of their curiosity regarding technological gadgets. Thus it is reasonable to say that young people from low-status socio-economic environments do not differ in their preference to deal with the mathematics embedded in such technological devices from any other socio-economic group.

These highly preferred choices by urban and peri-urban learners indicate a strong emphasis on mathematics in school (C45) and also for studies in mathematics at tertiary institutions (C23 and C11) with a link to skills related career choices. There is also a strong preference to technology related mathematics items.

There appears to be an indication that learners from grade 8 to grade 10 from low socio-economic environments assign a high priority to learning mathematics linked to professions that presumably leads to a better lifestyle.

In order to obtain this, academics, textbook writers and the policy formulators need to take notice of the preferences of the learners from urban and peri-urban areas and cater for their interest.

5.2.2 Contexts least preferred by learners from urban and peri-urban areas

For most of the learners from urban and peri-urban areas the four least preferred choices were C2, C14, C17 and C43 Two of these four items namely, C14: *mathematics to work out amount of fertilizer needed to grow a certain crop* and C17: *mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of certain size*, fall under the agriculture cluster.

Most of these learners from the urban and peri-urban areas have little knowledge of agriculture and this could be one of the reasons for agriculture to be at the bottom of their list. These learners have been brought up in an urban and peri-urban environment, far removed from any agricultural setting, without even a knowledge of simple gardening and knowledge and skills of agriculture, like the planting of seeds, estimation of crop production and knowing the amount of fertilizer needed to grow a certain crop. The only time they get into contact with agricultural activity is when they go to farms to buy agricultural products like vegetables and perhaps livestock for family festivities like weddings. They might also come into contact with farm workers who work very hard for a pittance. Planting seeds remind them of years of farming associated with apartheid, suffering and humiliation where their parents possibly grew up. This is however in line with Julie and Mbekwa (2005:40) where they refer to the low interests of learners in agriculture. Much motivation in this regard is needed at school level so as to generate interest and facilitate a steady flow of new entrants into the agricultural sector.

Another item which was ranked amongst the list of least-preferred items is C43, (*mathematics linked as the decorations of the houses of Ndebele women*). The reason for this may be seen as learners from urban and peri-urban areas having a low interest of activities in rural areas. Another plausible reason is that learners, in general, are unaware that such artefacts can be analysed with mathematics. The item, C2, (*mathematics of a lottery and gambling*) elicited the lowest interest of all the items.

This response is contradictory to the extensive coverage in the media and advertisements on television. All the learners are under eighteen years old which prohibits them from partaking in lotteries and gambling activities.

5.2.3 Contexts highly preferred by learners from urban areas and not from peri-urban areas

According to table 4.1 in chapter 4 there are no contexts highly preferred by learners from urban areas and not from peri-urban areas. For example, items C23, C11, C26, C45 and C46 are highly preferred by both sets of learners.

5.2.4 Contexts highly preferred by learners from peri-urban areas and not from urban areas

The items C16, C34 and C51 are part of the highly preferred from peri- urban learners but do not appear in items listed for the highly preferred urban areas. The item C15 is highly preferred by learners from peri-urban areas and urban areas.

5.2.5 Contexts least preferred by learners from urban areas and not from peri-urban areas

The items C33 and C53 are contexts least preferred by learners from urban areas and not from peri-urban areas. The item C33 is least preferred by learners from urban areas.

5.2.6 Contexts least preferred by learners from peri-urban areas and not from urban areas

The items C41 and C59 are contexts least preferred by learners from per-urban areas and not from urban areas. The item C41 is least preferred by learners from peri-urban areas.

5.3 Limitations of this study

One of the main limitations is the fact that the study was only conducted in certain disadvantaged schools in the Western Cape. This means the findings cannot be necessarily be generalised to the whole population of urban and peri-urban areas.

Although Xhosa speaking learners were part of the study they had to complete the questionnaires in English. These learners were all taught in the medium of Afrikaans and English which excluded their language namely, IsiXhosa.

5.4 Recommendations

This specific study focused on the contexts that learners from urban and peri-urban areas prefer to deal with in mathematical literacy. The current contexts favoured by textbook authors and proposed by curriculum documents can not be seen as the alpha and omega which means that any document can be changed with the insights of a study like this. Analysis such as the one done in this study sheds light on what learners prefer and this needs to be taken into account when considering which contexts to incorporate into the mathematical learning experiences of young people.

