

**Contexts preferred for use in  
mathematics by Swaziland high  
performing public schools' junior  
secondary learners.**



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**A thesis submitted in fulfilment of the requirements for the Degree of  
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## Declaration

*“Contexts preferred for use in mathematics by Swaziland high performing public schools’ junior secondary learners”* is my own work and all sources I have used and quoted have been indicated in the text and acknowledged by complete references

Minenhle Ngcobo

Signed.....



## Abstract

At primary school learners are excited about mathematics. This may be an indication that learning related to familiar contexts, connected to the learners' interests, values and goals is necessary for motivation. At secondary school level learners begin to question the applicability of certain topics in the school syllabus and sometimes do not see the necessity of mathematics in their future careers. This is an indication that they are apprehensive regarding the relevance of mathematics in various contexts. However, relevance has a point of reference, what is relevant to a teacher is not necessarily relevant to the learner and what is relevant to a text book writer might not be relevant to the text book reader.

As mathematics educators endeavour to encourage learners to appreciate the relevance of mathematics to everyday life, it is important to be aware of their interests. It is crucial to be informed on the subject areas they desire to know about in order to plan classroom activities that will occupy them in purposeful activity.

Usually contexts for learning are chosen by adults without conferring with learners at any point. The present study investigated learners' preferences for contexts to use in learning school mathematics. Furthermore the study sought to establish motivations learners have for preferring particular contexts.

The problem the study addressed was that of absence of learners' contribution in contexts used to learn mathematics. The aim was to find out the contexts learners preferred and the reasons they gave for their preferences. It is important to be aware of learners' preferences when choosing contexts to use in teaching. Preferences improve motivation and learning. Furthermore, consulting them sends a message that they matter and have an important role to play in their education.

This study acknowledges that learners' interests are influenced by their experiences. For this reason the conceptual framework used is constructed from their experiences and observations. These experiences and observations act as their backgrounds and inform their foregrounds. Their responses were analysed using a conceptual lens that acknowledges their experiences and aspirations.

The ROSME questionnaire was used to collect data for the study. From the questionnaire responses, using Kendal W. mean ranks, the order of preference for the given contexts was established. Percentiles were used to determine the first and last ten favoured contexts. The most and the least preferred contexts were studied with a lens of possible influences. Reasons for preferring contexts were analyzed using identity development influences and theories about interest.

Learners were mostly drawn to contexts that they perceived to impact on their future well being as well as technological contexts and those that are of social concern. The most preferred contexts included C23 (*Mathematics that will help me to do mathematics at universities and technikons*) C47 (*Mathematics involved in working out financial plans for profit making*). Other contexts of preference included *sport competitions*. Their most popular reason for preferring contexts was futuristic followed by learning. Basic everyday life contexts were the least preferred.

Learners' attraction to context seemed to be influenced by their previous experiences, aspirations about the future and people around them. Their reasons showed that they have some experiences about mathematics that caused them to want to learn it using contexts they preferred. The reasons also showed that they were aware of the importance of mathematics in their lives.

The findings have important implications for mathematics educators. Some implications are that mathematics educators need to be aware of learners' interests. The findings also suggest that mathematics educators need to approach mathematics as an open subject. As mathematics educators we have built a hedge around the subject such that we do not even associate it with the other activities on the school curriculum.



## **Key Words:**

**Contexts**

**Affect**

**Interest**

**Learners' views**

**Identity**

**Generalised Others**



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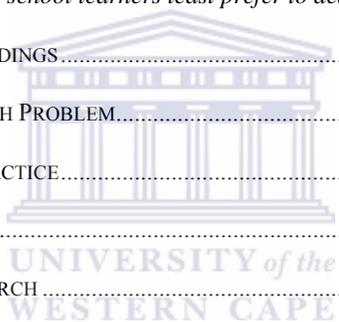
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# Abbreviations

F1	Form 1
F2	Form 2
F3	Form 3
IGCSE:	International General Certificate of Secondary Education
SGCSE:	Swaziland General Certificate of Secondary Education
ROSME:	Relevance of School Mathematics Education
NUFU:	Norwegian Universities' Funding Agency (Nasjonalt program for utvikling, forskning og utdanning)
GRASSMATE:	Graduate Studies in Science, Mathematics and Technology Education
GOs:	Generalized Others
ROSE:	Relevance of Science Education
GCE:	General Certificate of Education
MOE:	Ministry of Education
REO:	Regional Education Office
REO:	Regional Education Officer
NCC:	National Curriculum Centre
UNISWA:	University of Swaziland
UCLES:	University of Cambridge Local Examination Syndicate
UCIE:	University of Cambridge International Examinations
STS:	Science-Technology-Society
RME:	Realistic Mathematics Education
MiC:	Mathematics in Context
TD:	Technical Drawing

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# 1. CHAPTER 1

## INTRODUCTION

This study was aimed at investigating learners' contributions towards relevant contexts for the learning of school mathematics and their views were studied using a multifaceted lens constructed from ideas of the Generalized Others (GOs) in their lives. GOs refer to the social environment to which a person reacts (Mead, 1964). I expand the concept of GOs to include technology and the natural environment. The GOs have influence on the learners' identity development. Different learner identities were used to analyse the data. My thesis is that learners' preferences for contexts to be used in school mathematics are influenced by (GOs) and significant others in the micro-system concerned with schooling and these preferences reveal the learners' level of self development in the form of self identity.

This chapter is divided into 7 sections. Section 1 is a background to the study that begins with an introduction to the ROSME questionnaire. Section 2 introduces and states the problem. Sections 3 to 7 are the significance of the study; aims, objectives, and the research questions; an overview of the conceptual frameworks; a summary of the research design and the thesis chapter outline in that order.

### 1.1 Background to the Research

#### *1.1.1 The Relevance of School Mathematics (ROSME)*

The Relevance of School Mathematics Education (ROSME) project was a project led by Professor Julie from the University of the Western Cape. The project was motivated by the Relevance of Science Education (ROSE) project of Professor Sjøberg (Julie &

Mbekwa 2005). In the manner of the said works (Schreiner & Sjøberg 2004; Sjøberg, 2002) the ROSME instrument for learners was developed around 13 clusters (1 and 2 intra-mathematical and the other 11 clusters extra-mathematical; details on the clusters and original related items are shown in Appendix 1). The ROSME instrument was developed by mathematics educators from South Africa, Zimbabwe, Uganda, South Korea and Norway and it targeted learners in Forms 1 – 3 or learners of age 14-15 years (Julie & Mbekwa 2005). It was designed to determine contexts that learners as stakeholders would deem suitable for use in their learning of mathematics.

The original instrument was adapted, without major changes to its initial idea, to accommodate the Swaziland cohort. The instrument used in the present study is shown in Appendix 2. The items marked with asterisks are those where changes were made and the one marked with double asterisk is an item that was introduced by me. A detailed discussion of the instrument is provided in the Chapter 3 Section 3.2.

ROSME acknowledges the importance of parents, teachers and learners as stakeholders in educational activities. The questionnaire asks learners to indicate things they would like to learn about in mathematics. For this reason I have identified affect and contexts as relevant concepts in this study.

### ***1.1.2 Background literature***

Swaziland's General Certificate of Education (GCE) O-level examinations results statistics for the years 2000-2004, indicate that in all the four regions only two schools attained credit pass rates of at least 50 % during this period. This signals an existence of a problem in the teaching and learning of mathematics. There are various factors that contribute to achievement in mathematics such as teachers; school resources; attendance;

supervision; school size; prior-achievement; discipline; organizational structure; amount and quality of instruction; motivation, self-concept; environmental variables related to the home, teacher, peers and media exposure ; usefulness of mathematics; self-confidence in learning mathematics (Ercikan, McCreith & Lapointe, 2005; Ismail, 2009; Legotlo, Maaga , Sebegu, van der Westhuizen, Mosoge, Nieuwoudt & Steyn, 2002; Marshall, 2009; Ramírez, 2006; Schacter & Thum, 2004; Van den Broeck, Opdenakker & Van Damme, 2005). Central to some of these factors are contexts used in learning school mathematics. Quality of instruction for example can be improved by use of relevant contexts. In turn these relevant contexts can impact positively on motivation. Environmental variables such as media exposure help provide imaginable contexts for learning. When learners have seen something on TV for instance it is easy for them to imagine it if it is used as a learning context.

In my teaching experience I have heard learners question the applicability of some topics in the school syllabus and in some cases saying they do not need mathematics in their future careers. This is an indication that they were concerned about the use of mathematics in various contexts. Quilter & Harper (1988) conducted a study in the US on professionals who were not mathematics specialists but at least held a first degree. They found that the participants did not like mathematics, when they were children, because they perceived it as unyielding. In the same study it was indicated that the participants had found mathematics to be irrelevant i.e. its applicability in the real world was not realised. This quotation from Buerk (1982) (Quoted in Betts & McNaughton 2003, p 3) is also a sign that learners view school mathematics as rigid and irrelevant.

Math does make me think of a stainless steel wall-hard, cold smooth offering no handhold; all it does is glint back at me. Edge up to it, put your nose against it; it doesn't give anything

back; you can't put a dent in it; it doesn't take your shape; it doesn't have any smell; all it does is make your nose cold.

Inability to see relevance of school mathematics contributes to learners' negative attitudes towards school mathematics and to low achievement in the subject. However, relevance has a point of reference, what is relevant to a teacher is not necessarily relevant to the learner and what is relevant to a text book writer might not be relevant to the text book reader.

McPhail, Pierson, Freeman, Goodman, & Ayappa (2000, p. 44) assert that learners at primary school are excited about schooling but “in the middle school years begin to experience the labor of school as a duty increasingly detached from their interest, values and goals.” The nature of school mathematics is such that the higher the level of mathematics the more abstract the concepts become. It is highly likely that as the subject becomes abstract it becomes more difficult for teachers to find relevant contexts to relate the content. Flowerday & Schraw (2003, p. 207) say one challenge that educators face “involves the implementation of strategies designed to foster interest, engagement, and sustained effort in students, thereby optimizing learning outcomes.” The importance of this quotation is that when learners are interested learning is enhanced. As considerable effort and resources are being directed towards encouraging young people to appreciate the relevance of mathematics to everyday life, it is important to be aware of their interests (Edwards & Ruthven, 2003). Alexander, Kulikowich, & Jetton (1994), state that it is important to understand the subject areas learners desire to know about in order to plan classroom activities that will occupy them in purposeful activity. However, Callingham (2004) says teachers are often urged to make learning relevant or to teach mathematics in contexts without much guidance on how to go about it practically.

Contexts have many different meanings in education. Examples of meanings include the learning environment, physical tangible things that are used to aid the learning process, “external contexts” and physical imaginable things, “internal contexts” (Bartolini Bussi, Boni, Ferri & Garuti, 1999). The learning environment includes the external context and also the social atmosphere of the classroom. In the present study contexts is taken to include both physical things and the learning environment. This will become clearer when the ROSME questionnaire is discussed in detail in Chapter 3 Section 3.2.

### ***1.1.3 Context of the study***

This subsection positions the present study and also gives the reader some background to the Swaziland education system. Previous ROSME studies (Julie & Mbekwa, 2005; Barnes, 2006; Kim, 2006) were positioned in mathematics and mathematical literacy programmes. In Swaziland every learner studies the same mathematics curriculum. The differentiation only occurs in the writing of the examinations whereby learners who have proved to be of low ability through continuous assessment write core examinations and those of higher ability write core and extended examinations. Furthermore the secondary school programme claims to be learner-centred. Learner-centeredness was therefore identified as a relevant construct to anchor a ROSME study. Learner centeredness is discussed in this section to show the relevance of ROSME in Swaziland.

Learner-centeredness directs the focus of research towards learner-centred learning environments (Brown, 2003). By this Brown means that if the philosophy of a curriculum is learner-centred it is only logical that research agendas will also be towards learner-centred learning environments. The present study was inspired by the current reform’s claim to learner-centeredness. The IGCSE/SGCSE curriculum recommends a learner-centred philosophy as opposed to the teacher-centred philosophy of the previous

curriculum (MOE, 2005). The assumption of the study is that asking learners to state their preferences for contexts is one way of being learner-centred.

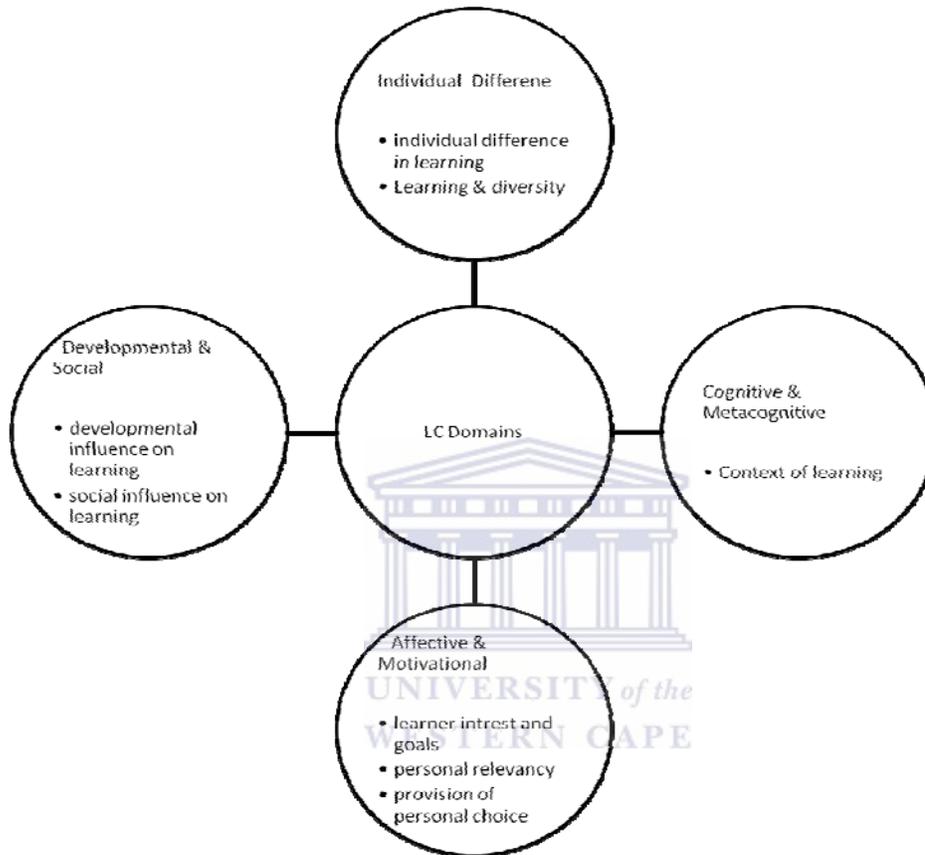
The term learner-centred is often discussed together with child-centeredness, pupil-centeredness and student-centeredness. This begs for the definition of the terms *learner*, *child*, *pupil* and *student*. According to the Microsoft Encarta (2006) dictionary the terms *learner*, *student*, *pupil* and *school child* mean the same. For this reason learner-centred, child-centred, pupil-centred and student-centred constructs will be treated as meaning the same in this study and used interchangeably.

Learner-centeredness is said to originate from constructivists philosophy (Daniels & Perry, 2003; Pillay, 2002). Constructivism by its nature positions the learner at the centre of the learning process as the learner in constructivism creates his or her own knowledge. In constructivism the significance of valid links between class activities and learners' everyday lives are also emphasized.

In learner-centred environments “children are seen as competent social actors, within a complex network of social and cultural influences” (Wood, 2007, p.119). In constructivists classrooms the learners and the teacher become a community of practice (Amit & Fried, 2005). Furthermore learner-centeredness mirrors the present society where choice and democracy are important concepts (O’Neill & McMahon, 2005).

According to McCombs (2001) four domains divided into fourteen learner-centred principles define learner centred education: *cognitive and meta-cognitive factors* having six principles; *affective and motivational factors* containing three principles; *developmental and social factors* includes two principles; and *individual difference factors* with three principles.

Figure 1.1 is an illustration of the four areas of learner-centeredness with eight of its fourteen principles shown by bullet points in the relevant areas. The eight principles are the ones I viewed as relevant to the present study.



**Figure 1.1:** The four domains of learner-centred principles, adapted from (McCombs, 2001)

The affective and motivational domain indicates that learner interests and goals, personal relevance of learning materials and provision of personal choice are pivotal to the nurturing of intrinsic motivation. Autonomous motivation, another term linked to intrinsic motivation, involves the experience of preference and choice (Vansteenkiste, Lens & Deci, 2006). Learner centred approaches should be informed by learners' experiences, motivation and interest (Gersten, Ferrin-Mundy, Benbow, Clements, Loveless, Williams, Arispe, & Banfield, n.d.). Since ROSME is centred on unearthing

learners' interests, the affective and motivational domain, it is an indication that ROSME can be used to determine learner-centred environments.

The cognitive and meta-cognitive domain, besides its emphasis on learning, includes the importance of environmental factors or contexts such as culture and technology. The individual difference domain touches on taking into account differential development of the learners. This differential development has implications on their differences in interest. Lastly the developmental and social development domain emphasises the social context of learning. This social context could include the public, the school as well as the home. Brown (2003) also argues that learner-centeredness is viable for meeting diverse needs in the classroom and focuses on individual learners' background.

In most cases when learner-centeredness is discussed the setting is classroom learning as opposed to defining curriculum. Learner-centeredness includes the idea that learners choose what to study, how to study and why it is important to study (O'Neill & McMahon, 2005). Within the context of curriculum making, learner-centeredness means that courses will focus on, and be committed to the involvement of learners at all stages of the process (Thornton & Chapman, 2000).

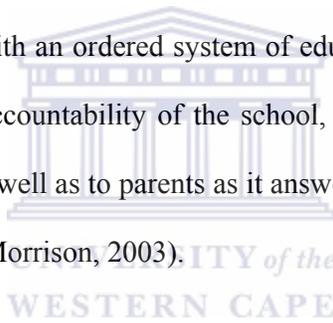
The IGCSE/SGCSE document suggests field work, project work, debate, group work, resource persons, role play and value clarification as teaching and learning methods to use in a learner-centred environment. (MOE, 2005, p. 7-8). In the IGCSE/SGCSE document, project work is said to elicit problem solving skills, intrinsic motivation, experimental technique and co-operation among learners. From these it is clear that IGCSE/SGCSE is also concerned with the affective domain in learning. Therefore, it can be concluded that IGCSE/SGCSE gives primacy to all the four domains in Figure 1.1.

Furthermore, the learner-centred aspect of IGCSE/SGCSE is shown by a differentiated curriculum for learners of varied abilities. Low ability learners in mathematics only write examinations based on the core content of the syllabus while the others write examinations on the core and extended content. It is clear from the preceding discussion to a certain extent IGCSE/SGCSE addresses all four areas of McCoombs' learner-centred education. The concern dealt with by this study was that of giving learners choice.

In searching for the learner preferred contexts for learning mathematics, the study aimed to centre the learner in choice of learning contexts. Most literature on learner-centeredness is concerned with what takes place in teaching and learning (Brodie, 2002; O'Sullivan, 2004). When educators are aware of learner preferred contexts for learning they are in a better position to create environments conducive to constructing knowledge. The learners' attraction or repulsion from some contexts was studied in view of how adolescents are said to interact with the natural environment, the social environment and the technological environment.

Brown (2003, p. 103) lists several conditions that ensure learners' success in learning. One of these is that "learning must be contextually relevant." On contextual relevance, he suggests that teachers should take into account knowledge that learners bring to the learning situation, especially that which focuses on real life contexts. Included in providing learners' choices is originality in approaches to assignments. Such autonomy privileges a variety of methods to a single task. Originality can best develop when learners are in a position to relate what they learn to familiar contexts. Besides the concept of learner centeredness it is important to be aware of the Swaziland education system to establish a proper background of the present study.

Swaziland has a centralised education system with the majority of policy-related decisions made by the Ministry of Education (MOE) which operates through four regional education offices (REOs). The Regional Education Offices are in Hhohho, Lubombo, Manzini and Shiselweni regions. Each regional office is headed by a Regional Education Officer (REO). The REOs control public schools through monitoring by inspectors. The MOE formulates policy guidelines; translates policies into plans, programs, projects and activities; develops curriculum syllabuses; and coordinates and implements national examinations. Such a system is an ordered system. This order is portrayed by monitoring structures that are put in place such as inspectors of schools, prescribed curricula, the use of prepared text books, the government scheme books, etc. The assurance that comes with an ordered system of education is difficult to resist. This order serves as a form of accountability of the school, the teachers and the Ministry of Education to government as well as to parents as it answers the what, who, how and when questions about schooling (Morrison, 2003).



At the highest position is the Minister of Education, who represents education in government. The Minister is housed in the Ministry of Education together with the school subjects' senior inspectors and chief inspectors of the various sections. There is also a unit for guidance and counselling in the Ministry of Education and in the regional offices. Each school has a teacher responsible for delivering the guidance and counselling curriculum in the schools. Part of the guidance and counselling programme deals with career guidance, teaching learners what subjects are important for different careers.

The Swaziland education system comprises of public and private schools. The majority of Swaziland schools follow the 7:3:2 system of primary, junior secondary and senior

secondary or high school respectively. The primary school takes the first seven years (grades 1-7), the junior secondary the next three years Form 1 to 3 (Grades 8-10) and the high school the last two years of school Form 4 to 5 (Grades 11-12). Although at the end of each phase there is an external examination the only important examination-for academic purposes- is the one at the end of Form 5 (Grade 12). In Swaziland learners are expected to learn mathematics at every level of their schooling.

The head of school mathematics is the Senior Inspector of Mathematics whose office is in the Ministry of Education. Each of the four regions has a Regional Education Office as stated earlier. The head is the Regional Education Officer (REO). Each Regional Education Office has an inspector of mathematics who is responsible for junior and senior secondary school mathematics. These inspectors work closely with the Senior Inspector.

The Senior Inspector heads the National Mathematics panel which oversees school mathematics in the country. This body is responsible for the secondary and primary mathematics education curriculum. The membership of this body is about four school teachers, regional mathematics inspectors, a member of the primary mathematics panel, members of the mathematics department of the National Curriculum Centre (NCC), the University of Swaziland (UNISWA) mathematics department, UNISWA mathematics curriculum and teaching personnel, UNISWA in-service department mathematics personnel, the mathematics department of the secondary teacher training college, the mathematics department of Mlalatini development centre (the centre that offers distance learning to upgrading secondary school learners), mathematics department from the Examination Council, the mathematics department of the government in-service office (this office deals with primary education issues) and members from the mathematics teachers' association.

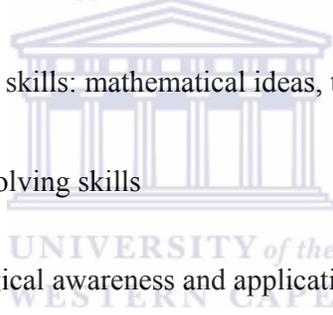
For a long time, the examination taken at the end of the last two years of secondary schooling has been the Cambridge General Certificate in Education (GCE) commonly called GCE O-level or simply O-level. The available grades for GCE are credit, pass and ungraded. A credit is a mark of 60% or more, a pass is a mark of 40% or more but less than 60% and ungraded is below 40%. From the end of 2007 learners wrote the Cambridge International General Certificate of Secondary education (IGCSE) examinations. By 2011 all public schools will be offering a localized IGCSE in all subjects (MOE, 2005). The localised version is the Swaziland General Certificate of Secondary Education (SGCSE). The IGCSE/SGCSE curriculum recommends a learner-centred philosophy.

On comparing the contents of GCE O-level mathematics and IGCSE mathematics it was found that they are equivalent. University of Cambridge Local Examination Syndicate [UCLES], (1997) also declares that the two are equivalent in standard. The main difference between the two is in the assessment procedures (University of Cambridge International Examinations [UCIE], 2004). IGCSE offers a syllabus with a coursework option, which if opted for could encourage autonomy in the learning of mathematics because in order to decide on a project to do, a learner would have to be aware of the applicability of mathematics in everyday life.

The opening statement of the SGCSE mathematics syllabus highlights some points from the national curriculum guidelines for Form 4 and Form 5. Below are some points that are pertinent to the present study.

- At the completion of secondary education learners will be equipped to meet the changing needs of the nation.

- Syllabuses will individually and collectively enable learners to develop essential skills and provide a broad learning experience which
  - encourage respect for human rights and freedom of speech
  - develops desirable attitudes and behaviour towards the environment
  - Provides insight and understanding of global issues which affect quality of life in Swaziland and elsewhere e.g. the AIDS pandemic; global warming; maldistribution of wealth; technological advances.
  
- Learners will be given opportunities to develop essential skills such as:
  - Numeracy skills: mathematical ideas, techniques and applications
  - Problem solving skills
  - Technological awareness and applications
  - Critical thinking skills
  - Independent learning
  - Working with others (MOE, 2007)

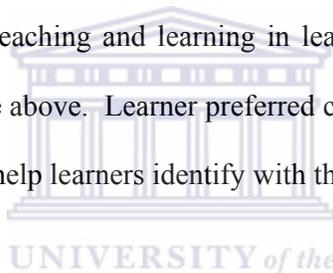


The traditional textbook approach to mathematics can not provide learners with the above skills abilities and outlooks. I believe the present study can contribute some insight into learner preferences for mathematics learning such as relevant contexts.

The Principal Secretary of the education ministry in Swaziland lists the following as objectives in the foreword remarks on the mathematics syllabi for Forms 1, 2 and 3:

- To develop knowledge, skills and understanding in numeracy and mathematical thinking;
- To develop the capacity for independent thought through inquiry, problem solving, information handling and reasoning;
- To develop positive attitudes to learning mathematics;
- To develop personal fulfilment through the achievement of personal objectives (Kunene, 2003)

Each of the above objectives call for a learner centred approach to the teaching and learning of mathematics. Teaching and learning in learner preferred contexts could be one way to develop all of the above. Learner preferred contexts have the potential to give meaning to learning as they help learners identify with the work.



## **1.2 The General Statement of the Problem**

The problem the present study addressed was the absence of learners' preferences in contexts chosen for learning mathematics. Contexts for learning in most cases are chosen by adults without consulting learners at any stage. These adult chosen contexts are usually a result of decontextualising mathematics and constructing fictitious contexts in which to embed a piece of mathematics.

## **1.3 Significance of the Study**

This thesis is based on the view that contexts used in the teaching and learning of mathematics should as much as possible include those that are of interest to learners. The contexts used should be those that learners can easily interact with. It should be every

educator's endeavour to find out what learners like and use it to the learners' advantage in teaching and learning. Knowing the contexts that learners prefer might help teachers investigate how these could be used in the classroom and in that way contribute to the improvement of the teaching and learning of mathematics. The aims objectives and research questions for this study are presented below.

## **1.4 Aims, Objectives and Research Questions**

### ***1.4.1 Aims of the study***

- To explore the contexts that Swaziland public schools' learners in Forms 1 to 3 prefer for learning mathematics.
- To investigate the motivations learners provide for their preferences.
- To interrogate and contribute towards generation of hypotheses around issues related to the use of contexts in mathematics and larger phenomenon such as:
  - Careers
  - Self-concept etc

### ***1.4.2 Objectives***

- To identify the contexts learners most prefer for learning school mathematics
- To identify the contexts learners least prefer for learning school mathematics
- To compare the most and the least preferred contexts between gender and between forms.
- To study reasons learners give for preferring or not preferring certain contexts

### ***1.4.3 Research questions***

1. What contexts do junior secondary school learners in Swaziland public schools most prefer to deal with in mathematics?
  - Which of the 61 core contexts were ranked as most preferred by the learners?
  - How are the most preferred contexts distributed according to gender or class level?
  - How do the learners support their reasons for choosing favourite contexts?
2. What contexts do junior secondary school learners in Swaziland public schools least prefer to deal with in mathematics?
  - Which of the 61 core contexts were ranked as least preferred by the learners?
  - How are the least preferred contexts distributed according to gender or class level?

## **1.5 Conceptual Framework of the study**

The analysis employed a sociological approach. The conceptual framework used is a multifaceted framework. It was thus named because it was constructed from various ideas and backgrounds. The faces of the framework are; generalized others (GOs)- the social environment to which an individual reacts (Mead, 1964)- including the natural environment, the social environment and the technological environment which are pillars

of Science-Technology-Society (STS). These were together recognized as identity development influences. The self-identities including mathematical self-identities and social-identities were used to explain the results.

Most literature relates to a significant person as one having a positive impact on children or adolescents' lives, however, negative attitudes and behaviours can also exert significance influence on young people (Schiff & Tatar, 2003). A learner's choice, therefore, is as much his or her own as it is socio-culturally influenced; thus like most other human thought structures, it should be seen in terms of the individual and his or her social and cultural situatedness (Pillay, 2002).

## **1.6 Summary of the Research Design**

A survey design using questionnaires was followed. This design was appropriate for the present study as its interest was unearthing what learners considered as relevant contexts for learning mathematics. Secondly the survey design was appropriate as it has potential to reveal other topics for future study. The questionnaire contains both closed and open questions. The closed questions allowed for quantitative analysis while the open questions were analysed qualitatively using interpretive methods. Questionnaires were chosen because they can be administered to a number of people at a go.

## **1.7 Thesis Chapter Outline**

### ***1.7.1 Introduction***

Chapter 1 comprises the rationale of the study based upon a brief examination of the Swaziland education system and a substantial exposition of learner-centeredness to

provide an anchor for a ROSME study. The aims and objectives of the study and the outline of the research methodology are stated.

### ***1.7.2 Literature review***

Chapter 2 presents an overview of literature relevant to the study. Concepts considered significant are affect and contexts in the learning of school mathematics. In affect the discussion focuses on interest. Some definitions of interest are offered and a working definition for the study is constructed. Use and importance of contexts in school mathematics is discussed. Finally some studies on learners' views are presented.

### ***1.7.3 The research methodology***

Chapter 3 elaborates on the approach and design adopted to answer the research questions. It employs the quantitative and the qualitative models. It gives details on sampling procedures, data collection and analysis techniques used.

### ***1.7.4 Conceptual framework***

Chapter 4 is a presentation of the conceptual framework. The conceptual framework used is a multifaceted framework. It is thus named because it is constructed from various ideas such as generalized others (GOs) and self-identities, identities incorporates mathematical self-identities and social-identities. The GOs include the natural environment and the technological environment.

### ***1.7.5 Presentation of results***

Chapter 5 documents results obtained. Both quantitative and qualitative data are presented here together with their analyses. Tables of summaries are presented and analysed.

### ***1.7.6 Discussion***

Chapter 6 discusses the results and the interpretations in line with the aims and the objectives of the study. This is where I indicate the extent at which the research questions have been answered. The contribution of this study to mathematics education and towards the overall theory is also evaluated. Reflections on the methodology and the conceptual framework are also made in Chapter 6.



## 2. CHAPTER 2

# LITERATURE REVIEW

## 2.1 Introduction

This chapter presents the literature pertinent to the study. Relevant concepts are *affect* and *contexts* in the learning of school mathematics. The literature will be presented in the order; affect then contexts in the learning of mathematics. Affect is a broad field that includes beliefs, attitudes, emotions, values, mood and interest (Zan, Brown, Evans & Hannula, 2006). There is sufficient amount of literature on the importance of contexts to the affective domain in learning (e.g. Boaler, 1993a, 1994; Klassen, 2006; Clarke & Helme, 1998).

## 2.2 Affect in School Mathematics

There has been an increased attention to affective variables in psychological and educational research over the past decade (Isiksal, Curran, Koc, & Askun, 2009). There are a number of constructs or variables classified under the affective domain. These include attitude, beliefs, emotions, values (Zan & Di Martino, 2007) as well as preferences and interest (Trumper, 2006). Some authors define interest as attitude (Krapp, Hidi & Renninger, 1992). The most commonly studied construct in the affective domain is attitude towards mathematics. This probably was popularized by the Fennema & Sherman's (1976) attitude scale.

A number of studies, however, have concentrated on studying affect in relation to classroom activities. For example, in studies on motivation learners have been observed to

study their emotions in relation to the task they were performing. Emotions, the most direct link to motivation, are manifested positively by: joy, relief or interest or negatively by anger, sadness or frustration (Hannula, 2006). So according to him interest is a motivational attribute. Furthermore, the usefulness of a range of theoretical approaches in shedding light on identifying dimensions of affect most relevant to mathematics education and how it is involved in development of mathematical thinking and behaviour has been considered (Zan, Brown, Evans & Hannula, 2006). They synthesized notions of affect or theoretical approaches to affect. One of these approaches gives a central role to the notion of discourse in considering emotions as socially organized and shaped by power relations (Evans, Morgan & Tsatsaroni, 2006). The authors drew together strands from social indicators, instructional discourse theories and psychological analyses, so as to discuss how the different positioning of individuals influence emotional experience and expression (Zan, Brown, Evans & Hannula 2006). The central issue was to study affect in relation to cognition. The authors based their writing on observations of one learner. It is however, not indicated if the learner in question was asked to choose context to use in learning or doing the mathematics task.

The present study required the learners to indicate the strength of their *interest* on the given contexts and this positions it in affective domain studies. The construct interest will be given more attention on this section. First general definitions of interest are given followed by a description of types of interest and finally the aspect of interest addressed in the present study.

The concept of interest as an educationally pertinent disposition is closely related to concepts of attitude in social psychology (Krapp, Hidi & Renninger, 1992). Interest in everyday language means liking, preference or attraction (Valsiner, 1992). In a classroom

situation it refers to a learner's tendency to persist in particular subject content over time and the psychological state that accompanies this commitment (Renninger, 2009). Interest is a phenomenon that emerges from a person's contact with his or her environment (Krapp, Hidi & Renninger, 1992). In their definition of environment they include object and stimulus. So interest can be triggered by objects or by stimuli. Interest develops through four phases: triggered situational interest, maintained situational interest, emerging individual interest and well-developed individual interest (Renninger, 2009). This leads to the discussion of two types of interest: situational interest and individual interest.

Situational interest is evoked by something in the immediate environment and, consequently, may or may not have lasting effect on personal interest and learning (Hidi & Anderson, 1992). This means that it is the interest that is generated mainly by certain conditions and/or concrete objects in the environment (Krapp, Hidi & Renninger, 1992). It can be described from the point of view of either the cause, or conditions that bring about interest, or the perspective of the learner (Krapp, Hidi & Renninger, 1992). They say, viewed from this angle, situational interest is not unique to the individual but tends to be common across individuals. Maybe that is why Hidi & Anderson (1992) refer to it as group interest. Situational interest triggered by environmental factors, may evoke or contribute to the development of long-lasting individual interest (Krapp, Hidi & Renninger, 1992).

Individual interest on the other hand can be interpreted as the relatively long-term orientation of an individual toward a type of object, an activity, or an area of knowledge (Schiefele, 1992). Individual interests are considered as characteristics that are based on mental patterns associating the object(s) of interest with positive emotional experiences

and the personal value system (Koller, Baumert, & Schnabel, 2001). It is considered to be relatively stable and is usually associated with increased knowledge, positive emotions and increased reference value (Hidi, & Anderson, 1992). It refers to a person's interaction with a specific class of tasks, objects, events or ideas. Such specificity distinguishes individual interest from psychological concepts such as intrinsic motivation, attention, arousal, curiosity and exploration (Krapp, Hidi & Renninger, 1992).

One must distinguish between two components of interest: a feeling-related (associated with feelings that precede, accompany, or follow activity involving the topic or object of interest) and a value-related (of personal significance) component (Schiefele, 1992). In this way interest is a domain specific or topic specific motivational characteristic of personality.

Three major points of view reflected in interest research are: interest as a characteristic of the person, interest as the characteristic of the learning environment and interest as a psychological state (Krapp, Hidi & Renninger, 1992).

In this study interest is taken to be both situational and individual. It is situational because learners were presented with contexts to indicate their preferences. In that way contexts served as stimulus objects that triggered the interest. Individual interest is implicated by the learners association of the contexts with emotional experiences and their personal value systems.

Our interests identify us. They point out who we are and who we are reveals our experiences. They show who we have been with, what we have read, and what we have seen. They also point out our future by showing who we can connect with and how we

can be reached. It is, therefore, crucial for educators to be aware of learners' interests in order to connect with them during instruction.

## 2.3 The Use of Contexts in School Mathematics

The term context has a number of meanings and uses in mathematics education. Clarke & Helme (1998) give two types of context; the interactive contexts and the figurative contexts. They define interactive contexts as those in which the task is met such as the mathematics classroom and everyday life.

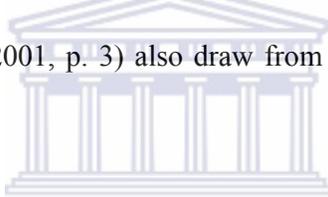
Figurative context on the other hand refers to the situation described in the task. They could be concrete objects that are physically there (external contexts) or can be imagined by the learners or teachers as a result of their experiences (internal contexts) (Bartolini Bussi, Boni, Ferri & Garuti, 1999). They say practice with external contexts enables the learner or the teacher to imagine internal contexts.

Finkelstein (2005, p. 119) says “context arises in the weaving together of constituent elements.” Finkelstein (2005) delves deeply into the aspect of situational context making analogies to a bowl that contains the soup and a rope that is made from several fibres. The soup represents learning and the shape of the bowl represents the learning context. In the rope analogy the rope is the learning that takes place while the different strands are the different contexts used for learning to take place. He asserts that the task and its context are mutually constitutive. By this he means the two cannot be separated or learning is shaped by the context in which it takes place.

Realistic Mathematics Education (RME) is one theory that has given prominence to contexts in the learning of school mathematics. Its contexts-driven nature makes it a

suitable component of a motivational theory for the present study. It is characterised by the following five characteristics: the use of contexts; the use of models; the use of students own productions and constructions; interactivity; and the intertwining of various learning strands (Zulkardi, 1999). The present study examines the nature of the categories of contexts learners prefer to use in learning mathematics including their perceptions on using other school subjects as contexts for learning mathematics. The contexts investigated have a potential to provide an appropriate environment to promote the five characteristics of RME. In RME a learner is portrayed as an active participant in the learning situation.

In their introductory remarks to *Mathematics in Context* (MiC), an American version of RME, Romberg & Meyer (2001, p. 3) also draw from the intertwining characteristic of RME. They assert that:



Connections are a key feature of the program—connections among topics, connections to other disciplines, and connections between mathematics and meaningful problems in the real world. *Mathematics in Context* emphasizes the dynamic, active nature of mathematics and the way mathematics enables students to make sense of their world.

The quotation above renders all the contexts included in the ROSME questionnaire used in this study useful in the learning of mathematics as contexts included in it are mathematical topics themselves and the others are contexts in the learners' real world. This real world includes other school subjects as contexts for learning mathematics and this links with MiC's idea of "connections to other disciplines."

The strength of RME comes from its capacity – in vertical mathematizing – to transform known mathematics itself into contexts for learning more mathematics. One criticism against learning in contexts is that some traditional school topics such as algebra, geometry, functions and trigonometry are rarely found in the everyday life experiences of

learners (Usiskin, 1997). In such cases RME as a theory becomes useful as mathematical knowledge acquired earlier becomes a context in which higher level mathematics can be learnt. Cobb (2000) also emphasises experiential contexts as one of the views central to RME.

There is a plethora of literature on the use of contexts in the learning of mathematics. For example, the journal 'Educational Studies in Mathematics' dedicated its 1999 Volume 39 number 1/3 to contexts in mathematics education (Klaoudatos & Papastavridis, 2004). This special issue offered a selection of studies related to teaching and learning mathematics in context. The common concerns these studies shared were: to go beyond the easiest and most superficial motivations for differing educational orientations related to the meanings of 'context', to study in detail the reasons behind effectiveness and cultural motivations, to point out possible limits characterising different perspectives and find possible ways of going beyond them (Boero, 1999).

Specific contexts could be used in modelling and problem solving tasks (Crouch & Haines, 2004; Chapman, 2006). Reasons for learning in contexts range from providing learners with a familiar allegory, to enhancing the transfer of mathematical learning through a demonstration of the connections between school mathematics and the real world (Boaler, 1993b, 1994) and motivating and engaging learners (Boaler, 1993a, 1994; Klassen, 2006; Clarke & Helme, 1998). Contexts enable instructors to design a teaching sequence sensitive to learners' needs, give learners the chance to position their understanding in their own familiar knowledge and promote the reinvention of mathematics (Gravemeijer & Doorman, 1999).

There are, however, some weaknesses that have been pointed out on the use of contexts. According to Clarke & Helme (1998) instructional material that is contextually based will not always appeal to all learners all the time and contextual detail might create undue cognitive burden. When the teacher or the learner has not had an experience with a context it can be difficult to imagine it and picturing it as an internal context could be impossible and a hindrance to teaching or learning (Klaoudatos & Papastavridis, 2004).

Teachers and learners might also face mathematically, linguistically, politically and ethically based problems when contexts are used without appropriate attention to the socio-political latitude (Zevenbergen, Sullivan & Mousley, 2002). They also condemn the use of indigenous activities, such as basket weaving, for western mathematical view points. Their argument is that the indigenous people “were not demonstrating mathematical concepts, but rather to represent other aspects of their culture” (Zevenbergen, Sullivan & Mousley, 2002 p. 2). The quotation gives an impression that mathematics is closed and not dynamic or developing from what is happening in the environment. Also one wonders if the historical development of mathematics was not motivated by the social lives of people in their different social backgrounds. Some writers recommend the use of historical developments of mathematics in its teaching (Gravemeijer & Doorman, 1999; Gulikers & Blom, 2001; Radford, Furinghetti & Katz, 2007). This is an indication that they acknowledge mathematics as a human activity. Indigenous cultural activities can provide useful significant contexts for learning mathematics as they describe realities that are meaningful to the learners (Linchevski & Williams, 1999). Proposing the use of indigenous activities does not imply exclusions of other contexts as doing that would place learners at a disadvantage. Meaningfulness of contexts should be cognizant of learners’ aspirations by using contexts that are not

necessarily in their cultural backgrounds but important in preparing them for the future (Skovsmose, 2005).

Another strong view against the use of contexts in school mathematics was the use of “pseudo-real” (Zevenbergen, Sullivan & Mousley, 2002 p. 3) context or “prefabricated” (Clarke & Helme, 1998, p.135) contexts. These make believe contexts are meant only for the mathematics classroom they do not translate to real life. This compounds the perceived irrelevance of school mathematics.

Contexts relevancy however is relative, they can be said to be relevant in relation to teachers or learners (Klassen, 2006). Unfortunately in most cases adults decide on the contexts ignoring the learners’ choices and yet, they form the majority in any school community. Despite an abundance of literature on contexts in the learning of mathematics contexts that learners would prefer to deal with in mathematics are still relatively under-researched (Julie & Mbekwa, 2005). Swaziland has developed text books for Forms 1 to 5 which use Swaziland contexts such as the use of the rondavel when teaching about circles, cylinders and cones. These contexts, however, are chosen by adults.