The poor performance of South African students in international surveys such as TIMMS (2003) has given me reason to conduct this study into learners' context preferences in mathematical literacy. The choices from urban and peri-urban learners indicate a strong leaning towards introducing more appropriate contexts within the learners' interest field. In this way levels of motivation of learners could be raised to study mathematics and so contribute towards enhanced performance.

5.5 Conclusion

The main outcome of this study is the dominant fact that learners from both urban and peri-urban area chose to do mathematics that is linked to specific careers in order to allow them to live a financial secure life. A second finding is the recognition that we live in global world and this is confirmed by learners in their choice of technological related mathematics.

Another outcome is that there are differences in preferences for some contexts between learners from urban and peri-urban areas. It should be borne in mind that teachers do have an influence in the selection of contexts in mathematics and mathematical literacy. Generally teachers use contexts which they perceive as interesting, helpful, and important for continuity in the curriculum.

There is thus a need to make teachers aware that their preferences for certain contexts might differ from those of learners and that they need to consult with learners to establish what their preferred interests are. A further study to explore this is recommended.

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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 <u>you</u> like.
The items are <u>not</u> 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: Overall Rankings

Peri-Urban		Urban	
Mean Ranking		Mean Ranking	
Mathematics that will help me to do mathematics at universities and technikons	47,97	Mathematics that will help me to do mathematics at universities and technikons	45,31
Mathematics that is relevant to professionals such as engineers, lawyers and accountants	43,67	Mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM	40,57
Numbers	41,78	Mathematics involved in sending of messages by SMS, cellphones and e-mails	39,98
Mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM	41,04	Mathematics that is relevant to professionals such as engineers, lawyers and accountants	39,29
Mathematics involved in working out financial plans for profit-making	39,14	Numbers	39,21
The kind of work mathematicians do	38,71	Mathematics involved in making computer games such as play stations and TV games	37,29
Mathematics involved in sending of messages by SMS, cellphones and e-mails	37,80	The kind of work mathematicians do	37,02
Geometry	37,75	Mathematics of the storage of music on CD's	36,57
Algebra	36,80	Mathematics involved in working out financial plans for profit-making	35,97

Mathematics to prescribe the amount of medicine a sick person must take	36,76	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	35,66
Mathematics used to calculate the taxes people and companies must pay to the government	36,51	Mathematics to prescribe the amount of medicine a sick person must take	35,38
Mathematics to assist in the determination of the level of development regarding employment, education and poverty of my community	36,20	Geometry	35,33
How mathematicians make their discoveries	36,02	Mathematics involved in determining the state of health of a person	35,32
Mathematics involved in making computer games such as play stations and TV games	35,73	Mathematics to assist in the determination of the level of development regarding employment, education and poverty of my community	33,62
How to predict the sex of a baby	35,35	How mathematicians make their discoveries	33,61
Mathematics involved in determining the state of health of a person	34,89	How mathematics is used to predict the spread of diseases caused by weapons of mass destruction such as chemical, biological and nuclear weapons	33,52

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	34,78	Mathematics to monitor the growth of a baby the first period of life	33,51
Mathematics that entertain and surprise us	34,59	How mathematics can be used in sport competitions like ski jumping, athletics, aerobic, swimming, gymnastics and soccer	33,23
How mathematics is used to predict the spread of diseases caused by weapons of mass destruction such as chemical, biological and nuclear weapons	34,00	Mathematics linked to South African pop music	33,19
Mathematics used to predict the growth and decline of epidemics such as AIDS; tuberculosis and cholera	33,76	Mathematics used to predict the growth and decline of epidemics such as AIDS; tuberculosis and cholera	33,11
Mathematics of the storage of music on CD's	33,52	How mathematics can be used in planning a journey	32,89
Mathematics about the age of the universe	33,07	Mathematics used to calculate the taxes people and companies must pay to the government	32,89
How mathematics can be used by setting up a physical training program, and measure fitness	32,95	Mathematics involved in my favourite sport	32,56
Why mathematicians sometimes disagree	32,95	How to predict the sex of a baby	32,50