Also highlighted in the literature on contexts is the problem of transfer from real situation to the classroom situation and vice versa. Evans (1999, p.23) defines transfer as “the use of ideas and knowledge learned in one context in another.” His examples of fields of transfer are between mathematics and other subjects, application of classroom knowledge to work or everyday life and the use of out of school activities for the learning of mathematics. He says transfer is not impossible and its success might relatively depend on an affective dimension. The familiarity of the context to the students might increase the affective dimension and in that way facilitate the learning of mathematics.

Modelling or model building is a process leading from the real situation to a mathematical model (Blum & Niss, 1991). Lingefjärd (2006) reports that his students after exposure to different mathematical modelling problem situations argued that models in medicine are “real” in some overall sense. They rated geometry third claiming that it is fun. Sport was rated lowest. When intrinsically motivated a person is moved to act for the fun or challenge entailed rather than because of external pressures, or rewards (Ryan, & Deci, 2000).

A majority of studies on contexts in the learning of mathematics are directed to curriculum content and the classroom environment. A number of these have looked at contexts of learning tasks (Boaler, 1994; Clarke & Helme, 1998; Palm, 2002; Klaoudatos & Papastavridis, 2004). Other studies such as Turner & Meyer (2000) have related contexts to classroom situations. A substantial number of these studies support the use of contexts in the learning of mathematics.

In Swaziland studies on the use of contexts have been conducted mainly in science education (Dlamini & Dlamini, 2003; Putsoa, Dlamini, Dlamini, Dube, Khumalo, Masango, Ndlela, Nhlengethwa & Tsabedze 2005; Dlamini, 2005; Dlamini, Dlamini & Dube, 2007). These science education studies focussed on material development, implementation and evaluation of the contextualized approach to school science. Evaluation studies included both teachers and learners perceptions on the contextualized approach. Dlamini & Dlamini (2003) report a study that investigated learners’ perceptions on contextualisation versus traditional methods of approach. They report that the learners from both primary and secondary schools preferred to be taught using the non-contextualised approach. Lubben, Campbell & Dlamini (1996) reported that learners

considered the contextualised approach to increase their participation, rate of concept development and motivation. The seemingly contradictory findings reported above are a result of differing focuses of the two studies. Dlamini, Dlamini & Dube (2007) investigated teachers' opinions on the implementation of contextualised science. They found that teachers were comfortable with some aspects, but not with others and they concluded that contextualization was not well understood and expressed doubt about the efficacy of its implementation. The results from the studies on contextualized methods of teaching and learning science indicate that there is a lot of work that still needs to be done in the country for the method to work properly.

The present study focused on contexts learners would prefer for learning mathematics. The emphasis was on eliciting contexts learners view as relevant for learning school mathematics, excluding details on how these contexts might be utilised in delivering the school mathematics curriculum. Getting learners to say what context they prefer for the learning of mathematics is a search for their views on contexts in the learning of mathematics. The learners were presented with 61 core contexts to choose from. Most of these 61 core contexts can be used as figurative contexts. Some of them, such as "Mathematics that will help me to do mathematics at universities and technikons" can also be used as interactive contexts. Other contexts in the ROSME questionnaire include other school subjects and media. There is no doubt that these contexts are interactive contexts. In this study contexts were defined as both interactive and figurative.

The fact that learners have varying curricular needs requires that they be consulted about the curriculum. The idea of involving learners in curricular designs was coined from Rousseau's Romanticism but later developed by Dewey who argued that the curricula must be inclined to learners' needs and interests (Passe, 1996). Romanticism has

idealistic or impractical expectations such as designing a curriculum solely from what learners want. Although Dewey fully supports involving children in curriculum designs, Passe (1996) says he likened Romanticism to a dark cloud that produces no rain because of the impracticality of having a curriculum designed entirely from learners' input. Seeking learners' views on contexts for learning school mathematics does not imply the abandonment of responsibility for curriculum making by professionals nor does it mean giving learners free reign to make decisions. Rather it is giving them a say in the choice and development of learning opportunities, both 'the what' and 'the how' of the curriculum (Thornton & Chapman, 2000). Below I report on some studies on learners' views and preferences related to school mathematics.

## **2.4 Studies on Learners' Views**

Kaiser-Messmer (1993) investigated upper and lower secondary school learners in Germany on gender differences in attitudes towards mathematics. She used questionnaires with most questions open-ended. Her study examined learners' positions on various issues such as interest in mathematics, importance of doing well in mathematics, eagerness to contemplate entering careers requiring mathematics and to find out mathematical activities and themes from the real world which interests learners. Some findings of her study are presented below.

At lower secondary level significantly fewer girls than boys expressed an interest in mathematics. Gender specific differences were also found in the explanations of the learners for their interest in or indifference to mathematics. A larger number of boys gave mathematics as being fun as a reason for their interest in mathematics (19% compared to 14%). The girls' reason for their indifference was almost exclusively explained by their

evaluation of mathematics as being difficult and complicated or impersonal and dry. The possible importance of mathematics for future careers did not seem to influence the decision of either girls or boys in this age group as less than 10% of all those questioned gave this reason.

A clearly smaller percentage of girls than boys were inclined to enter a career involving mathematics at both lower secondary level and upper secondary basic course level. Girls were distinctly opposed to a mathematics-based career. Furthermore, the explanations for the willingness to work in such careers demonstrate gender difference. Boys often give mathematics as being fun as a reason, while girls hardly ever offer this response. The explanations for the rejection of such careers also exhibit clear gender differences. Responding similarly to the question on "interest in mathematics", it is almost exclusively girls who state that such a job would be difficult or boring and not much fun. Furthermore, the girls frequently said they would not have the confidence to cope with such a job, although they claimed to have good grades in mathematics. This observation did not apply to any of the boys.

At the advanced level a totally different picture emerged. Here, significantly more girls than boys could imagine themselves working in a mathematics-related career (86% compared to 64%). More boys than girls refused to enter a career involving mathematics. Looking at the reasons for their willingness, 37% of girls and 26% of boys said such a job would be fun. About 20% of girls and boys actually gave concrete career plans as an explanation.

The lower secondary girls were mainly interested in arithmetical problems, followed by an interest in geometrical activities. More boys than girls preferred theory-based

considerations; however, the girls did not completely reject these. Real-world problems, which the girls and boys generally only know as "word problems", were relatively unpopular for both sexes.

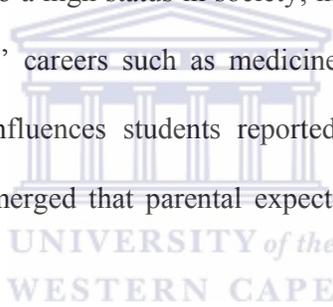
Lower secondary level girls favoured very strongly the topic ecology, followed by sport, biology or medicine and every-day life. In the areas of ecology and biology or medicine, differences from the boys were most obvious, since only a few boys named these topics. The most dominant themes for boys were sport, technology, the economy and physics, with big gender differences in technology and physics, which were hardly ever chosen by girls.

At upper secondary level significant differences between the basic course and the advanced level course emerged. At the basic course level the girls indicated a high interest in social topics, followed by ecology, every-day life topics, technology and sport. The boys' order of interest was slightly changed, with more boys choosing society and technology. Clear gender differences were only apparent for the topic economy, which was named as interesting by significantly more boys than girls. Clear gender differences were apparent for physics, which was very popular with the boys, but very unpopular with the girls. In contrast, biology or medicine was named by significantly more girls than boys. Overall, it was noticeable that topics such as ecology, society, every-day life are clearly less interesting to girls and boys at the advanced level than at the basic course level.

A study was carried out in the United Kingdom on how students talk about their aspirations in regard to higher education and their mathematics (Hernandez-Martinez, Black, Williams, Davis, Pampaka & Wake, 2008). They interviewed 40 students. Their

analysis revealed four themes: ‘becoming successful’, ‘personal satisfaction’, ‘vocational’, and ‘idealist.’ They called the themes interpretive repertoires. Most of the sample was found to use a single, predominant repertoire, which they termed the students’ repertoire ‘style’. They studied each repertoire for aspirations, external influences and the students’ view of mathematics. Their findings on three of the repertoires are reported in the following paragraphs.

The ‘becoming successful’ repertoire focused on a particular type of aspiration – going to university as a way to achieve social respectability or ‘success’. Furthermore, they noted that career choices were narrowed by what is culturally regarded as respectable professions which can lead to a high status in society, including financial rewards. These mainly involved ‘traditional’ careers such as medicine, accountancy, business or law. Looking at the kinds of influences students reported as important or significant in ‘becoming successful’, it emerged that parental expectations of the students for higher education were strong.



They found that for these students mathematics was seen as instrumental in achieving their goals, as a high status discipline that can move one along a respectable career path. Hence, students who used this repertoire could speak of mathematics as ‘hard’, ‘not relevant to everyday life’, but as a ‘pre-requisite’ for their future plans, or helpful in their future rather than now.

A third repertoire, the ‘vocational’ repertoire, identified focused on the representation of a clear vocational pathway where mathematics was integrally connected and useful. The majority of students who used this repertoire were males on engineering courses and spoke predominantly of their intention to pursue a career in this field. There were no

consistent influences on students' ambitions identified within this repertoire, which may be connected to the fact that many had already opted for a particular vocational pathway. Most of the students using this repertoire talked about mathematics being highly useful and relevant to the engineering they were doing and wanted to do in the future. These students' identity as mathematics learners was very much aligned with their desire to become engineers. These students – many with apparently weak grades – used this repertoire to express a strong identity as mathematics learners. Mathematics was not only useful for their future plans, but also for the everyday activity of doing engineering.

Lastly the 'idealist' repertoire, in this repertoire, targets related to pursuing a future which was marked out as either different from the reality they currently lived or as the realisation of a dream – a yearning which had sometimes been with the student for a while.

The students who used this repertoire generally reported being the first in their families to be going to university, so did not have an immediate role model in this respect, and their parents did not generally provide them with guidance. Some of them knew people in their extended families or had friends who had been to university, but mainly their ideals had weak foundations, and were often based on the popular media. Mathematics within this repertoire generally did not play a central role; rather, it came into play mainly by chance if it was understood to be implicated in their dream. Students spoke of their decision to choose maths at a higher level because it seemed like 'a good idea' at a specific moment in time (e.g. because they liked it at school), even if they did not 'need' it in the future.

A study conducted by Lerman (1998) on years 9 to 11 learners in 4 schools in London in the United Kingdom reveals the learners' images of certain aspects about mathematics. The purpose of the study was to find out the voices of school learners or their perceptions of mathematics and to access their views of mathematics outside of lessons. The categories he reports on are: learners' images of mathematics, learners' images of teachers of mathematics, learners' images of mathematics in the work place and learners' images of mathematics in everyday life.

Lerman (1998) reports that his study indicates that learners have a positive *Image of mathematics* as over 80% of each group of boys and girls indicated a positive image as they answered yes to each of the three questions in this category (Amongst your friends is it OK to be good at mathematics? Amongst your friends is it OK to like mathematics? Amongst your friends is it OK to work in mathematics lessons?)

His study reveals that learners have a negative *Image of teachers of mathematics* as he reports that: Less than 50% of each of the boys and girls answered positively when asked if they thought differently of mathematics teachers compared to the way they thought of other teachers. When asked how they were different, less than a third gave favourable reasons.

Although more than 85% of each of the boys and girls in the study answered positively when asked if their parents were good at mathematics when they were asked about the mathematics their parents used at work, a number of students cited using the till, working out wages, using measures, a general mention of one or all of the four rules. There were few descriptions of the use of mathematics where the adults were accountants, teachers,

engineers and those working with computers. This is an indication that they had a limited view of *Mathematics in the work place*.

When asked where people use mathematics in their daily lives outside of work, about 80% of those who answered gave shopping as an example. Many also answered personal finance and a few answered “cooking”, “quizzes”, “sport”, “currency” and “games”. About mathematics on TV or newspapers many responded that they did not watch news on TV nor read newspapers. The few that said they saw mathematics on TV included stocks and shares, charts and graphs. This is another indication that the learners did not relate other branches of mathematics to *everyday life* except simple mathematics.

The images Lerman (1998) investigate targets particular people and areas in the learners’ environment such as popularity of mathematics with the learners’ peers and adults in their micro-system. What are missing in the study are various individual images of mathematics that could emerge from an open study such as ROSME. Lerman’s (1998) study gives a glimpse into a wide spectrum of images that learners have about school mathematics.

Mathematics in everyday life and mathematics at the work place are pertinent in the present study as the contexts used in the questionnaire are issues in society. Asking learners about the context which they would prefer to learn mathematics in places them in a position to interrogate the value of mathematics in their everyday lives.

Also in the United Kingdom a study was carried out by Edwards & Ruthven (2003) on years 7 and 10 learners. The study explored the learners’ perceptions of mathematics involved in five everyday activities. They used interviews in relation to cards, with each portraying the following socially varied everyday activities:

- Playing chess
- Dressmaking (making a pair of trousers)
- Knitting a cardigan
- Making a Lego robot
- Playing snooker or pool

The learners were asked about the processes involved in doing each activity and the skills the activity might require or develop. They were told that some people believed that some or all of the above activities used mathematics or helped develop mathematical skills or mathematical thinking. They were then asked if they agreed with the statement and to identify the mathematical uses or thinking in the activities. The learners were also interviewed about the people associated with each activity. The results of Edwards & Ruthven's (2003) study showed that the learners were aware of the mathematical processes involved in at least some of the everyday activities and some learners identified mathematical processes involved in an activity. In general, the learners provided two examples of the mathematics used in each activity. The majority of them focused on fairly undemanding processes such as shape, space and measure.

Edward & Ruthven (2003) presented the learners with everyday contexts and required them to identify how mathematics was used in these contexts. In their study the learners were required to see mathematics in some activity. None of the activities required learners to identify contexts that would be useful in the learning of mathematics. The study focused on learners' ability to see the applicability of school mathematics in their daily lives. These researchers, it would seem, were starting from a position where the learners had a marked out domain known as mathematics. In the present study the learners were

not asked to identify mathematics in the contexts but to identify those contexts they deemed relevant for learning of mathematics. One might argue that to do that they first need to be aware of the mathematics in these contexts. Their concept of mathematics was likely to be influenced by their experiences of it. Edwards & Ruthven's (2003) study is related to the present study in that it relies on learners' attitudes, images and perceptions about what constitutes mathematics and how it was used by society. It was also relevant because it also aimed at hearing learners' voices and was located in research on contexts

Several studies have been conducted using the ROSME questionnaire. Among these are: (Julie & Mbekwa, 2005; Barnes, 2006; Ngcobo, 2006 and Kim, 2006). Other ROSME studies such as (Julie, 2006 and van Schalkwyk, 2007) investigated teachers' positions on the context for learning school mathematics.

Julie & Mbekwa (2005) conducted their study at a public school in the Western Cape in South Africa. They used mean scores to rank the contexts as least and most favoured. In their study they found that the five highest ranked contexts were; *mathematics that will help me do mathematics at universities and technikons, mathematics involved in making computer games, mathematics involved in sending of messages by SMS, cellphones and e-mails, mathematics involved in determining the state of health of a person and mathematics to assist in the determination of the level of development regarding employment, education & poverty of my community.* The five lowest ranked were; *mathematics linked to decorations such as the house decorations made by Ndebele women, mathematics for determining the number of fish in a lake, river or certain section of the sea, mathematics involved in working out the best arrangement for planting seeds,*

*mathematics to predict whether certain species of animals are on the brink of extinction and how to estimate and project crop production.*

Another study in the Western Cape was carried out on Grades 8 – 10 by Barnes (2006). He conducted his study in the Western Cape in South Africa. The aim of his study was to compare the most and the least preferred contexts of the three grades for learning school mathematics. He used 20 schools of low socio – economic backgrounds. The total number of learners in his study was 1 177. He used mean ranks to determine the most and the least favoured contexts. He found that *mathematics that will help me do mathematics at universities and technikons, numbers, mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM, mathematics that is relevant to professionals such as engineers, lawyers and accountants, the kind of work mathematicians do, and mathematics involved in working out financial plans for profit making* were amongst the first ten most preferred contexts for all three grades. In all three grades *mathematics that will help me do mathematics at universities and technikons* was rated highest. The common least preferred were *mathematics of lottery and gambling, mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of a certain size, mathematics involved in packing goods to use space efficiently and mathematics involved in working out the best arrangements for planting seeds* with *mathematics of lottery and gambling* rated lowest in all three grades. He reports that intra – mathematical and extra – mathematical clusters were ranked highly while the agriculture and political clusters were ranked low.

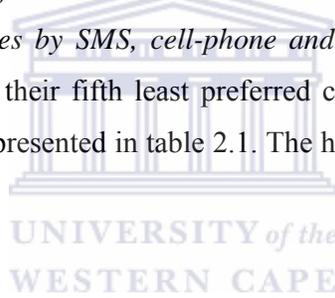
In Swaziland Ngcobo (2006) investigated contexts in which Forms 2 to 4 (Grades 9 to 11) in some private schools prefer to learn mathematics. Data for that study were collected using the ROSME questionnaire. The target population for the paper was secondary

school learners from private high schools that offer the International General Certificate of Secondary Education. One class from each targeted Forms (2-4) took part in the study. Factor analysis was used to obtain subgroups of the items using the learners' responses. Emerging groupings were *fun and entertainment, health & environment, mathematics and mathematicians, technological and socio-economic issues*. Frequency counts were used to find the most popular and the least popular items. The findings showed that the five contexts in which learners were mostly interested were: *mathematics that will help them do mathematics at universities and technikons, mathematics that is relevant to professionals, mathematics involved in secret codes, mathematics involved in working out financial plans for profit making and mathematics involved in the sending of messages by SMS, cell phone and e-mails*. Except for the last one each of the above contexts had a median of 4 and an interquartile range of 1 indicating that at least 75% of these learners had a strong preference for the most preferred contexts. Results from the open item indicated an emphasis in the interest in these contexts. The five contexts in which learners were least interested were: *Mathematics involved in designing delivery routes of goods, mathematics involved in working out the best arrangement for planting seeds, mathematics involved in deciding the number of cattle, sheep or reindeer to graze in a field of a certain size, mathematics used in decorations on mats and handicraft made by the market ladies, mathematics needed to work out the amount of fertilizer needed to grow a certain crop*. The most reasons given for interest in contexts were curiosity, career prospects and financial freedom in the future.

Lastly Kim (2006) in a similar fashion carried out a study in Korea. In this case the most favoured contexts were *mathematics that entertains and surprises us; mathematics involved in determining the state of health of a person; mathematics involved in sending messages by SMS, cell phones, and e-mails; mathematics about the age of the universe and mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM*. The least favoured contexts were *mathematics used to calculate the number of seats for parliament given to political parties after elections, geometry, mathematics involved in working out the best arrangements for planting seeds, algebra and mathematics needed to work out the amount of fertilizer needed to grow a certain crop*.

Teachers who attended continuing professional development teacher education courses at the University of the Western Cape were investigated for their views on contexts relevant for learning school mathematics (Julie, 2006). These were mathematic teachers (36), language teachers (25), other subjects' teachers (70) and 13 primary school teachers. They all ranked *health* amongst the five highest ranked items and *military matters* as well as *lottery and gambling* amongst the five lowest ranked items.

Van Schalkwyk (2007) compared teachers' data from South Africa with data from Korea. The contexts the teachers had to choose from were 20. Teachers chose contexts they deemed appropriate for Grades 8-10 learners. The five least preferred contexts were quite comparable between the two countries as they both included: *The mathematics of lottery and gambling*, *Mathematics in military matters*, *Mathematics linked to rave and disco dance patterns* and *Mathematics in political matters such as the allocation for parliament given to political parties after elections*. While South Africa included *mathematics involved in sending messages by SMS, cell-phone and e-mails* Korea had *the kinds of work mathematicians do* as their fifth least preferred context. From his results the five most preferred contexts are presented in table 2.1. The highest ranked context in the table is the first on the list.



**Table 2.1** Comparison of South African and Korean teachers' preferences for contexts

<b>Most preferred contexts</b>	
<b>SA</b>	<b>Korea</b>
Mathematics that will help learners learn mathematics at university and technikons	The mathematics of making bridges, airplanes and rockets
The use of mathematics in issues about health such as mathematics to prescribe the amount of medicine a person must take; mathematics used to describe the spread of diseases such as HIV/AIDS	The placement of emergency such as police stations, fire brigades, ambulance stations so that they can reach emergency spots in the shortest possible time.
The mathematics in making bridges, airplanes and rockets	Mathematics that will help learners to understand how decisions are made about the sustainable harvesting of natural resources.
The mathematics to assist in determination of the level of development regarding employment, education and poverty of their community	The mathematics of inflation
The placement of emergency such as police stations, fire brigades, ambulance stations so that they can reach emergency spots in the shortest possible time.	To do their mathematics with calculators and computers

The present study is different from the other ROSME studies in that it is conducted in Swaziland government schools and the present research has restructured and interpreted the instrument differently. Although there were some overlaps, the methods used to answer the research questions were also different from the above studies.

ROSME authorises learners to choose the contexts themselves. Due to their different backgrounds, learners bring to the learning situation varied views about knowledge (Pillay, 2002). Differences in learners in the same class occur in a variety of ways. In Swaziland it is possible to find learners from different geographical backgrounds in the same classroom. Some learners might come from rural areas, others from an urban background and sometimes a few from foreign countries. These are some practical issues that need to be weighed when considering use of learning contexts offered by learners as

they could be interested in different contextual situations for learning school mathematics. A democratic approach would be to consciously take into consideration their most and least favoured contexts when planning a curriculum that accommodates their views. This consideration emphasizes the importance of adults' input on what contexts to be used. Learners' preferences are taken into account so as to avoid the least preferred contexts and to uphold the most preferred ones. Consulting them on contextual issues to be incorporated in the curriculum acknowledges them as important members of the school community. However, with the number of learners in a class it would not be practical to consider each individual learner's interest when planning for learning.

## 2.5 Summary

In this chapter I presented theoretical views on affect and contexts. On affect special attention was given to interest. General issues on use of contexts in school mathematics were discussed. Some research studies on consulting learners were reviewed. Lastly studies that have been carried out using the ROSME questionnaires were presented.

A number of studies on contexts in mathematics education have focused on the use and effects of contexts in the teaching and learning of mathematics. Thus, those studies were on the effectiveness of contexts in the learning of mathematics. None of the studies asked the learners about their preferences of contexts to be used. Boaler (1993b) says one criticism on contexts used in mathematics classrooms is that they are extracted from the adult world and learners might not identify with them. The present study consulted learners on contexts they would prefer to use in learning mathematics. It drew from the other studies in that it presented the learners with contexts to choose from, but differed in that it privileged their originality by asking them to state any three contexts they mostly

preferred to use for learning mathematics. The research questions this study aimed to answer were: What contexts learners most prefer? What contexts they least prefer? What reasons they give for the most and least preferred contexts?



## **3. CHAPTER 3**

# **RESEARCH DESIGN AND METHODS**

## **3.1 Introduction**

The focus of the study is on contexts preferred by Swaziland junior secondary school learners for learning mathematics. Studying people's views cannot be done through numbers only. The analysis of their verbal responses is also important. The instrument chosen for this study has questions that privilege the use of both quantitative and qualitative methods of data collection. The design chosen is descriptive. It is descriptive in that the natures of the categories of contexts that learners most or least prefer are described and it's investigative because the preferences of contexts between boys and girls and between form levels are compared. This chapter deals with the research design, the research instrument, piloting of the instrument, sampling procedures, data collection, data analysis and ethical issues.

## **3.2 Research Design**

The study followed a survey design using questionnaires. Questionnaires were chosen because they facilitate collection of large data set, allow participants to remain anonymous and – if hand delivered and self administered– are a quick method for collecting data ensuring a high rate of return. The present study is descriptive, explanatory and exploratory therefore amenable to the survey design (Babbie, 2007). Furthermore the survey design was appropriate as the results were used to generalise to the target population (Creswell, 2003; Babbie, 2007).

Quantitative research involves numeric data and thus statistical processes are used in the analysis. Results are expressed in statistical terminology. Statistics is also used to justify findings (Golafshani, 2003). Data in section 2 of the research instrument and in the first part of item C63 were numeric thus amenable to quantitative methods. The quantitative approach was used to establish the most and the least favoured contexts for learning mathematics. It was also used to find out if learners were interested in learning mathematics in a context of another school subject.

Qualitative research, on the other hand, seeks to understand phenomena in context-specific settings. Findings do not rely on statistical procedures or any form of quantification. The emphasis is on illumination and understanding of the situation (Golafshani, 2003). It is grounded in a broadly interpretive philosophical position and cannot be done experimentally for practical or ethical reasons. The trend of interest unfolds naturally in this type of research and as such variables are usually identified a posteriori (Mason, 1996).

The qualitative methods were used in the second part of item C63. According to Perry (1994) qualitative research methods is applicable when construction of meanings that have not been considered previously is involved. In this sense the qualitative method was used to analyse the reasons that the learners gave for choosing contexts. Table 3.1 summarises the methods used to answer research questions.

**Table 3.1:** Research Questions and Method Used to Answer Each.

Research Question	Method
<ul style="list-style-type: none"> <li>• What contexts do learners in Swaziland public schools prefer to deal with in mathematics?</li> </ul>	<ul style="list-style-type: none"> <li>• Quartiles and percentiles on the closed item were used to identify most favoured contexts. Kendall W mean ranks were used to rank the contexts. Percentages were used to determine whether learners prefer to study mathematics in a context of another school subject.</li> <li>• The Mann-Whitney U test was used to test the level of significance in the ranking of contexts by gender and by class levels.</li> <li>• Found reasons given for the most preferred contexts (core contexts and subject contexts) and categorised them according to their most common nature.</li> </ul>
<ul style="list-style-type: none"> <li>• What contexts do junior secondary learners in Swaziland public schools least prefer to deal with in mathematics?</li> </ul>	<ul style="list-style-type: none"> <li>• Quartiles and percentiles on the closed item were used to identify least favoured contexts. Kendall W mean ranks were used to rank the contexts</li> </ul>

### 3.3 The ROSME Instrument

The study used the ROSME questionnaire described briefly in Chapter 1 Section 1.1. The questionnaire consists of a demographic section and 66 items. For ease in reporting I describe the questionnaire using four sections. Section 1 is the section on demographic information of age, class level and gender. Section 2 consists of 61 closed items based on a four – point Likert scale 1- not at all interested, 2 - a bit interested, 3 - quite interested and 4 -very interested. Learners had to indicate the extent of their interest by circling one of the numbers. The 61 items are statements on possible contexts that learners might be interested in to deal with in learning mathematics. These 61 contexts are referred to as core contexts or closed items. Section 3 contains five open items (C62, C63, C64, and C65). Each of these open items required learners to give support for the answers they gave. Item C62 required learners to state three contexts in which they would be very

interested to learn mathematics. Item C63 asked them if they would like to learn mathematics while learning other school subjects. Item C64 asked them to indicate whether they would like to learn mathematics based on a recent issue they had seen, read or heard from the media. Item C65 required learners to list three topics they enjoyed learning since entering secondary school. In section 4, item C66, learners had to draw a mathematician at work.

Responses to the closed items and to the first part of items in section 3 provided quantitative data. The second part of answers to items in section 3 gave qualitative data in the form of reasons. This is said to be qualitative since it involved written explanations and was opened to interpretation by the researcher (Chi, 1997).

The present report will be based on sections 1, 2 and the first two items of section 3 (C62 and C63). As item C62 had a potential of bringing up other contexts besides the ones given in the questionnaire, C1 to C61 and C63 and C64 are referred to as given contexts.

Items on the ROSME questionnaire are not categorized into types even though initially 13 clusters were identified as shown in Appendix 1. An attempt was made to classify the 61 core contexts into the original clusters with an intention to discuss results using the clusters. Clustering the contexts was abandoned because the contexts were not equally distributed among clusters. However, the advantage of not presenting contexts in groups to the participants is that the broad group concept does not influence their choices. The learner makes a decision based on an individual context.

### 3.4 Piloting and Amendments

The purpose of piloting a questionnaire is to test its quality (Saris & Gallhofer, 2007) establish content validity, improve questions on it, improve formatting and improve scales (Creswell, 2003). Piloting can also help establish possible themes for textual data.

Two schools in the Hhohho region were used to pilot the instrument in Swaziland. These two schools were part of the schools in the target population. The schools were chosen for their proximity to my place of residence. In line with the ROSME project the instrument was tested on Form 1, 2 and 3. Altogether there were 235 participants for the pilot. Piloting was conducted in the first term of 2005. In one school the instrument was administered by me and in the other school class teachers administered the instrument using guidelines (Appendix 3) I prepared.

The teachers were told that it was not compulsory for the learners to participate in the study but once they had agreed to take part they had to answer every question honestly. The teachers were also told that they could explain any word on the questionnaire except the word 'mathematician' as their explanations might influence the sketches drawn in the last item. Learners wanted an interpretation of the words mathematician, paradox and inflation. The words paradox and inflation were explained. The word mathematician was not explained as its explanation would interfere with learners' responses to C66, the drawing of a mathematician working. In both schools answering the questionnaire for each class took one and a half hours.

Before they started answering the questionnaire learners were given numbers using the numbering on their class lists. Learners were instructed on how to answer each part of the questionnaire. After completing the instrument they were asked to check that they

had answered every question. In analyzing the data, from the pilot study, it was found that in some cases information was missing. In section 2 of the questionnaire the most common error was skipping an item or circling two numbers on the same item. For the main study the spaces between items in the second section were increased to avoid learners skipping questions and circling two numbers on one row. Another measure to combat skipping of questions was to read out each item and have the learners circle their choice at the end of the reading of an item. Increasing spaces between items considerably minimised skipping of questions. Although learners wanted to know the meanings of some words in the pilot study, in the main study I deliberately did not go out of the way to explain these words because I felt explaining them could send wrong messages about the contexts containing the words.

Another anomaly that I noticed was that a few learners did not answer the questionnaire faithfully. This was indicated by patterns in answers of section two such as choosing 4 for every item in C1-C61 or creating a zigzag pattern of choices. There was no easy way to deal with this problem as trying to correct it could itself suggest that there was a desired pattern in answering this section. In the main study there were no learners who chose patterns in answering this section.

The main problem in section three was language. The learners had difficulty expressing themselves in correct English language. Some expressions were direct interpretation of the SiSwati language. In analysing answers to item C62 I found that the majority of the learners could not come up with original contexts. They reproduced the contexts in the questionnaire or contexts in their text books or created contexts that could easily be linked with the ones on the questionnaire. A number of learners interpreted item C64 as either asking them if they liked reading papers or watching TV or if they watched TV or read

newspapers. Due to the absence of art in the public schools' curriculum most of the learners had a problem in drawing a mathematician at work.

To deal with the problem of language I suggested that the learners could give answers in SiSwati in Section 3. However, no learner opted to answer in SiSwati. After analysing the pilot study I realised that items C1-C63 could easily be linked while C64 to C65 are different aspects of contexts. While all items were on contexts items C64-C65 could demand literature reviews diverse from C1-C63. I also added an item to establish a link between contexts in the ROSME questionnaire and contexts used in the school. This item became C65 and the original C65 became C66. Although learners answered all questions in the questionnaire I chose to use items C1- C63 for the study.

### **3.5 Sampling**

The research was aimed at junior secondary learners in Swaziland's highest performing public schools. In Chapter 1 Section 1.1.2 it was stated that in the years 2000-2004 only 2 schools managed to obtain credit passes of 50% or more in the country. For this reason the highest performing schools were identified as those that had at least 21% of their learners obtaining credits in at least three years of the O-Level mathematics results for the period 2000 – 2004. This was an arbitrary choice to get a reasonable number of schools to choose from. Using statistics for 2000, schools obtaining 21% credits or more were identified. For the following years, until 2004, schools belonging to the required group were added if not already in the set. Crosses were used to indicate that a school had at least 21% credits in a particular year. There were 23 schools identified. The spread of the schools in the target group were; 60.9% urban, 17.4% peri-urban, 13% industrial and 8.7% rural. These schools were then grouped into the four regions of Hhohho, Lubombo,

Manzini and Shiselweni to ensure representation of each region. It was difficult to have a sample that reflected a ratio similar to the spread in the target population since I needed to have representation of each region.

The sample for the study comprised eight public high schools. The schools were selected through stratified, judgmental and random sampling techniques. The judgmental and stratified selection was done so as to ensure that the final sample included schools from each of the four geographic regions of the country and that the chosen schools belonged to the target population as described above. Stratification was done to ensure inclusion of schools from all the four geographic regions of the country. Judgements were made by only selecting those schools whose performance was at least 21% credits for at least three years in the period 2000 – 2004. Once the target schools were identified the participating schools were chosen using random sampling in each region. Except for one school all the schools were situated within 10 km from a town or a city.

My sampling assumption stems from research findings on attitude and achievement such as (Ma & Xu, 2004; Van den Boeck, Opendenakker & Van Damme, 2005). These researchers suggest that there is a relationship between achievement in mathematics and attitude towards it. I therefore assumed that negative attitudes to mathematics would be compounded in learners from schools where the performance is poor. I assumed these attitudes would influence the outcome of the study because if one continuously fails a subject one loses interest in it (Adie, 1987). Any mention of the subject evokes negative feelings. This could lead to the choice of “not at all interested” in the Likert scale part of the questionnaire.

In each of the selected schools one Form 1 class, one Form 2 class and one Form 3 class responded to the questionnaire. There was no requirement for particular ability. I simply requested for a class in each level. A total of 1028 learners participated in the study. Only 977 learners indicated their age and the average age of these learners was 15.1years. Table 3.2 is a distribution of the ages.



**Table 3.2:** Learners' age distribution

Age	Class Level			Total
	F1	F2	F3	
12	5	1	0	6
13	114	8	0	122
14	120	83	7	210
15	50	139	98	287
16	32	59	94	185
17	13	33	74	120
18	5	6	15	26
19	2	3	12	17
20	1	0	2	3
21	0	0	1	1
Missing	44	3	4	51

The location of a school is given as urban, peri – urban, industrial and rural depending on its proximity from a town or city. If a school is within 5 km from a town or city it was classified as urban, if within 5 km of an industrial town it was said to be industrial, if outside a 5 km distance but within 10 km it was identified as peri – urban and a rural school is more than 10 km away from a city or town. I did not determine the socio – economic status of the learners because I had no intention to study their answers against that background. This might have been a concern if the focus had been individual learners or individual contexts. Table 3.3 below presents a summary of the demographic data.

**Table 3.3:** Summary of the demographic data

		Number	Percentage of Total Number	Total Number
Gender	Male	574	55.8	1028
	Female	454	44.2	
Class	Form 1	386	37.5	1028
	Form 2	335	32.6	
	Form 3	307	29.9	
Geographic Location of Schools	Urban	5	62.5	8
	Peri - urban	1	12.5	
	Industrial	1	12.5	
	Rural	1	12.5	

## 3.6 Data Collection

I administered the questionnaire at each of the participating schools. In some schools where there was a big hall the questionnaire was administered to the three forms simultaneously. Data from six schools were collected on the last week of the second term and data from the remaining two schools were collected on the first week of the third term. These times were agreed upon because at those times the teachers were more willing to release their pupils.

When administering the questionnaire I made the learners aware that it was not compulsory for them to participate in the study but once they had agreed to take part they had to answer every question honestly. Before the start learners were given numbers using the numbering on their class lists and a school number I allocated to the school. I gave each learner a number so that I could be able to get back to him or her if I needed to. Another reason for the numbers was to conceal the learners' identities when working on the data.

Learners were instructed on how to answer each part of the questionnaire. I also encouraged them to ask questions if there was something they did not understand. Predominantly learners needed explanations for the words; *mathematician*, *inflation* and *paradox*. The words inflation and paradox were explained. The word mathematician was not explained since its explanation would influence the drawings in C66. Each of items C1 to C61 was read aloud by the researcher and the learners indicated their choices by circling a number at the end of reading each item. At the end they were asked to check that they had answered every question. Reading the items to them shortened the time by thirty minutes and checking their answers decreased the number of missed items.

### 3.7 Data Analysis

The second section of the instrument uses a Likert scale. Data collected this way is ordinal and therefore was analysed using nonparametric methods. A number of researchers have erroneously used parametric methods in analyzing such data. There have been suggestions that parametric tests on such data are permissible if the distribution is large and fairly normal (Erickson & Nosanchuk, 1992; Hinton, 2004). However, parametric tests are only applicable if the data satisfy the following conditions:

- Should be normally distributed
- There should be homogeneity of variance
- It should be interval data
- Should be independent (Field, 2005, p 64)

The data for this study did not satisfy any of the above conditions thus the choice to use nonparametric tests. Motulsky (1995) lists the median and the interquartile range as descriptive measures for nonparametric data. Velleman & Wilkinson (1993) also suggest that the median and percentiles are permissible statistics for ordinal data. Hinton (2004) recommends using ranks for such data. He says if a person rates a context 4 it is clear that he or she has rated it higher than another context he or she rated less than 4. Learners who rated a context 3 or 4 rated it higher than those that rated the same context 2 or 1.

In line with literature cited above, quantitative methods used in this study were simple descriptive statistics involving mean ranks, percentages, quartiles and percentiles. The use of quartiles and percentiles simplifies the identification of highly rated contexts and lowly rated contexts. The mean ranks on the other hand help rank the contexts. However, these ranks should not be mistaken as the mean ratings of each context by different learners. To obtain mean ranks each learner's rating of each of the 61 contexts is ranked then the mean rank of each context calculated. Table 3.4 below shows an example with fewer

participants and contexts to illustrate the difference between mean ranks and the mean of the ratings.

**Table 3.4:** Differences in calculations of mean ranks and calculations of the means of ratings

Contexts Participants	C1[2.13]	C2[1.50]	C3[3.38]	C4[3.00]
1	1(1.5)	1(1.5)	4(4)	2(3)
2	2(3)	1(1.5)	4(4)	1(1.5)
3	1(2)	1(2)	1(2)	2(4)
4	2(2)	1(1)	3(3.5)	3(3.5)
Mean Rating	1.5	1.5	3	3

The numbers inside round brackets show how each context was ranked by each participant while those outside the bracket are the participants' ratings of the context. Those in square brackets are the mean ranks for each context. The numbers in the last row are the mean rating of each context. While mean ranks are accepted ways of analysing nonparametric data they tend to be affected by the calculations that are involved in ranking and working out the mean ranks. This necessitated another method of identifying most and least preferred contexts.

For each context in the second section of the instrument, SPSS version 12 was used to determine quartiles, percentiles and Kendall W mean ranks -referred simply as mean ranks in the report. The most preferred contexts are defined as those where medians and the lower quartiles were greater than 2 and the 20<sup>th</sup> percentile was at least 2. This means a

context is said to be most favoured if rated 3 or more by at least 75% of the learners. The least preferred contexts are defined as those where the median and the lower quartile were at most 2 and the 20<sup>th</sup> percentile was lower than 2. Contexts that were rated 2 or less by at least 50% of the learners were classified as least favoured. The reason for using 2 as a decider is that when people do not want to commit themselves to an answer they usually choose to be in the middle (Oppenheim, 1992 in Schreiner & Sjøberg 2004). The decision to have a four-point Likert scale was to circumvent learners from indecision (Schreiner & Sjøberg 2004). However, I believe that people can figure out the middle or midpoint of a distribution despite it being even thus the decision to classify ‘most preferred’ and ‘least preferred’ the way I did. In doing this I am assuming that learners who did not want to commit themselves chose 2. Indeed, statistically speaking the middle numbers are 2 and 3 but if one does not want to oblige one would not choose 3 as 3 says “I am quite interested” while 2 says “I am a bit interested.” Quartiles and percentiles were chosen because they can serve as frequency measures. A lower quartile of 3 for example is an indication that at least 75 % of the participants rated the context 3 or 4. The mean ranks were used to rank the contexts from most favoured to least favoured contexts. This ranking was compared with the conclusion reached using quartiles and percentiles. If a context was ranked highly but was not identified as belonging to the first ten favoured context by the other method then it was not considered as among the first ten most favoured contexts.

The 61 core contexts were divided into three groups of 20, 21 and 20 using mean ranks to show the most preferred contexts, middle contexts and least contexts as shown in appendix 4. The nature of the categories of the most favoured contexts and the 10 least favoured contexts were studied. In this way the quantitative method included some

qualitative decisions. The ranking of the most and the least favoured contexts by different groups such as gender and class levels were investigated. The significance of differences between groups was measured using the Mann-Whitney U test, the nonparametric counterpart of the t-test used in parametric statistics (Leedy & Ormrod, 2005). According to Perry (1994) in two tailed test the strength of significance is significant for  $0.01 < p < 0.05$ , highly significant, when  $0.001 < p < 0.01$  and is highly significant when  $0.001 > p$ . This measure of significance was used to describe differences between girls and boys and differences between class levels in ranking core contexts.

Section 3 items C63 was used to find out if learners preferred to learn mathematics in the context of other school subjects. The percentage number choosing 'yes' and 'no' in item C63 was used to determine students' decisions on learning mathematics while learning other subjects. Gender distribution of the "yes" and "no" choice was studied.

The qualitative approach was used to analyze the open part of the instrument and whenever insight was used in the analysis. These included, decisions to use results from all methods used to determine the most and the least favoured contexts, analyses of reasons given for choosing contexts and interpretations of reasons, using the most favoured items found in the analysis of section 2, item C62 in the third section to identify reasons learners gave for preferring the contexts. ATLAS/ti 4.1 was used to code the reasons that learners stated for preferring or not preferring contexts. Learners' reasons for preferring or not preferring contexts were coded using a process of open coding. The categories can, therefore, be thought of as emerging from the data, rather than being imposed from outside.

## **3.8 Ethical Issues and Reliability**

### **3.8.1 Ethical issues**

I sought permission to conduct the study in public schools from the Chief Inspector of secondary education. I used the permission letter from the Chief Inspector to support my request to carry out the study at each school. Once a school had granted permission for the study to take place learners were informed that participation was voluntary. In all the schools only one learner refused participation on account that he did not like mathematics. Attempts to convince him that there was nothing mathematical in the questionnaire were futile.

### **3.8.2 Reliability**

Three aspects of reliability were established. First the second section of the instrument was tested for reliability using the test re-tests method. Secondly the reliability of this section as a scale was established using a Cronbach alpha coefficient (a measure of the internal consistency reliability of an instrument) and lastly inter-coder agreements were checked for the open section of the instrument.

The second pilot school Form 3 class was used for a re-test. Each learner's rating of contexts for the first test was compared with their second test rating using Spearman rho. Spearman was chosen because the type of data was ordinal data. One tail tests of significance were performed on the correlations. The results showed correlation significance for 20 of the 40 learners. Six of these were significant at 0.01 level while the remaining 14 were significant at 0.05 level. This was an indication that the core section of the instrument was reliable for 50% of the test retest group.