Mathematical ideas that have had a major influence in world affairs	32,75	Mathematics that entertain and surprise us	32,46
Mathematics used to work out the repayments (instalment) for things bought on credit are worked out	32,74	Mathematics about the age of the universe	32,42
Mathematics to monitor the growth of a baby the first period of life	32,53	Mathematics linked to music from the United States, Britain and other such countries	32,32
Mathematics involved in my favourite sport	32,04	Algebra	32,29
How mathematics can be used in sport competitions like ski jumping, athletics, aerobic, swimming, gymnastics and soccer	31,87	How mathematics can be used by setting up a physical training program, and measure fitness	32,16
Mathematics that air traffic controllers use for sending off and landing planes	31,17	Mathematics involved in military matters	32,07
Mathematics involved in dispatching a helicopter for rescuing people	31,00	Mathematics used to work out the repayments (instalment) for things bought on credit are worked out	32,01
Mathematics about renewable energy sources such as wind and solar power	30,56	The personal life stories of famous mathematicians	31,97
Mathematics linked to music from the United States, Britain and other such countries	30,54	Mathematics involved in dispatching a helicopter for rescuing people	31,62
Mathematics to predict whether certain species of animals are on the	30,32	Mathematics that air traffic controllers use for sending off and landing planes	31,56

brink of extinction			
Mathematics used in making aeroplanes and rockets.	30,21	Mathematics used in making aeroplanes and rockets.	31,43
Blunders and mistakes some mathematicians have made	29,89	Mathematical ideas that have had a major influence in world affairs	31,20
Mathematics linked to rave and disco dance patterns	29,22	Mathematics about renewable energy sources such as wind and solar power	31,08
Mathematics involved in military matters	29,01	Mathematics linked to rave and disco dance patterns	30,00
Mathematics involved in assigning people to tasks when a set of different tasks must be completed	28,35	Mathematics involved in making pension and retirement schemes	29,69
The personal life stories of famous mathematicians	28,15	Why mathematicians sometimes disagree	29,60
Mathematics linked to South African pop music	27,77	Mathematics involved in determining levels of pollution	27,98
How mathematics can be used in planning a journey	27,56	Mathematics to describe movement of big groups of people in situations such as emigration and refugees fleeing from their countries	27,29
Mathematics of inflation	27,46	Mathematics involved in assigning people to tasks when a set of different tasks must be completed	27,26
Mathematics involved in making complex structures such as bridges	27,43	Mathematics involved in making complex structures such as bridges	27,19
Mathematics involved in determining levels of pollution	27,17	Mathematics of inflation	27,19

Strange results and paradoxes in Mathematics	26,91	Mathematics to predict whether certain species of animals are on the brink of extinction	27,17	
Mathematics involved in making pension and retirement schemes	26,84	Mathematics to determine the number of fish in a lake, river or a certain section of the sea	27,12	
Mathematics to describe movement of big groups of people in situations such as emigration and refugees fleeing from their countries	26,15	Mathematics used to calculate the number of seats for parliament given to political parties after elections	26,91	
How to estimate and project crop production	26,14	Blunders and mistakes some mathematicians have made	26,52	
Mathematics to determine the number of fish in a lake, river or a certain section of the sea	25,44	Strange results and paradoxes in Mathematics	26,20	
Mathematics political parties use for election purposes	25,32	Mathematics linked to designer clothes and shoes	25,68	
Mathematics to describe facts about diminishing rain forest and growing deserts	25,10	Mathematics to describe facts about diminishing rain forest and growing deserts	25,66	
Mathematics linked to designer clothes and shoes	24,22	Mathematics political parties use for election purposes	24,90	
Mathematics used to calculate the number of seats for parliament given to political parties after elections	23,09	Mathematics involved in designing delivery routes of goods such as delivering bread from a bakery to the shops	24,59	
Mathematics involved in packing goods to use space efficiently	22,72	Mathematics needed to work out the amount of fertilizer needed to grow a certain crop	23,90	

Mathematics involved in working out the best arrangement for planting seeds	22,65	Mathematics involved in packing goods to use space efficiently	23,85
Mathematics involved in designing delivery routes of goods such as delivering bread from a bakery to the shops	21,76	Mathematics linked to decorations such as the house decorations made by Ndebele women	23,23
Mathematics linked to decorations such as the house decorations made by Ndebele women	21,16	How to estimate and project crop production	23,10
Mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of a certain size	20,91	Mathematics involved in working out the best arrangement for planting seeds	21,77
Mathematics needed to work out the amount of fertilizer needed to grow a certain crop	20,66	Mathematics of a lottery and gambling	21,09
Mathematics of a lottery and gambling	18,43	Mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of a certain size	20,97