A reliability test performed on the whole group yielded a Cronbach alpha coefficient of 0.884 which indicated that the instrument was reliable with the sample. Pallant (2001) suggests that a scale is reliable if its Cronbach alpha is greater than 0.7. If the corrected item–total correlation (an indication of the degree to which each item correlates with the total score) is less than 0.3 the item is measuring something different to the scale as a whole. She suggests that such items could be removed if the overall Cronbach alpha is less than 0.7. Gifi (1990) also suggests that such items should be ignored. In the present study there were 10 items which had the corrected item –total correlation less than 0.3. These items were retained and used in the discussion since the overall Cronbach alpha was greater than 0.7.

There are differing views concerning inter-coder agreement in qualitative studies. Some people are opposed to it while others argue that there is some value in reliability testing in qualitative studies (Harris, Pryor & Adams, n.d). Those that are against it argue on the grounds that people’s interpretations will always differ and those in favour argue that it ensures that when the study is replicated the meanings are the same.

Three colleagues were asked to code a sample of reasons and contexts to establish inter-coder agreement. All the three coders were Swazis whose first language is SiSwati. I consciously chose Swazis because I wanted them to code from a Swazi perspective as the majority of the participants were themselves Swazis. Inter-coders were supplied with a code book with explanations of each code. There was no detailed explanation on how to use the code book as it is often done when a team of people are coding different chunks of text for the same research (Neuendorf, 2002). Where different coders are coding different parts of the same research a high reliability coefficient is required since the meanings must be the same. My view is that in the study reported here the inter-coder check is to

ascertain the replicability of the study. Table 3.5 below shows the number of reasons that inter-coders had to code and the agreements in comparison with the researcher. As can be seen from the table there was at least a 60% agreement amongst the coders on most of the items. Items that were less than 60% on average are C45, C46, and the “yes” reasons for C63.



**Table 3.5: Inter-coder agreements**

Item	Sample size		Inter-coder 1 Agreements		Inter-coder 2 Agreements		Inter-coder 3 Agreements	
	No.	% of total	No.	% of sample	No.	% of sample	No.	% of sample
C63 Yes	87	10	42	48	52	60	55	63
C63 No	15	10	10	67	11	73	12	80
C62 Context C23	12	34.3	6	50	10	83	9	75
C62 Context C11	12	22.6	9	75	7	58	10	83
C62 Context C15	4	33	3	75	1	25	4	100
C62 Context C45	18	27.3	10	56	9	50	11	61
C62 Context C46	8	24	5	63	3	38	6	75
C62 Context C22	6	27.3	5	83	3	50	4	67
C62 Context C3	8	23.5	7	88	6	75	6	75

## 3.9 Summary

This chapter has expounded on the methods used for the study. Elements of the ROSME instrument are described in line with the research questions. Piloting and amendments methods are explained. The target population and sampling procedures are spelt out. Procedures for data collection and analysis are described and supported from the literature. Finally this chapter has shown how the study dealt with ethical issues and issues of reliability.



## 4. CHAPTER 4

# CONCEPTUAL FRAMEWORK

## 4.1 Introduction

Learners' views must be analyzed in the context of an integrated approach that considers all the beliefs and motivating forces that influence them since their affective reactions occur within a larger framework of how they make sense of their world (Evans, Morgan & Tsatsaroni, 2006).

In this chapter I present some sociological considerations to use in constructing the conceptual framework. The main ideas in the framework are: the Generalized Others (GOs) including pillars of Science-Technology-Society (STS), which I consider as identity development influences, and identities such as mathematical self-identity and social-identity. Using identities allows for the possibilities that individuals can have multiple influences for their choices and their reasons. In this chapter GOs and STS are discussed under identity to develop the conceptual framework.

## 4.2 Identity

Identity describes a person's domain general sense of self with reference to groups or particular content (Renninger, 2009). In this study the identity is studied in connection with school mathematics. Sfard & Prusak (2005) define identity as a set of reifying, significant, endurable stories about a person. Identity has a point of reference, the identifier. The identified can also be the identifier. I quote from Sfard & Prusak (2005) to elucidate the last two sentences:

As a narrative, every identifying story may be represented by the triple  ${}_B A_C$ , where A is the identified person, B is the author, and C the recipient. Within this rendering it becomes clear that multiple identities exist for any person.....

${}_A A_C$  = an identity story told by the identified person herself. This story we call A's first-person identity (1st P).

${}_B A_A$  = an identifying story told to the identified person. This story we call A's second-person identity (2nd P).

${}_B A_C$  = a story about A told by a third party to a third party. This story we call A's third-person identity (3rd P).

Among these, there is one special identity that comprises reifying, endorsable, significant 1st P stories that the story teller addresses to herself ( ${}_A A_A$ ). It is this last type of story that is usually intended when the word identity is used unassisted by additional specifications (Sfard & Prusak, 2005, p.17).

It seems that when they say a person can have multiple identities they mean a person can be identified differently by different people. For example when a learner excels in mathematics but struggles in history the report sent to parents will reflect different identities.

In this study the formulation  ${}_A A_C$  and the  ${}_B A_C$  identities were central as the learners identified themselves through the responses they gave and the researcher in reporting made her own input about the learners' identity. Identity, however, is developed through interactions with one's environment. This environment includes people and technology.

The self is not innate but develops from social experiences and interactions (Mead, 1964). Drawing from Mead, Mellin-Olsen (1988), calls the social environment to which the individual reacts, the Generalized Others (GOs) or what Lloyd (2002) calls 'significant others.' Mellin-Olsen and Lloyd restricted the Generalize Others to human aspect of the social environment. In this study I included the technological and the natural environments as GOs because influences on identity development includes more than physical people (Finkelstein, 2005). One may be influenced by television, computers and what one reads. Even within our immediate personal universe, we are not at complete

liberty to do as we please, because we are intricately linked to our natural environment, to social and professional institutions with which we are associated and even countless technological devices that we use (Waldrop, 1992). The GOs are responsible for the attitudes, expectations and reactions of an individual. They function as the individual's referent for his or her behaviour. Thus the identity of a learner is influenced by discursive practices within which the learner has developed (Egbochuku, & Aihie, 2004). In the tetrahedral model of sub-domains of affect (DeBellis & Goldin, 2006) it can be seen that affect is influenced by others. The inner rectangle represents an individual's affect domains.

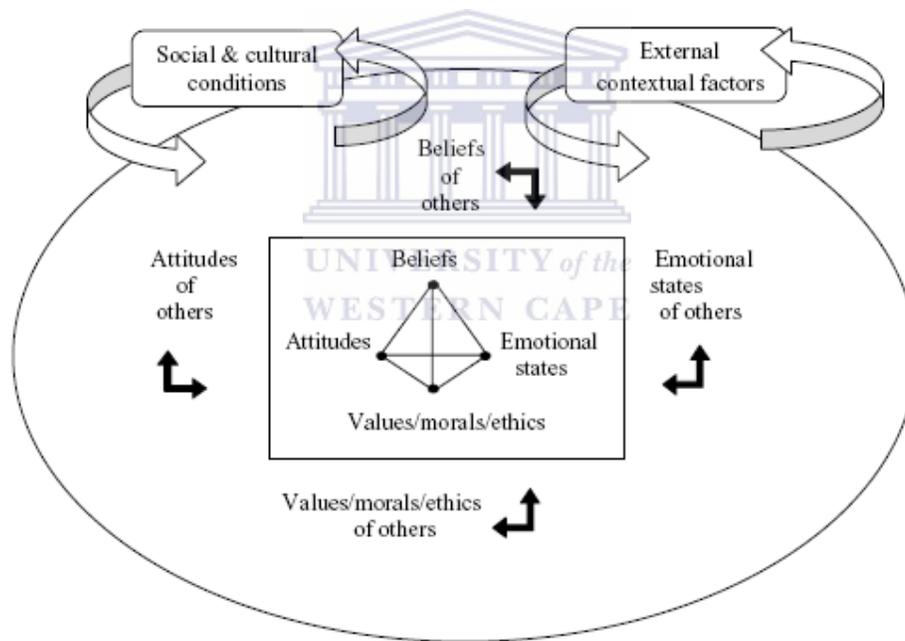


Figure 4.1: The Tetrahedral Model of Sub-Domains of Affect

Mead (1964) also describes two parts that make up an individual; the “I” and the “me”. The “me” is that which has been moulded by society and the “I” is the idiosyncratic natural self. The “I” self is difficult to study because deeply private thoughts and feelings

can neither be easily known nor readily shared (Mageo, 2002). Mead (1964) says the “me” is external but the “I” is internal. The “I” self is derived from internal thought and feelings while the “me” originates in others who are internalised (Mageo, 2002). Lloyd (2002) refers to identity diffused or confused, identity foreclosed, moratorium and identity achieved as different stages of identity development. In the identity diffused or confused stage the individual has not taken on the group identity and in the next stage the identity is mainly influenced by adults or experts in the group. The moratorium stage signals someone who is still searching and struggling to find beliefs to call his or her own. At the identity achieved stage the individual is devoted to a set of central identity characteristics.

Valsiner’s (1992) idea of canalisation says interest is a product of the processes of social organization. She relates these to the zones of free movement, promoted action and proximal development. Within these zones the individual constructs himself or herself into an acceptable person in the society or group. The process of free movement, promoted action and proximal development “is central for understanding how phenomena that we intend to label “interest” can emerge” (Valsiner, 1992, p. 34). The zone of free movement can be likened to the area where the “I” self ideas are freely used and the zone of promoted movement is where “I” ideas meet approval from the GOs and the zone of proximal development is where the “I” self and the GOs ideas are being debated by the individual in order to be internalized. The final stage is the “me” stage which is the stage where the learner has assimilated and accommodated the GOs ideas as his or her own. This is the identity-achieved stage (Lloyd, 2002).

Mellin-Olsen describes S & I rationales for learning as:

1. The S-rationale (is of social importance) This 'is a rationale for learning evoked in the pupil by a synthesis of his self-concept, his cognition of school and schooling, and his concept of what is significant knowledge and valuable future, as developed in his social setting'.

2. The I-rationale: This goes beyond the content of the curriculum, the subject matter itself. It is the rationale related to the school as an instrument for the pupil to have a 'good future'. It is the rationale which creates instrumental learning, i.e., the kind of learning which shows no interest in the content itself, but which is due to some showing off, demonstrating some knowledge, in order to obtain the teacher's praise and subsequently a good mark or degree (Mellin-Olsen, 1981, p. 357 & 359)

The above rationales bring to mind two concepts that have appeared in mathematics education: foreground and background. *Foreground* refers to a person's interpretation of his or her learning possibilities and 'life' opportunities, in relation to what the socio-political setting seems to make acceptable for and available to the person (Alro, Skovsmose, & Valero, 2009). Skovsmose (2005) relates foregrounds to the opportunities that a person perceives the social, political and cultural situation(s) make available. The background of a person is the person's previous experiences given his or her involvement with the cultural and socio-political setting (Alro, Skovsmose, & Valero, 2009). They consider it to be a dynamic construction in which the person is constantly giving meaning to previous experiences, some of which may have a structural character given by the person's positioning in social structures. The S-rationale of Mellin-Olsen (1981) seems to be influenced by both backgrounds and foregrounds. Alro, Skovsmose, & Valero (2009) argue that they use the plural, foregrounds, because a person can develop several foregrounds. The same argument could be used for backgrounds since a person who is exposed to various settings could have different backgrounds to reflect upon. On the other hand the I-rationale is a rationale for learning connected to the role school has as an instrument for future schooling and employment. A foreground does not represent an unrealistic interpretation of dreams and desires of what the person would like to be or

become in the future; rather, it is based on a realistic consideration of what the person perceives to be his or her chances in the future given what the environment shows the person to be possible to attain (Alro, Skovsmose, & Valero, 2009). According to Mellin-Olsen (1981), a pupil can have varying and sometimes contradictory rationales for learning depending on his or her relation to different members of the society. Societal pressures force an individual to construct different roles or contextual selves (Harter, Waters, and Whitesell, 1997).

We are one thing to one man and another thing to another. There are parts of the self which exist only for the self in relationship to itself. We divide ourselves up in all sorts of different selves with reference to our acquaintances. We discuss politics with one and religion with another. There are all sorts of different selves answering to all sorts of different social reactions. It is the social process itself that is responsible for the appearance of the self; it is not there as a self apart from this type of experience (Mead 1964, p. 207).

It is apparent from the above authors that people have pluralistic identities. A person uses each or a combination of them dependent on where they are, whom they are with and the particular social setting in which they find themselves (Ross, 2007). This means a question could be given different answers by the same person depending on the arena where the question is asked. Giving a response in relation to group identity does not necessarily indicate a false self or being at a stage before identity achieved but could be a reflection of the “me” or identity achieved self in that particular group.

Adapting Mellin-Olsen’s (1981) S-rationale and I-rationale I now define two types of identities to use in this report: the S-identity and the I-identity. The S-identity can be seen as that which is shaped by society. This means the individual has accommodated and embraced the ideas instilled in him or her by the GOs as his own. The S-identity is that which is commonly accepted by the GOs and the individual has embraced. It is characterised by the “me” self. On the other hand, the Instrumental-identity is mainly

controlled by the “I” self. The “I” self portrays an individual in any one of the following stages of identity development the identity diffused or confused, identity foreclosed and moratorium. What makes these stages to be thus termed is the domain in which one is trying to fit. I term it the instrumental identity because the individual is using this identity as a tool to fit himself or herself in a particular group.

Identity can also be divided into two: actual identity and designated identity (Sfard & Prusak, 2005). They describe actual identity as the actual state of affairs that is usually stated in present tense such as “I am good in maths.” This is an example of identity achieved. On the other hand, designated identities are recognised by the use of the future tense like “I have to do well in maths.” This indicates identity still under development. From Sfard & Prusak (2005) it seems there is a way of distinguishing the “I” or I-identity and the “me” or S-identity. The I-identity in this case is the designated identity and the S-Identity is the actual identity. When a person says “I am good in maths” they have established that they are good. However, when they say “I have to do well in maths” it shows they are aware of expectations or advantages that come with doing well.

Mathematical self-identities refers to perceptions of one’s ability to learn and perform tasks in mathematics, one’s confidence in being able to learn mathematical new topics, and how interested one is in pursuing mathematical ideas (Isiksal, Curran, Koc, & Askun, 2009). Mathematical self-identities can also be classified as S-identities and I-identities because they also develop from influences of significant others. It is important to study both S-identities and I-identities because like situational interest and individual interest I-identities can develop into S-identities. As mathematics educators when we are aware of I-identities we can devise ways of developing them to S-identities. Mathematical self-systems develop from learners’ past history with mathematics in social environments

(Malmivuori, 2006). In this sense mathematical self-systems are the domain that influences mathematical-self identities and mathematical images.

The S and I identities as defined in the above paragraph can be used to explain the reasons the learners gave for preferring the most and the least favoured contexts in the study. The S-identity types of reasons are more stable than the reasons he has not embraced as his own, though also arising from societal influences. S-Identity reasons sound original and plausible to the reader. I-identity responses are influenced by the spur of the moment. Their source can be found from the circumstances of the time. They are usually uttered without thinking. These kinds of responses are characterised by lack of assurance in what a person says. Sfard & Prusak's (2005) suggestion about actual and designated identities will be used to study the reasons learners gave.

In Science Education the “student oriented nature” of teaching science through science-technology-society (STS) is premised by teaching science such that it is rooted in the technological and social environments of the learners (Aikenhead, 1994). The learner oriented character of STS arises from the central position given to the learner's different environments. The core contexts in the ROSME instrument, C1- C61, can be classified in the three pillars of STS which are the natural environment, the social environment and the technological environment. From the initial 13 clusters the social environment is equated to politics, agriculture, youth culture, sport and crime. The natural environment is likened to the life science cluster and lastly the technological environment parallels the technology and physical science clusters. Aspects of Aikenhead's (1994) three pillars are conceptualised as a component of the GOs and used as one facet to study the nature of the categories of contexts that learners most or least prefer from the core contexts. A pictorial illustration of the conceptual framework is now presented.

### 4.2.1 *The Multi-faceted conceptual framework*

In this section I diagrammatically present the conceptual framework I will use to analyse the data followed by an explanation of each part on the diagram. Aspects of the framework are S-Identity, I-Identity, mathematical self identity and GOs. GOs are composed of the social environment, the technological environment and the natural environment. These aspects are appropriate lenses to study what the learners are saying as the broad focus of student voice research is “who is speaking” (Herbel-Eisenmann, 2007, p. 347). The other three boxes in the framework represent the data. The arrows indicate influences between elements in the framework. The direction of the arrow shows the influence between aspects of the framework. For example, images of mathematics influence the given reason while the given reasons are a reflection of the images that the learners have about mathematics.

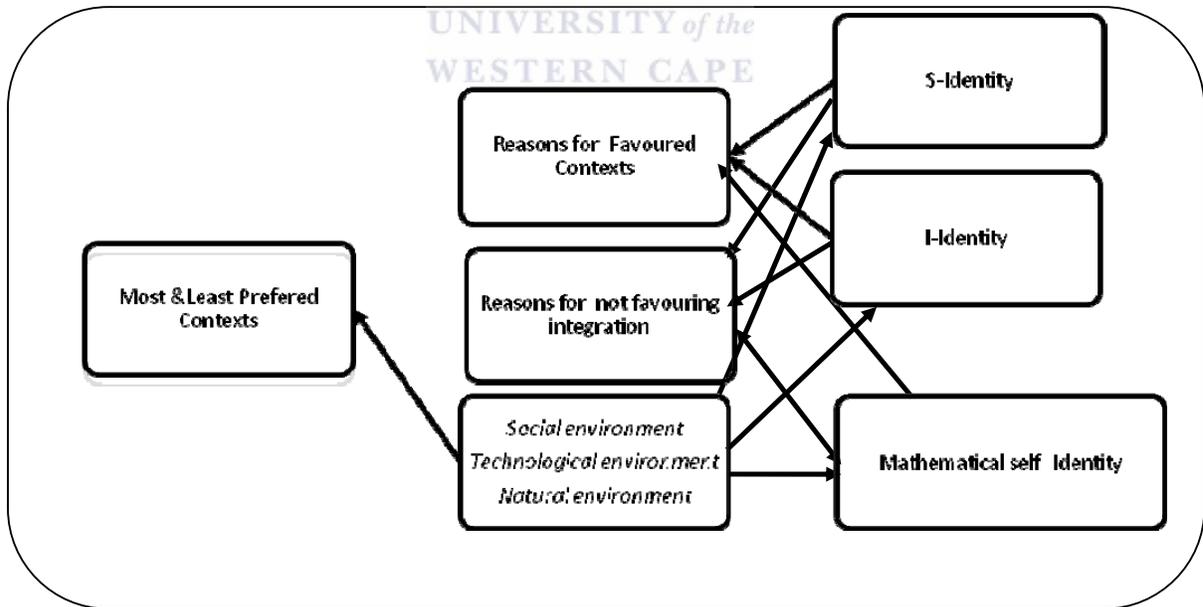


Figure 4.2: The Multi-faceted Conceptual Framework

#### **4.2.1.1 The most and least favoured contexts**

The most favoured contexts are central to the study. The nature of the categories of the most and least favoured contexts will be examined in the light of societal influences in the form of adult chosen contexts as common in school culture, and results of teachers' responses on the ROSME questionnaire. Societal and environmental influences on learners' choices were also investigated.

#### **4.2.1.2 Societal and environmental influences**

The social environment includes the family, peers, community members, artefacts and activities that take place in the learners' immediate micro-system. The technological environment is what Tully (2003) calls 'technology II.' These include gadgets that are likely to be found in one's house but exclude the big machinery found in industries. Examples of technology II are cell phones, computers, TVsets and electronic toys. The natural environment consists of the atmosphere, climatic changes, natural vegetation and wild life.

The concept of GOs together with Valsiner's (1992) idea of canalization are what could explain influences on the learners' choices. Other influences on the learners are brought about by the natural environment, media, technology and globalization. The most favoured and the least favoured will be examined using the lens of GOs.

#### **4.2.1.3 Reasons for Favouring or not Favouring Contexts**

The reasons that learners gave were studied using the S-identity and the I-identity as described in Section 4.1.

## 5. CHAPTER 5

# DATA PRESENTATION AND ANALYSIS

## 5.1 Introduction

This chapter presents the collected data and its analysis. The data are analysed in response to the research questions stated in the first Chapter. The main research questions driving the study are:

1. What contexts do junior secondary school learners in Swaziland public schools most prefer to deal with in mathematics?
  - Which of the 61 core contexts were ranked as most preferred by the learners?
  - How are the most preferred contexts distributed according to gender or class level?
  - How do the learners support their reasons for choosing favourite contexts?
  
2. What contexts do junior secondary school learners in Swaziland public schools least prefer to deal with in mathematics?
  - Which of the 61 core contexts were ranked as least preferred by the learners?

- How are the least preferred contexts distributed according to gender or class level?

Discussion of the results in the context of the literature will be dealt with in chapter 6. In this section I report on (1.) (i) the contexts that learners most prefer and their ratings in different class levels and gender and (ii) the most common reasons for preferring contexts. (2.) (i) the least preferred contexts.

## 5.2 Findings

### 5.2.1 *Contexts junior secondary learners most prefer to deal with in mathematics.*

This question will be answered in 5 ways. First the most preferred 20 contexts of the 61 core contexts as determined by mean ranks will be shown. Secondly the first ten most preferred contexts as determined by percentiles will be presented. Thirdly comparison between boys' and girls' rating of the first ten most preferred contexts will be made. Fourthly comparisons between class levels in the rating of the first ten most preferred contexts will be made. Lastly a report will be made on whether learners are interested in using other school subjects as context for learning mathematics.

### 5.2.1.1 How the 61 core contexts were ranked as most preferred by the learners.

**Table 5.1:** 20 most preferred contexts in descending order

<b>20 Most Favoured Contexts</b>		
C23 Mathematics that will help me to do mathematics at universities and technikons [61]	C22 Mathematics to prescribe the amount of medicine a sick person must take [54]	C50 Mathematics used to work out the repayments (instalment) for things bought on credit are worked out [47]
C11 Mathematics that is relevant to professionals such as engineers, lawyers and accountants [60]	C16 Mathematics used to calculate the taxes people and companies must pay to the government [53]	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 [46]
C47 Mathematics involved in working out financial plans for profit-making [59]	C26 The kind of work mathematicians do [52]	C39 Mathematics that air traffic controllers use for sending off and landing planes [45]
C15 Mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM [58]	C3 Mathematics involved in making computer games such as play stations and TV games [51]	C20 Mathematics involved in determining the state of health of a person [44]
C45 Numbers [57]	C35 Mathematics about the age of the universe [50]	C42 Mathematics of the storage of music on CD's [43]
C46 Mathematics involved in sending of messages by SMS, cell phones and e-mails [56]	C58 How mathematics can be used in sport competitions like ski jumping, athletics, aerobic, swimming, gymnastics and soccer [49]	C57 How mathematics can be used in planning a journey [42]
C21 Mathematics to assist in the determination of the level of development regarding employment, education and poverty of my community [55]	C29 How mathematicians make their discoveries [48]	

Numbers in square brackets indicate the ranking of the contexts by learners. 61 represents the highest ranking.

From the table it can be observed that the learners were mostly attracted to contexts that had an influence on their future well being, technological contexts and those that were of social concern. Other contexts in this group were *sport competitions*, *age of the universe* and *mathematicians and their discoveries*.

#### **5.2.1.2 The most preferred contexts as determined by percentiles**

The percentiles were used to ascertain the first ten highest ranked contexts. To illustrate, C23 (*Mathematics that will help me to do mathematics at universities and technikons*) had a 20 percentile of 3, a 25percentile of 4, a 50 percentile of 4 and a 75 percentile of 4. Using brackets this can be written as C23 (3, 4, 4, 4). The other most preferred contexts' percentiles are similarly presented in brackets next to each context as (20percentile, 25percentile/lower quartile, 50percentile/median, 75percentile/upper quartile). The other most preferred contexts' percentiles were C11(3,4,4,4), C47(3,3,4,4), C15(3,3,4,4), C45(2,3,4,4), C46(2,3,4,4), C21(2,3,3,4), C22(2,3,3,4), C16(2,3,3,4) and C3(2,3,4,4). Each of these contexts were rated 3 or better by 75% of the learners that rated them. The reader should note that C26(2,2,4,4) was not amongst the first ten most favoured contexts according to the percentile measure even though it was ranked higher than C3 by the Kendal W mean rank measure. This context was rated 3 or better by less than 75% of those that rated it.

### 5.2.1.3 How the ten most preferred contexts were ranked by different classes

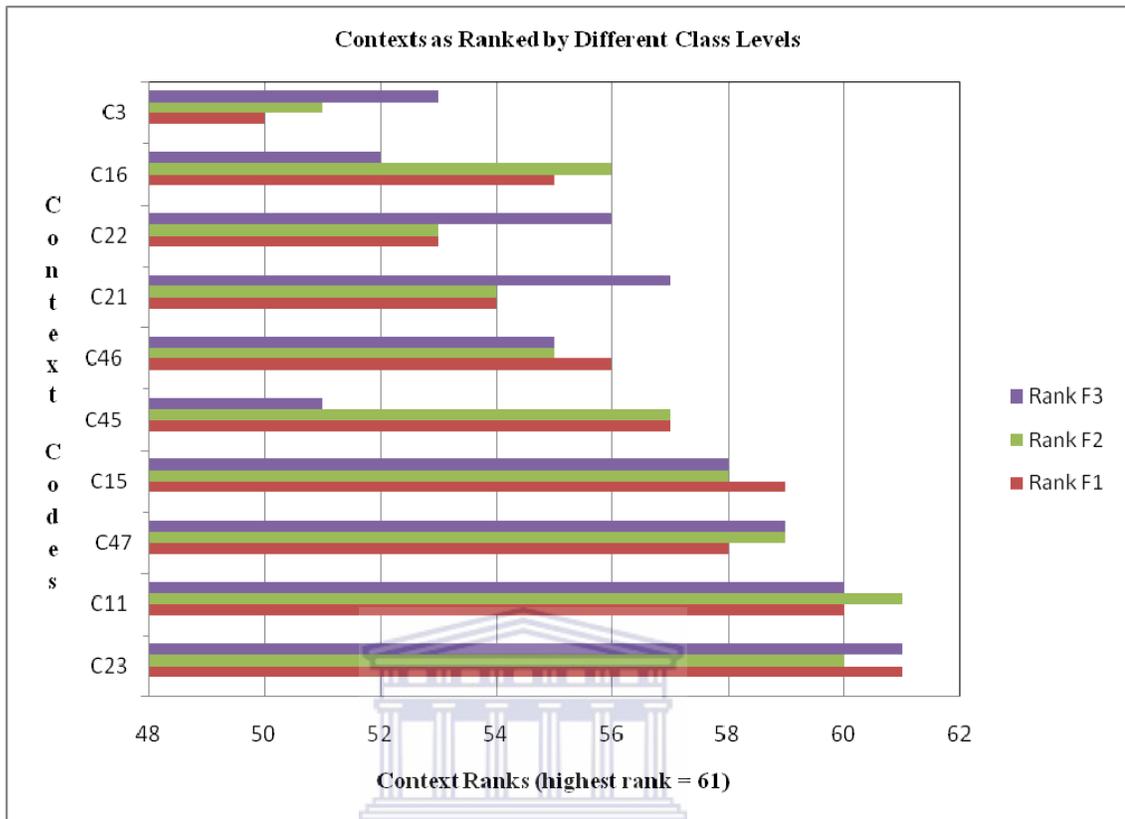
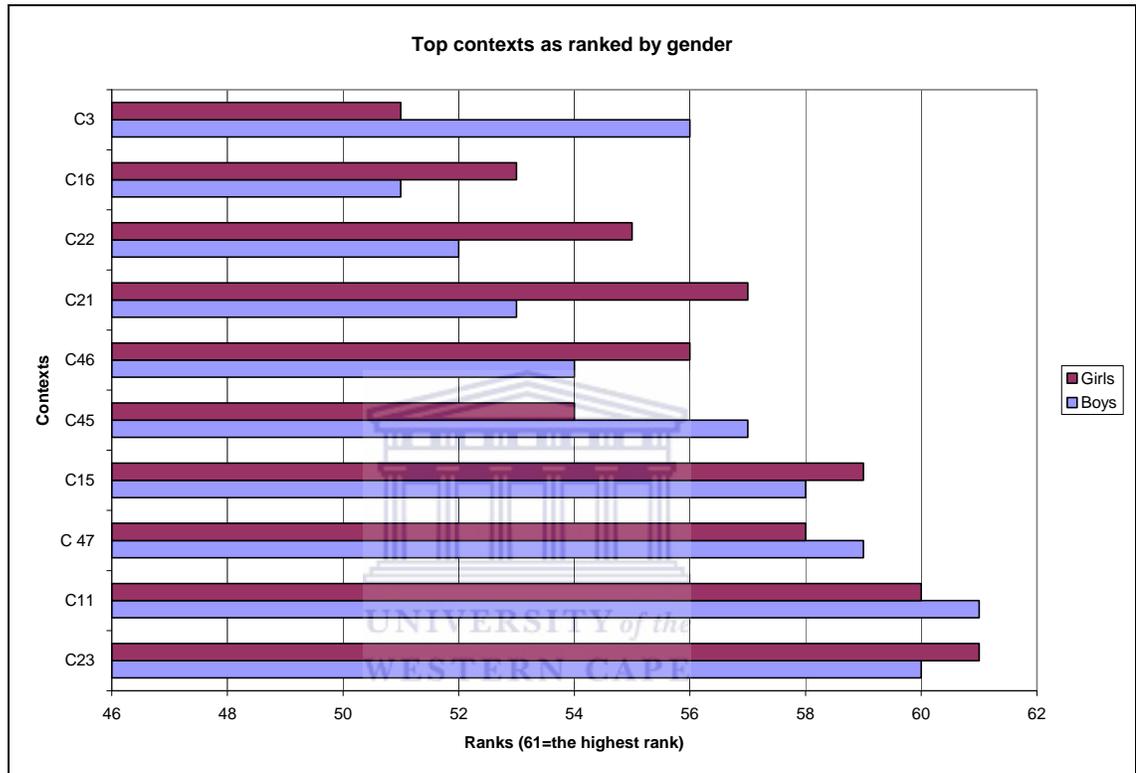


Figure 5.1: The ten most preferred contexts as ranked by different classes

From the graph it seems that differences between Forms in ranking C46 and the most preferred four contexts (C23, C11, C47 and C15) were not significant. However there was a significant difference in the ranking of C23 (*Mathematics that will help me to do mathematics at universities and technikons*) between Form 1 and Form 2 and between Form 1 and Form 3 at the 0.05 level of significance. The difference in ranking C47 (*Mathematics involved in working out financial plans for profit making*) between Form 1 and Form 2 and between Form 1 and Form 3 was also significant at the 0.05 level of significance. Form 3s noticeably rated C45 (*numbers*) lower than the form 1s and 2s and this difference is significant at 0.05 level of significance. On another note form 3s rated C21 (*Mathematics to assist in the determination of the level of development regarding*

*employment, education and poverty of my community*) significantly higher than the Form 1s and C22 (*Mathematics to prescribe the amount of medicine a sick person must take*) significantly higher than the Form 1s and 2s.

#### 5.2.1.4 Comparison of gender on the most preferred contexts



**Figure 5.2:** Gender comparison on the most preferred contexts

The difference between boys and girls in ranking the most preferred four contexts was insignificant at the 0.05 level of significance. The differences in the ranking of C46 (*Mathematics involved in sending of messages by SMS, cell phones and e-mails*), C21 (*Mathematics to assist in the determination of the level of development regarding employment, education and poverty of my community*) and C22 (*Mathematics to prescribe the amount of medicine a sick person must take*) was significant at the 0.05 level of significance with girls' ranking higher than boys' ranking. There was a marked difference

of five points in the ranking of C3 (*Mathematics involved in making computer games such as play stations and TV games*) with boys' ranking it higher than girls' ranking, however this difference is not significant at a 0.05 level of significance.

**Table 5.2:** *p* values used to discern significance of differences in ranking of most favoured contexts between class levels and gender.

Context	F1 & 2	F1& 3	F2& 3	Gender
C23.University and tech maths	.048	.039	.848	110
C11.Relevant to professionals	.000	.055	.074	.892
C47.Financial plans for profit making	.033	.043	.957	.787
C15.ATM pin numbers	.960	.053	.056	.094
C45.Numbers	.599	.010	.040	.210
C46.Sending SMS and e-mails	.441	.000	.006	.006
C21.Community level of development	.092	.001	.064	.000
C22.Prescription for sick person	.040	.000	.024	.002
C16.Taxes	.446	.869	.559	.012
C3.Computer games	.290	.100	.479	.082

Asymp. Sig. (2-tailed)

### 5.2.1.5 Other school subjects as contexts for learning school mathematics

The majority of the learners responded positively to learning mathematics that arises while they were learning other school subjects. Out of the total of 1028 learners 862 (84%) responded positively, 154 (15%) responded negatively and 12 (1%) gave no response. Table 5.3 shows the distributions of the “yes” and “no” between different groups.

**Table 5.3:** Distributions of responses on learning mathematics that arises in other subjects

Class Level	Yes		No		No Response	
	Boys	Girls	Boys	Girls	Boys	Girls
Form 1	146	179	23	30	2	6
Form 2	136	144	26	26	2	1
Form 3	99	158	19	30	1	0
<b>Totals</b>	381(85%)	481(85%)	68(15%)	86(15%)	5	7

85% of the girls and 85% of the boys who responded to this question said yes to learning mathematics that arises while learning another school subject.

### 5.2.1.6 Reasons for most preferred contexts

This sub-section will be presented as two parts because the reasons for the most preferred contexts included those for most preferred core contexts and those for preferring to learn mathematics in the context of another school subject.

The questionnaire did not explicitly require learners to supply reasons for their most preferred core contexts. These reasons emerged from item C62. Due to this inevitable limitation of the study some most favoured core contexts had very few reasons. However, learners that listed the most favoured core contexts in C62 were learners that either rated them 3 or 4 in section 2 with the majority rating a context 4. This established the validity of the most favoured contexts.

Reasons for preferring first ten core contexts were classified into six categories of *futuristic (147)*, *learning (55)*, *mathematics is everywhere (2)*, *positive attitude to mathematics (26)*, *curiosity (23)* and *context (55)*. Futuristic was sub-divided into *access to university (4)*, *career prospects (101)*, *financial power or gain (35)* and *business prospects (7)*. Learning was divided into *learning generally (16)* and *learning mathematics (39)*. The numbers in brackets are an indication of the frequency of reasons classified into that category or sub-category. It was clear that the learners most popular reason for the contexts was futuristic followed by learning. From the numbers in brackets it would seem there was a tie between context and learning but context is not a plausible reason since it arose from the context itself or from the questionnaire. Below are exemplar reasons for the two most popular categories and for positive attitudes to mathematics.

### **Futuristic**

***Access to tertiary education (4):*** Any reason to do with aspiration to get to university or college.

I would like to do maths at the university

They will help us go to university

I want to get to university

To learn useful maths for university

***Career prospects (101):*** Career and employment opportunities

It would help me study maths so that I become a doctor

Want to be an engineer

Being an artist may bring interest to me

I want to be a successful businessman

Want to work for a big company

Because many people who learn mathematics easily get jobs

To repair them and also load money in an ATM for people

Want to be an accountant

Because I want to be a nurse

I'd like to do computer science



**Financial power or gain (35):** Reasons associated with getting a lot of money and ability to help.

I'm interested in that because in the end I'll begin to have a nice and good life

It can help me to make money and give to my family

Because lawyers get a lot of money

You can live a happy life in the future

To earn lots of money

Maths is a living thing for me to be a successful person in the future

This may improve the way of living in many African countries

It makes people to have a brighter future

If I can do this I can have a lot of money to help my parents

It can promote my living standard

**Business prospects (7):** Reasons that could be linked to doing business

I want to be a business woman

Help hawkers in making profit

You can do your own business

Work out financial profits when selling

To know if you have made some profit or loss in your business

When you sell you need profit

I would like to have my own cell phone company

## **Learning**

**Learning generally (16):** Where the reason was about learning but the subject was not specified

I believe it can help me in my studies

I don't want to have a problem at university

Encourages me to work

It can be my way of studying the world and its population

Makes us understand our environment

Makes us understand

Because it sharpens the mind

To increase my knowledge

It will help learn important things

To help me pass

***Learning mathematics (39):*** Any reason associated with mathematics learning, learning a topic in mathematics or motivation to learn mathematics.

Want to learn more maths

It will make maths more interesting

They will help me understand and enjoy maths

To be able to do algebra

It will make learning maths easy

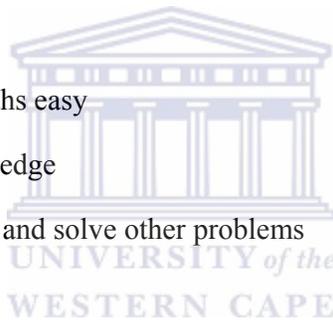
To improve maths knowledge

It helps us calculate time and solve other problems

To be able to calculate

To know the use of maths

It will keep me busy and active in a relaxed way



**Positive attitude to mathematics (26):** Any reasons that show an optimistic viewpoint about mathematics.

I understand maths well

Mathematics is the important subject

Maths is challenging and fascinating

Because I like to count numbers

I am capable of working them out

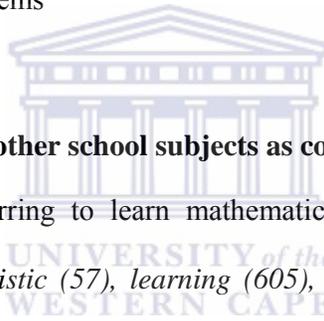
Because I can do this

It's easy to do

I understand maths well

Like solving maths problems

It's nice to use numbers



#### **5.2.1.7 Reasons for preferring other school subjects as contexts**

Students' reasons for preferring to learn mathematics while learning another school subject were coded as *futuristic* (57), *learning* (605), *mathematics is everywhere* (90), *positive attitude to mathematics* (58), *positive attitude to other subject(s)* (3), *utilitarian* (32), *context(s)* (6) and *other* (24). Futuristic reasons were broken down into three sub-categories of *career* (43), *future learning* (13) and *improving living standards* (1). Learning was sub-divided into *learning generally* (225), *learning mathematics* (194), *learning other subject(s)* (127), *specified subject(s)* (48) and *teacher dependent* (11). Mathematics is everywhere was split into two sub-categories of *mathematics is in other subjects* (53) and *unavoidable* (37). The most popular reasons for learning in the context of another subject were learning, mathematics is everywhere, positive attitude to mathematics and futuristic. Exemplar reasons for the most popular categories are presented below.

## **Futuristic**

### ***Career (43):*** Career and employment opportunities

To come out with other things that would help me know what to do when I grow up

I can have many job options

I can be easily employed

Help get a good job

Because I would be a scientist

It talks about weather, solar system all the things that a pilot needs to know

You cannot get a job without maths

Because I learn many things that can make me have a job

When I grow up I want to be a nurse

To get any kind of job that will help me get wages

### ***Future learning (13):*** University and other tertiary institutions.

So that when I am at University I can continue learning maths

It can help me in future and in other problems that may occur

It will help me at university

In future I don't have a problem when one arises I have to know what it means

So that it can help me in the future or in maths

So that I have knowledge that can help me in my studies and life

To make sure that we pursue our studies and the generations will be helped by them

I want to be a doctor (PhD) in Science subjects

I may find out that it's interesting and it can help me on my study for the future

### ***Improve living standards (1):*** Anything to do with a better future.

To improve the standard of living

## **Learning**

***Learning generally (225):*** Where the reason was about learning but the subject was not specified

We are getting to know many things

It helps me in understanding those subjects easily because they are related

I get to know more things than in one subject

It shows me how to solve other problems in some ways

Knowledge does not have an end

Will understand whatever I had not understood

I can understand better if I had not understood the other teacher

I would be able to know more about things that I did not know and also pass the subject

So that the subjects are related and we are not learning many unrelated things

Study load would be better because I would already know about it

***Learning mathematics (194):*** Any reason associated with maths learning, learning a topic in maths or motivation to learn maths.

It's because it makes me to know how to be brave in calculations

Because they encourage me to learn mathematics

Because when I'm learning they remind me the terms of mathematics

Because that thing I will know it very much

It is because there are some other topics which help you in maths

If you did not understand it when learning maths you may get it correct now

Because maths needs to be practised everyday

Because other topics are easy to work with in other subjects

If I learn it many times I will be able to master it very well

Maybe if it's in a subject I like then I'll like it too

***Learning the other subject (127):*** Any reason concerned with improvement in the learning of the other subject.

To calculate in other subjects

Sometimes you can find that some problems fall under maths in those subjects

That particular subject can be easy because you once had it  
So that when you get to those topics in other subjects it will be some kind of revision  
I can use the knowledge I got in maths  
Because I can do better than those who are not learning maths  
So I can understand what is not understandable in the other subject  
Maths helps in understanding other subjects clearly  
I have to learn every subject not only Maths  
If I know maths I will be able to pass the subject

**Specified subject (48):** Where they specified a subject in which they would learn mathematics

Subjects like science need maths  
Because it may help me when marking plots in agriculture  
It can help in geography when you want to know the km of Swaziland  
Yes because I will get to know on other subjects like English subjects  
They help in the other subjects e.g. accounting  
Because it's in TD and I can be an architect  
In home economics you need to use maths  
Especially if it pertains economics  
E.g. in history I want to know how the machine for determining the age of something that is made  
I want to find out how to calculate the number of people in a continent

**Teacher dependent (11):** Where the teacher was mentioned in the reason given

It is better to understand maybe one of the teachers  
The teacher in the other subject may explain better than the maths teacher  
Teachers are not teaching likely (alike) maybe other teachers can teach me and understand  
The other teachers teach nicely

Because when the maths teacher teaches I understand but have difficult when trying to do it on my own

Because one of the teachers may explain better

The other teacher will help me understand

I may sometimes tend to ask the teacher how they got to the answer

To get different explanation

### **Mathematics is everywhere**

***Mathematics is in other subjects (53):*** Any reference to the presence of maths in other subjects.

Some subjects need maths

Maths links with other subjects

Because it's often in other subjects

Maths is any calculation you do, in other subjects there is a time of counting and calculating

Because one has to use it in other subjects

To save time when doing the calculations, nothing can be done without maths

Because it goes with my favourites

I believe that all subjects are related to one another somehow

In all the subjects we do at school Maths is always involved

Most important subjects involve Maths

***Unavoidable (37):*** Any reason that suggests maths is everywhere.

Some are related to what goes on in life

Its part of my school work

Mathematics we use everyday

Mathematics is in everything

Because maths is involved in anything you do

There is nothing one can do without maths

Everything in life needs Maths

Many things in the world need Maths

Everything outside is related to Maths

You can't do anything without Maths

**Positive attitude to mathematics (58):** Any reasons that showed an optimistic viewpoint about mathematics.

Working with world problems involving maths is fun

I like maths more than other subjects

Because maths is easier than the other subjects

I love maths I wish I could learn it all the time

Because maths is my favourite subject

Maths is very interesting

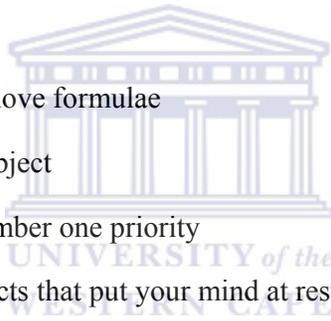
There are no notes and I love formulae

Maths is my favourite subject

Nowadays Maths is a number one priority

Maths is one of the subjects that put your mind at rest

It can help me know that certain things happen because of Maths



### **5.2.2** *Contexts junior secondary learners least prefer to deal with in mathematics.*

This question will be answered in 4 ways. First the least 20 contexts of the 61 core contexts as determined by mean ranks will be shown. Secondly the least ten contexts as determined by percentiles will be presented. Thirdly comparisons between class levels in the rating of the least ten contexts will be made. Fourthly comparison between boys' and girls' rating of the least ten contexts will be made. Table 5.5 at the end of this subsection shows the  $p$  values used to ascertain the significance of the differences between groups.

### 5.2.2.1 How the 61 core contexts were ranked as least preferred by the learners.

**Table 5.4:** 20 Least preferred contexts in ascending order

Least 20 Contexts		
C43 Decorations on mats and handicraft made by market ladies [1]	C18 Mathematics of inflation [8]	C17 Mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of a certain size [15]
C40 Mathematics linked to rave and disco dance patterns [2]	C32 Mathematics involved in assigning people to tasks when a set of different tasks must be completed [9]	C9 Mathematics to predict whether certain species of animals are on the brink of extinction [16]
C2 Mathematics of lottery and gambling [3]	C28 Mathematics involved in packing goods to use space efficiently [10]	C61 Mathematics involved in military matters [17]
C37 Mathematics to determine the number of fish in a lake, river or a certain section of the sea [4]	C53 Strange results and paradoxes in Mathematics [11]	C25 Mathematics involved in making complex structures such as bridges [18]
C1 Mathematics linked to designer clothes and shoes [5]	C51 How to predict the sex of a baby [12]	C10 Mathematics political parties use for election purposes [19]
C36 Mathematics involved in working out the best arrangement for planting seeds [6]	C30 Mathematics linked to South African pop music [13]	C59 Mathematics to describe movement of big groups of people in situations such as emigration and refugees fleeing from their countries [20]
C13 Mathematics involved in designing delivery routes of goods such as delivering bread from a bakery to the shops [7]	C56 Mathematics to describe facts about diminishing rain forest and growing deserts [14]	

Numbers in square brackets indicate the ranking of the contexts by learners. 1 represents the lowest ranking.

Basic everyday life contexts were the most common in the least preferred list. Notable is the presence of *mathematics linked to South African pop music* and *mathematics linked to designer clothes and shoes*. These contexts would be expected to be of interest to youth.

### 5.2.2.2 The least preferred contexts as determined by percentiles

The least ten contexts as determined by percentiles in ascending preference order were C43(1,1,2,3), C40(1,1,2,3), C2(1,1,2,3), C37(1,1,2,3), C1(1,1,2,3), C36(1,1,2,3), C13(1,1,2,3), C18(1,2,2,3), C32(1,2,2,3) and C28(1,2,2,3). Each of these contexts was scored 2 or less by at least 50% of the learners that rated them. In fact each of these contexts had a 60 percentile of 2 indicating that they were rated 2 or less by at least 60% of learners that rated them.

### 5.2.2.3 Comparison of class levels on the least preferred contexts

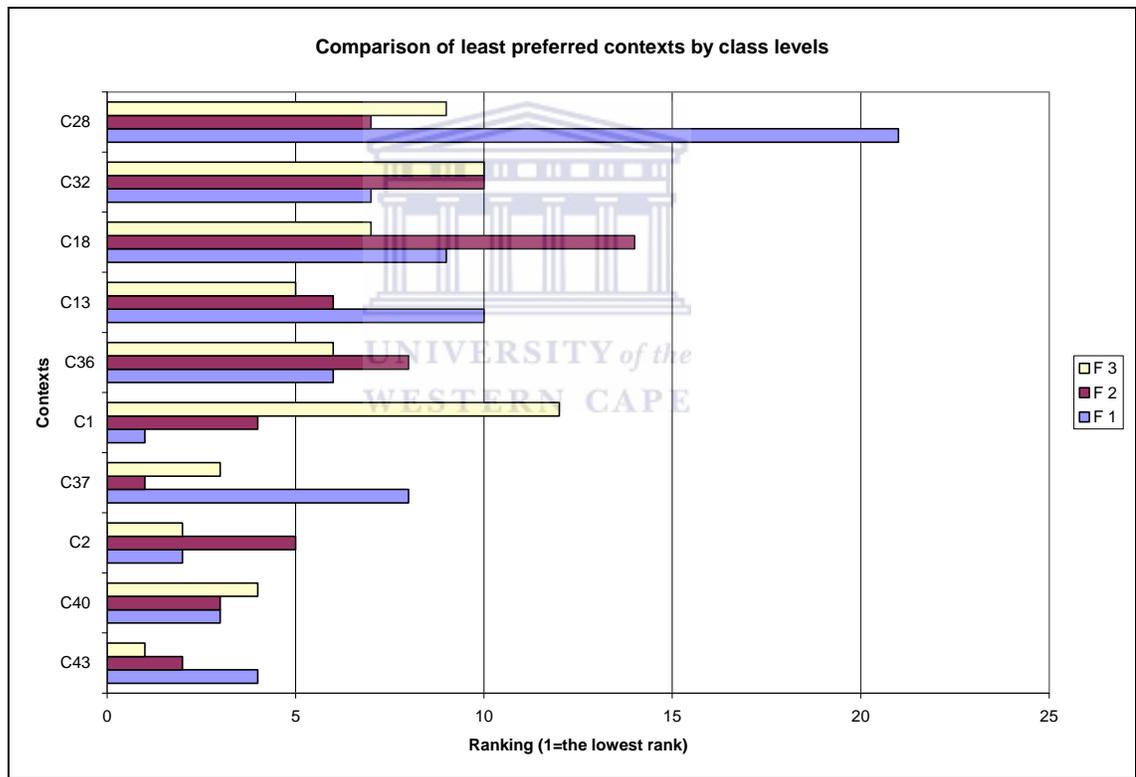


Figure 5.3: Least preferred contexts by class levels

There was a marked difference between Form 1s' ranking of C28 (*Mathematics involved in packing goods to use space efficiently*) in comparison with the form 2s and 3s and this was significant at the 0.05 level of significance. There was a significant difference at the

0.05 level of significance in the ranking of C1 (*Mathematics linked to designer clothes and shoes*) between Form 1 and Form 3 and also between Form 2 and Form 3. The difference in ranking of C37 (*Mathematics to determine the number of fish in a lake, river or a certain section of the sea*) between form 2 and form 1 was significant at 0.05 level. The difference in ranking C43 (*Decorations on mats and handicraft made by market ladies*) between form 1 and form 3s was insignificant at 0.05 level. C40 (*Mathematics linked to rave and disco dance patterns*) was almost ranked the same by all the classes with Form 3s ranking it higher by just one point and this difference was not significant at the 0.05 level of significance.



### 5.2.2.4 Comparison of gender on the least preferred contexts

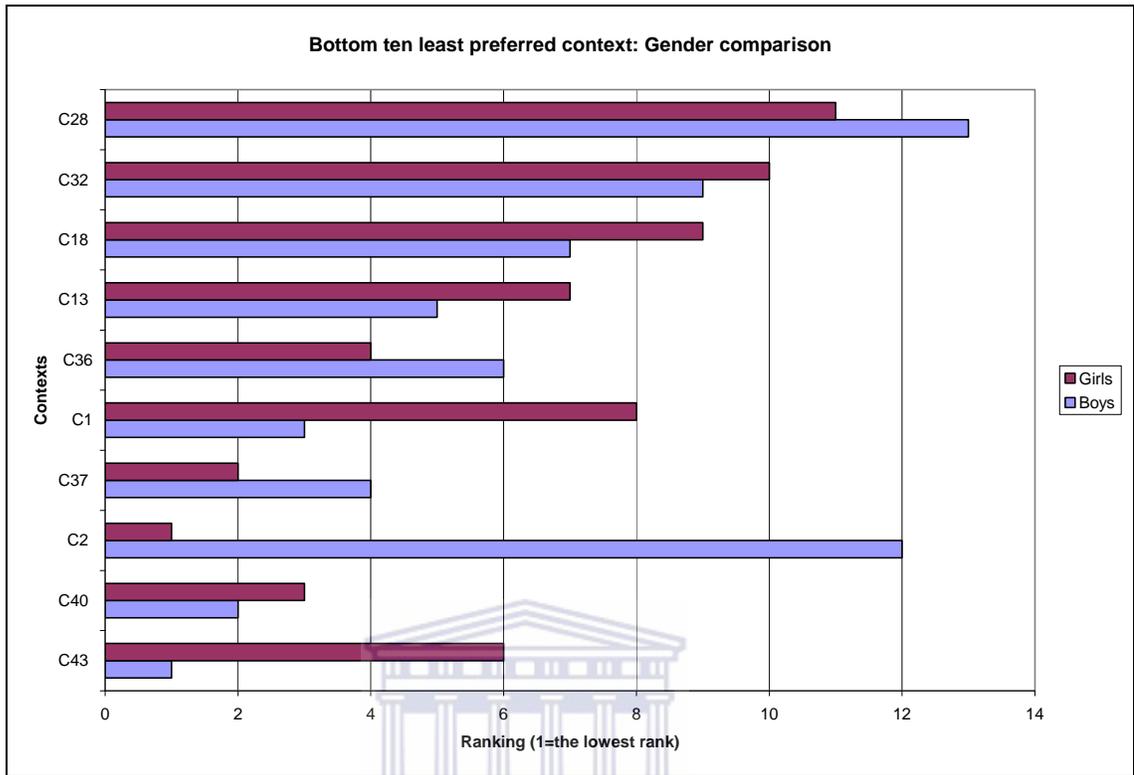


Figure 5.4: Least preferred contexts by gender

There was a one or two points difference in the ranking of C40 (*Mathematics linked to rave and disco dance patterns*), C32 (*Mathematics involved in assigning people to tasks when a set of different tasks must be completed*), C37 (*Mathematics to determine the number of fish in a lake, river or a certain section of the sea*), C36 (*Mathematics involved in working out the best arrangement for planting seeds*), C13 (*Mathematics involved in designing delivery routes of goods such as delivering bread from a bakery to the shops*), C18 (*Mathematics of inflation*), and C28 (*Mathematics involved in packing goods to use space efficiently*). These differences were not significant at 0.05 level of significance. Girls ranked C2 (*Mathematics of lottery and gambling*) lowest while boys ranked C43 (*Decorations on mats and handicraft made by market ladies*) lowest. The differences between girls and boys ranking of these contexts were significant at 0.05 level of

significance. There was a ten points difference in the ranking of C2 by girls and boys. The ranking of C43 had a five points difference between boys and girls. C1 (*Mathematics linked to designer clothes and shoes*) also had a five points difference between boys and girls with girls' ranking higher than boys' ranking. This difference was significant at 0.05 level of significance.



**Table 5.5:** *p* values used to discern significance of differences in ranking of least favoured contexts between class levels and gender.

	Context	F1&2	F1&3	F2&3	Gender
C43	Decorations on mats and handicraft	.169	.073	.603	.000
C40	Linked to rave and disco dance patterns	.921	.756	.782	.085
C2	Lottery gambling	.532	.143	.052	.000
C37	Determine number of fish in a lake	.018	.051	.762	.864
C1	Designer clothes	.870	.001	.001	.003
C36	Working out best arrangement for planting seeds	.740	.152	.277	.605
C13	Delivery routes	.167	.035	.544	.370
C18	Inflation	.066	.584	.025	.225
C32	Assigning people to tasks	.144	.594	.377	.591
C28	Packing goods to use space efficiently	.005	.013	.672	.765

Asymp. Sig. (2-tailed)

## 5.3 Serendipitous Results

The study reported here is on contexts that learners prefer to use in learning mathematics. The learners indicated they would prefer to learn mathematics that arises while they are learning another school subject. However the item required them to choose between yes and no and give reasons for their choice. The result below is a report on the reasons they gave for choosing no to learning mathematics that arises in another school subject.

### ***5.3.1 The most common reasons for not preferring to learn mathematics while learning another school subject.***

Most common categories for reasons for not preferring to learn mathematics while learning another subject were; negative learning impact, negative attitude to mathematics and each subject has its own slot. Table 5.6 shows frequency of reasons in each category and some exemplar reasons.



**Table 5.6:** Reasons for not preferring to learn mathematics while learning another subject

Category	Freq.	Exemplar Reasons
Each Subject Has its Own Slot	30	<ul style="list-style-type: none"> <li>• Because I have already learnt it in other subject</li> <li>• Because its not maths time</li> <li>• Because I will be concentrating on the other subject</li> </ul>
Futuristic	2	<ul style="list-style-type: none"> <li>• What I would like to do in the future does not need maths</li> </ul>
Negative Attitude to Maths	48	<ul style="list-style-type: none"> <li>• I do not like maths</li> <li>• Maths is difficult</li> <li>• I am not interested in learning maths because I don't understand the teacher</li> <li>• I fail it almost every time we write</li> <li>• The subjects I'm learning at the time are interesting to me.</li> </ul>
Negative Learning Impact	51	<ul style="list-style-type: none"> <li>• I can get more confused</li> <li>• Other subjects require one to study too much</li> <li>• You find that the maths used there is difficult than during maths time.</li> <li>• Because we might not have covered them in maths</li> <li>• Could make my performance go down in the other subject</li> </ul>
They are different subjects	10	<ul style="list-style-type: none"> <li>• What I learn in these subjects is different from what I learn in maths</li> </ul>
Other Affective Reasons	4	<ul style="list-style-type: none"> <li>• Not gifted in the subjects that make use of maths</li> </ul>
Unclassified /other	9	<ul style="list-style-type: none"> <li>• The teacher of that subject may not describe anything about maths</li> </ul>

It is seems the most popular reason for not wanting to learn mathematics while learning another school subject were that it would have a negative learning impact, negative attitudes to mathematics and that each subject was seen as a different entity.



## 6. CHAPTER 6

# DISCUSSION AND CONCLUSIONS

## 6.1 Introduction

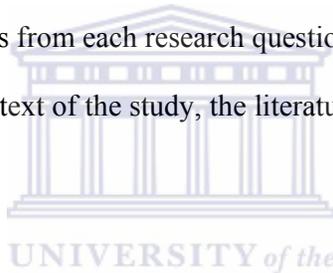
This chapter discusses the findings of the study. The problem addressed by the study was the absence of learners' preferences on contexts for learning mathematics. In searching for solutions to the problem the following research questions were posed:

1. What contexts do junior secondary school learners in Swaziland public schools most prefer to deal with in mathematics?
  - Which of the 61 core contexts were ranked as most preferred by the learners?
  - How are the most preferred contexts distributed according to gender or class level?
  - How do the learners support their reasons for choosing favourite contexts?
  
2. What contexts do junior secondary school learners in Swaziland public schools least prefer to deal with in mathematics?
  - Which of the 61 core contexts were ranked as least preferred by the learners?

- How are the least preferred contexts distributed according to gender or class level?

To answer the first question the 61 core contexts were arranged into the most 20 the middle 21 and the least 20 favoured contexts. This helped identify how each core context was rated by the learners before doing a thorough study of the first ten highly ranked and the least preferred contexts. Studying all the 61 core contexts gave a general picture of the nature of the most and the least favoured contexts. Reasons for the most or least preferred contexts were also studied.

This chapter therefore, presents learners' views on contexts relevant for the learning of school mathematics. Findings from each research question are summarised from chapter 5 and explained within the context of the study, the literature and the conceptual framework (Perry, 1994).



## 6.2 Discussion on Each Research Question

### 6.2.1 *Contexts junior secondary school learners most prefer to deal with in mathematics.*

#### 6.2.1.1 Which of the 61 core contexts were ranked as most preferred

The learners who participated in this study clearly considered context they perceived to impact on their future comfort as most relevant. This was indicated by their first three highest ranked contexts: C23 (*Mathematics that will help me to do mathematics at universities and technikons*), C11 (*Mathematics that is relevant to professionals such as engineers, lawyers and accountants*) and C47 (*Mathematics involved in working out financial plans for profit-making*). Technological contexts and those to do with social concerns were also rated highly by the learners. A general perception

about schooling, in Swaziland, is that at the end of Form 5 one should enrol into a tertiary institution. This general expectation is compounded by the availability of scholarships for university and college education. These scholarships come with good personal allowances such that once they get to university they live well. Going to university after Form 5 is every learner's dream and every parent's dream for his or her child. In the first year of implementation of pre-vocational education parents wanted to know the institutions that would consider those children that have done pre-vocational studies. This changed the initial plan of venturing into business for pre-vocational education graduates. Another common view is that the measure of one's education is in his or her living a successful life. Certainly mathematics has been made an entrance requirement for a number of programmes in different institutions. Some of these programmes have greater chances for employment opportunities than those not requiring mathematics. This is in agreement with what Hernandez-Martinez, Black, Williams, Davis, Pampaka & Wake (2008) found: that the focus goal for the becoming successful repertoire, was going to university and they say this was motivated by a desire to achieve social respect and financial rewards.

Comparisons between results of this study and the other ROSME studies show similarities between South African results (Julie & Mbekwa, 2005) and Swaziland results on the contexts learners most and least favoured. There is also a strong connection between the first five highest ranked contexts from the South African teachers study (Julie, 2006; van Schalkwyk, 2007) and the contexts learners from Swaziland preferred. The Korean learners' results are different. Korean learners' results (Kim, 2006) have a very weak relation to those of Korean teachers (van Schalkwyk, 2007). This could be an indication that the social environment does

influence learners' choices of contexts. There are commonalities in the socialization of Swazi children and South African children as in most cases they are exposed to the same television programmes.

The nature of the ten most preferred contexts has a strong bearing on the GOs. It shows that the learners are sensitive to what is happening in the environment. They are cognizant of the presence and strength of technology in the society. They also perceive education as providing a better future. Their choices also reveal their understanding of the importance of money in the present generation.

#### **6.2.1.2 How the most preferred contexts were ranked by different classes**

There were no significant differences between class levels in ranking the most preferred contexts. Form 3s rated C45 (*number*) lower than the Form 1s and Form 2s. This is in line with Lerman's (1998) findings where the learners cited situations that make use of the four basic operations as evidence of use of mathematics in their parents' work places. There is a tendency of thinking of number as synonymous with mathematics. Indeed at lower levels of schooling mathematics in most cases involves number work. Their reasons for choosing C45 also demonstrate their association of number work with mathematics.

Form 3s, it would seem have come to realise that there is more to mathematics than number work. Those of us who have taught algebra to form 1s can recall the question "what is  $x$ ?" This was a turning point from knowing mathematics as number to learning it can be something else either than number.

### 6.2.1.3 Most preferred contexts as ranked by gender

Girls ranked C22 (*Mathematics to prescribe the amount of medicine a sick person must take*) and C21 (*Mathematics to assist in the determination of the level of development regarding employment, education and poverty of my community*) higher than the boys. C22 and C21 are matters of social concern. In most cases relatives that care for the sick are women. When women or children are sick it is their female relatives that take care of them, wives may take care of their husbands but it is not common to find a husband watching over his sick wife. In most cases women are the ones who ensure the welfare of their families. The majority of hawkers and street vendors are women. A fairly consistent finding in the literature is that girls tend to behave in a pro-social manner more often than boys (Wentzel, Filisetti & Looney, 2007). Societal expectations for girls are caring and nurturing (Reid, Cooper & Bank, 2008).

Boys ranked C3 higher than the girls but this difference was not significant. In Kaiser-Messmer's (1993) study boys most dominant theme was technology and girl hardly chose this theme. Surprisingly girls ranked C46 (*Mathematics involved in sending of messages by SMS, cell phones and e-mails*) significantly higher than the boys and yet it also involves a technological aspect. Could it be that the girls' interest was triggered by using the phone for talking, the writing of SMS and e-mails?

Contrary to Kaiser-Messmer's (1993) study where fewer girls than boys were significantly interested to enter careers involving mathematics, in the present study boys ranked C11 (*mathematics that is relevant to professionals such as engineers, lawyers and accountants*) higher than girls but the differences were not significant.

#### **6.2.1.4 Reasons for preferring core contexts**

Most reasons for choosing the highest ranked core contexts were futuristic followed by learning. The futuristic reasons' categories in order of preference were: career prospects, business prospects, financial power or gain and access to tertiary education. All these categories have implications for monetary gain. This is an indication that the learners associated schooling with a better future. Hernandez-Martinez, Black, Williams, Davis, Pampaka & Wake (2008) found that students talked about mathematics as being useful and relevant to their future while others saw success in mathematics as a way of escape from their current circumstances. In their study they established that parental influence on higher education was strong. However, Kaiser-Messmer (1993) found that both boys and girls at lower secondary did not attach the importance of mathematics to future careers.

Reasons for learning included learning mathematics and learning generally. These reasons sounded more like speculations. However they showed that the learners hoped that the contexts would improve their learning. This is in agreement with proponents of the use of contexts in the learning of mathematics (Boaler, 1993b, 1994; Klassen, 2006; Clarke & Helme, 1998). These advocates allude that contexts motivate and engage learners.

Learners also gave reasons that showed their positive dispositions towards mathematics. These reasons were of the actual identity type. One could conjecture that the learners who gave these kinds of reasons are those that have ability in mathematics.

### 6.2.1.5 Reasons for preferring to learn mathematics in other school subjects

When mathematics is isolated a message that is sent to the learners is that mathematics is irrelevant except for achieving success in future mathematics classes, becoming a scientist or mathematician or making commercial transactions (Peterson, 2005).

The learners were in favour of learning school mathematics while learning other school subjects. The most popular reasons for their choice were: *learning, mathematics is everywhere, positive attitude to mathematics and futuristic* in that order.

The reasons classified as learning were learning generally, learning mathematics, learning the other subject, learning a specified subject and teacher dependent. Those who gave reasons classified into learning generally saw learning as holistic and also saw learning in the context of another subject as minimising the work load for them. Advocates of subject integration see it as a way of decreasing work load for both learners and teachers (Kinniburgh & Byrd, 2008; Applebee, Adler & Flihan, 2007).

Some learners saw learning in the context of another school subject helping them learn mathematics. They felt that if a concept appeared more than once, in the curriculum, it had a better chance to be understood.

On the other hand mathematics was seen as helping learn the other subject. It would seem learners sometimes encounter difficulties in learning some aspects of other subjects due to the mathematics involved. For this reason learners saw learning mathematics in the other subject as alleviating such learning hindrances. Reasons for learning were in most cases indicated an actual identity, therefore, they can be seen to

portray the S-identity of the learners. Some reasons, however, were of designated identity type these were reasons such as “maybe if it’s in a subject I like then I’ll like it too” this portrays an instrumental identity, I-identity.

Subjects that were identified as requiring mathematics for their learning were Science, Agriculture, Geography, Accounting, Technical Drawing, Home Economics, Economics, History and English.

Another reason highlighted was that the other teacher might explain better. They expressed their preference for the other subject teacher by reasons such as: “The teacher in the other subject may explain better than the maths teacher” and “The other teachers teach nicely.” This is in line with Lerman (1998)’s findings that the learners saw mathematics teachers negatively different from the way they viewed other subject teachers. Another reason associated with teachers was that it would give them different explanations and thus enable them to grasp the concept better than if one teacher taught them.

The positive attitude to mathematics revealed the learners dispositions towards mathematics. Learners felt that mathematics does not require much studying. This was expressed in reasons such as: “There are no notes and I love formulae” and “Maths is one of the subjects that put your mind at rest.” All 58 reasons in this category were phrased confidently and with assurance. For these reasons they could be identified as the learners’ actual identities of mathematics (Sfard &Prusak, 2005).

## **6.2.2 Contexts junior secondary school learners least prefer to deal with in mathematics.**

### **6.2.2.1 How the 61 contexts were ranked as least preferred**

The least preferred contexts included contexts from physical science, environmental, adult world, some mathematics, agricultural and surprisingly contexts that can be classified in youth culture such as *South African pop music* and *disco dance patterns*. Among the adult world contexts are *political parties* and *military matters*. These contexts are probably irrelevant for Swaziland as the army has not been involved in any war and there are no political parties in Swaziland. It is surprising to find agricultural and youth contexts amongst the least favoured contexts. Swaziland is an agricultural country. Could it be possible that the learners saw this as an everyday activity that has nothing to do with schooling? Maybe as Zevenbergen, Sullivan & Mousley (2002) condemned the use of indigenous activities for Western mathematics the learners also felt that the day to day activities had nothing to do with formal schooling. An alternative explanation could be that the learners were thinking about their foregrounds and they did not see these everyday activities taking them to where they want to go as observed by (Skovsmose, 2005). The learners' failure to see the relevance of these day to day contexts in the learning of mathematics could also signal a fragmented picture about knowledge.

In the early sixties one of the reasons for the change from traditional mathematics was that it was not holistic in its approach. A holistic approach is not linear but it is willing to view things from different perspectives. When mathematical knowledge is not approached holistically learners consider it not connected to social reality in any practical way (Peterson, 2005). Furthermore, one of the characteristics of RME is

intertwining of different strands. This enables learners to have a broad and deeper view of mathematics and could hopefully advance the indigenous activities.

#### **6.2.2.2 How the least preferred contexts were ranked by different classes**

There was general agreement on the ranking of the lowest ranked five contexts. They were ranked at most 5. However, Form 3s ranked C1 (*Mathematics linked to designer clothes and shoes*) high and Form 1s ranked C37 (*Mathematics to determine the number of fish in a lake, river or a certain section of the sea*) high. The sixth to tenth lowest ranked items were ranked between 5 and 10 except C18 (*Mathematics of inflation*), which was ranked high by Form 2s and C28 (*Mathematics involved in packing goods to use space efficiently*) was ranked high by Form 3s.

#### **6.2.2.3 Least preferred contexts as ranked by gender**

The 5 lowest ranked items were ranked between 1 and 5 by both girls and boys except C1 (*Mathematics linked to designer clothes and shoes*) and C43 (*Decorations on mats and handicraft made by market ladies*) which were ranked highly by the girls while C2 (*Mathematics of lottery and gambling*) was ranked highly by boys. The other lowly ranked items were ranked between 5 and 10 except C28 (*Mathematics involved in packing goods to use space efficiently*) was ranked highly by both girls and boys. It was no surprise that girls ranked designer clothes and shoes highly as girls tend to be more into fashion than boys. This is in line with Anderson's (2006) allusion that fashion and dressmaking has a traditional gender bias in favour of girls. In addition Boaler (1993a) reasoned that girls were disadvantaged on a task involving fashion because they valued this context and therefore had difficulty abstracting issues from it. Media in the form of advertisements, talk shows and movies always portray girls as

fashionable. Reid, Cooper & Bank (2008) suggest that 83% of girls read fashion magazines.

### 6.3 Discussion on Serendipitous Findings

The most common reason given for not preferring to learn mathematics that arises while they are learning other school subjects were: *negative learning impact, negative attitudes to mathematics* and that *each subject has its own slot* on the time table. The learners saw this as resulting in a negative learning impact. This negative learning impact can be viewed from both the learning of mathematics and the learning of the other subject. When a student said “I can get confused” that has implications of disturbing either subjects. Responses like “other subjects require one to study too much” and “you find that the maths used there is difficult” have implications for impacting negatively on the learning of mathematics. On the other hand the answer “Could make my performance go down in the other subject” implies a negative impact on the other subject.

The answer to the question on the questionnaire could be provoked by different interpretations of the question. One interpretation could be “take that piece of mathematics from the other subject and learn it in mathematics so that you do not have to learn it in the other subject but use it.” Another would be “take the mathematics and house it in the other subject.”

Negative attitudes to mathematics contributed to the learners’ refusal to learn mathematics that arises in the other school subjects. Some students feared that the mathematics teacher would teach it while others felt their hatred of mathematics

would rub onto the other subject. The mathematics teacher element tallies with Lerman's (1998) findings on learners' images of mathematics teachers.

The last category: *each subject has its own slot*. This arises from the grammar of schooling-seeing subjects as different- that learners experience as early as Grade 5 in some cases. In some primary schools mathematics is taught by a specialist teacher while in secondary schools subjects are always taught by specialist teachers. It is clear that knowledge at secondary school level is not approached holistically but compartmentalised into subjects.

## 6.4 Conclusions about the Research Problem

The problem the present study was addressing was the absence of learners' preferences in contexts chosen for learning mathematics. The main aim was to find and study the contexts that the learners most prefer and also study the reasons they gave for preferring these contexts. Studying the nature of the contexts they most prefer together with the reasons they gave for preferring the contexts exposed the identities they have about mathematics as well as their self-identities in relationship to mathematics. For any communication to be successful it is important to know the audience very well. As educators our audience are the learners.

The study indicates that learners were interested in issues that were of concern to their society. They were influenced by the GOs. This indicates that they are aware of what goes on in their environment. When they said they were interested in mathematics that would enable them to study mathematics at universities and technikons it was an indication of their awareness of the importance of mathematics for their future. Their interest in the technological contexts showed they were aware and appreciated the

technology around them. They were also aware of the HIV/AIDS pandemic and they wished to come out with a solution.

Studying the reasons the learners gave for preferring contexts revealed their perceptions of the value of school mathematics. This was particularly evident in their reasons for preferring to learn mathematics that arises while they are learning another subject. It revealed their beliefs, emotions and behaviours in relation to mathematics. These reasons were classified under “positive attitudes to mathematics.” An example of an attitude related to emotions was “I like mathematics” one related to beliefs is “Mathematics is useful” and one related to behaviour was “I always do my homework in maths” (Zan & Martino, 2007).

## 6.5 Implications for Policy and Practice

Schoenfeld (2002) states that curriculum change in America has been motivated by some crisis. For example the new math came about because of Russia’s launch of Sputnik (Schoenfeld, 2002). Probably the Americans felt their curriculum was lacking something that the Russian curriculum had. Furthermore, textbook mathematics is not conducive to the learners’ needs and will not lead to improved mathematical performance beyond the classroom (Brown, 2008). The present study has implications for policy and for practice.

A learner-centred policy is already in place but whether it is practised is another thing. Secondly this policy focuses on classroom instruction and omits learner consultation. Learners, through this study, have shown that they can contribute worthwhile information. They have shown that they want a curriculum that is cognizant of the changes in the environment. They have shown that they are mindful of the technological

changes, they are aware that society tends to leave their rural settlements to live in urban setting. They are conscious that the urban life style requires money.

Consulting learners is not compatible with an examination oriented system. Studies in science education have indicated that learners preferred to be taught using the traditional methods and that teachers were not sure about contextualising (Dlamini & Dlamini, 2003; Dlamini, Dlamini & Dube (2007)). For contextualising to be effective the system of education needs to review its assessment methods to incorporate contextualising.

Learners have to be consulted about what they learn and it should be related to their interest. This study has shown that learners believed learning in these contexts would enhance learning. In some instances the learners showed their interest in the contexts itself, that was an indication that these contexts could motivate them to learn mathematics. It would give them another perspective of mathematics. The large percentage of learners that indicated an interest in learning mathematics while learning another school subject challenges teacher education to present a holistic view of knowledge to teachers in training. When the learners reported that the other teacher taught better one would wonder if he or she taught better because they could relate to what he or she was teaching or methods of teaching the other subjects were better than the methods that mathematics teachers were using.

## **6.6 Limitations**

On analysing the data it became apparent that it would have enhanced the results to have had an item that required learners to have given reasons for the items they had rated high and those they had rated low. Avoiding this question for fear of influencing their choices resulted in the reasons emerging from item C62 with some high rated items having fewer

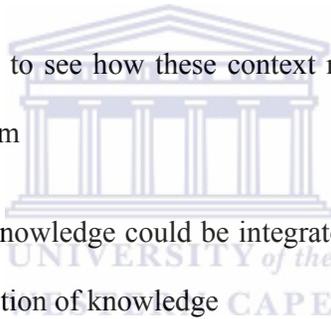
reasons. This limitation also resulted in studying the reasons for the core contexts as a whole and yet a better way could have been to study reasons for individual contexts. For instance, what reasons were they giving for preferring C3 (*making computer games such as play stations & TV games*)?



## 6.7 Implications for Further Research

Below is a list of some issues that need to be investigated further:

- Seeing that many of the learners chose C23 (*Mathematics that will help me to do mathematics at universities and technikons*) it is paramount to find out what the mathematical aspects for the various programmes that call for mathematics as an entrance requirement are and to establish the actual mathematics prerequisite knowledge.
- Investigate how activities, problem tasks located in the most favoured contexts might enhance the learning of mathematics.
- Carry out a study to see how these context might be used in an examination oriented curriculum
- Investigate how knowledge could be integrated in teacher training to alleviate the fragmented notion of knowledge

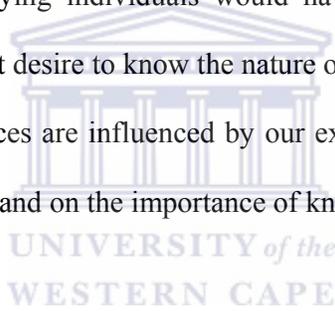


## 6.8 Reflections on the Methods and the Framework

In searching for contexts learners prefer the ROSME questionnaire presented the learners with several contexts and required them to indicate their strength of interest on those contexts. How the learners ranked the contexts was used to determine how the learners rated a context. This was used to study the nature of the categories of favoured contexts and least favoured contexts. Learners were also required to give reasons for their preferences. These reasons were studied against theories on interest and on identity. This was different from other affect studies where learners were studied using attitude scales. Sometimes learners had been studied to evaluate their affect as they were doing some mathematical task (Zan, Brown,

Evans & Hannula, 2006). Learner observation on task is a good method for studying affect; however, it can not give the overall picture about the learner. The nature of the task and the topic(s) it involves may influence affect. Task affect studies might be best carried out by class teachers since they are in a better chance of observing the learner on different tasks and for a longer period.

Interest develops through time and is often influenced by experiences. The conceptual framework was used to find out why learners chose the contexts they chose and why they were giving the reasons they gave. This enabled studying their responses against their backgrounds and foregrounds. Although in the present study the learners were studied as a group I acknowledge that studying individuals would have been more profitable. Going through the results there was that desire to know the nature of the learner. The findings of this study have shown that our choices are influenced by our experiences. This has implications for what learners are exposed to and on the importance of knowing our learners.



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## 8. Appendices

### 8.1 Appendix 1: The ROSME Clusters

Table 8.2 Clusters, number of items per cluster, and exemplar item

Cluster	Number of Items	Exemplar Indicator Item
Mathematics	6	Mathematics that will help me do mathematics at universities and technikons
Mathematicians' Practices	5	How mathematicians make their discoveries
Health	4	Mathematics involved in determining the state of health of a person
Physical Science	3	Mathematics involved in making complex structures such as bridges
Technology	5	Mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM
General	7	Mathematics involved in assigning people to tasks when a set of different tasks must be completed
Transport and delivery	3	Mathematics involved in the sending of messages by SMS cell phones and e-mails
Life Science	3	Mathematics to determine the number of fish in a lake, river or a certain section of the sea
Crime	4	Mathematics involved in setting up a crime barometer for my area
Sport	2	Mathematics involved in crowd control at a sport meeting

Youth Culture	4	Mathematics linked to music from the United States, Britain and other such countries
Politics	3	Mathematics used to calculate the number of seats for parliament given to political parties after elections
Agriculture	4	Mathematics involved in working out the best arrangement for planting seed



## 8.2 Appendix 2: The ROSME Instrument

CODE:.....



RELEVANCE OF SCHOOL MATHEMATICS EDUCATION (ROSME)

October 2003

Things I'd like to learn about in Mathematics

### Section 1 (Demography)

I am:      a female .....      a male .....

I am ..... years old

I am in Grade .....



### Section 2

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

1 = Not at all interested

2 = A bit interested

3 = Quite interested

4 = Very interested

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

<b>Context Number</b>	<b>Things I'd like to learn about in Mathematics</b>	<b>Not at all interested</b>	<b>A bit interested</b>	<b>Quite interested</b>	<b>Very interested</b>
C1	Mathematics linked to designer clothes and shoes	1	2	3	4
C2	Mathematics of 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	4
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	4
*C27	Geometry (e.g. angles, transformation, loci, solid and plane shapes)	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	Decorations on mats and handicraft made by market ladies	1	2	3	4
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, cell phones 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.				
C53	Strange results and paradoxes in Mathematics				
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, aerobic, swimming, gymnastics and soccer.	1	2	3	4
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

### Section 3

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

NO

Why? .....

Why not? .....

.....

.....



(iii) .....

## Section 4

C66 Make a sketch or drawing of a mathematician



## 8.3 Appendix 3 Teachers' Guidelines

### Instructions for Questionnaire administration

Please read the questionnaire to the students. Explain any difficult word except 'mathematician'. Instead ask them what a musician is and from there they should answer the question according to their individual idea as to what a mathematician is. Later on they are asked to draw a mathematician that's why we do not want them to draw the teacher's idea but their own. The aim of the study is to find out what contexts **individual children** would like to learn mathematics in; therefore it is important that they do not influence each other's responses. As you read the questions ask them not to comment but individuals to circle the number they prefer. Questions 1 to 61 lists some contexts but question 62 requires them to state three contexts they would prefer to learn mathematics in, this is deliberately left open so that those who want to offer contexts different from the given in question 1 to 61 may do so.

Questions 62 to 66 are open questions which they also have to answer. Please emphasise that they should answer all question.

Make sure they fill in the spaces on the front page. Your school no is ..... So every one should fill in ..... There after using the class list give them the numbers on the class list e.g.

1. Bhembe Dumisani [S4/1]
2. Dlamini Sam
3. Dlamini Zamo

These students would fill the code section as ....., ..... and ..... I have made an example as to how the first person on the above list would complete the front page (this means

their school number is S4. Please include the class lists with the papers that will come back to me, this will help if there is an answer I am not clear about especially in question 62 to 66. **Thank you very much for helping me out with this I sincerely appreciate it.**

## 8.4 Appendix 4: Ranking of the 61 core contexts

**Table 8.3:** Ranking of contexts by learners in descending order

Most20 Contexts	Middle 21 Contexts	Least 20 Contexts
C23 Mathematics that will help me to do mathematics at universities and technikons [61]	C48 Mathematics involved in my favourite sport [41]	C59 Mathematics to describe movement of big groups of people in situations such as emigration and refugees fleeing from their countries [20]
C11 Mathematics that is relevant to professionals such as engineers, lawyers and accountants [60]	C49 Mathematics involved in dispatching a helicopter for rescuing people [40]	C10 Mathematics political parties use for election purposes [19]
C47 Mathematics involved in working out financial plans for profit-making [59]	C55 Mathematics that entertain and surprise us [39]	C25 Mathematics involved in making complex structures such as bridges [18]
C15 Mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM [58]	C34 Algebra [38]	C61 Mathematics involved in military matters [17]
C45 Numbers [57]	C27 Geometry [37]	C9 Mathematics to predict whether certain species of animals are on the brink of extinction [16]
C46 Mathematics involved in sending of messages by SMS, cell phones and e-mails [56]	C7 Mathematics used in making aeroplanes and rockets [36]	C17 Mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of a certain size [15]
C21 Mathematics to assist in the determination of the level of development regarding employment, education and poverty of my community [55]	C44 Mathematical ideas that have had a major influence in world affairs [35]	C56 Mathematics to describe facts about diminishing rain forest and growing deserts [14]
C22 Mathematics to prescribe the amount of medicine a sick person must take [54]	C12 How mathematics is used to predict the spread of diseases caused by weapons of mass	C30 Mathematics linked to South African pop music [13]

destruction such as chemical, biological and nuclear weapons [34]

- |   |  |  |
|---|--|--|
| C16 Mathematics used to calculate the taxes people and companies must pay to the government [53]  | C54 Mathematics to monitor the growth of a baby the first period of life [33]                                  | C51 How to predict the sex of a baby [12]  |
| C26 The kind of work mathematicians do [52]   | C6 The personal life stories of famous mathematicians [32]   | C53 Strange results and paradoxes in Mathematics [11]  |
| C3 Mathematics involved in making computer games such as play stations and TV games [51]  | C52 How mathematics can be used by setting up a physical training program, and measure fitness [31]            | C28 Mathematics involved in packing goods to use space efficiently [10]  |
| C35 Mathematics about the age of the universe [50]  | C60 Mathematics involved in determining levels of pollution [30]   | C32 Mathematics involved in assigning people to tasks when a set of different tasks must be completed [9]              |
| C58 How mathematics can be used in sport competitions like ski jumping, athletics, aerobic, swimming, gymnastics and soccer [49]  | C5 Mathematics used to predict the growth and decline of epidemics such as AIDS; tuberculosis and cholera [29] | C18 Mathematics of inflation [8]   |
| C29 How mathematicians make their discoveries [48]  | C8 How to estimate and predict crop production [28]  | C13 Mathematics involved in designing delivery routes of goods such as delivering bread from a bakery to the shops [7] |
| C50 Mathematics used to work out the repayments (instalment) for things bought on credit are worked out [47]  | C41 Mathematics involved in making pension and retirement schemes [27]   | C36 Mathematics involved in working out the best arrangement for planting seeds [6]                                    |
| 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 [46] | C19 Mathematics about renewable energy sources such as wind and solar power [26]                               | C1 Mathematics linked to designer clothes and shoes [5]  |
| C39 Mathematics that air traffic controllers use for sending off and landing planes [45]  | C38 Mathematics linked to music from the United States, Britain and other such countries [25]                  | C37 Mathematics to determine the number of fish in a lake, river or a certain section of the sea [4]                   |

C20 Mathematics involved in determining the state of health of a person [44]	C14 Mathematics needed to work out the amount of fertilizer needed to grow a certain crop [24]	C2 Mathematics of lottery and gambling [3]
C42 Mathematics of the storage of music on CD's [43]	C31 Mathematics used to calculate the number of seats for parliament given to political parties after elections [23]	C40 Mathematics linked to rave and disco dance patterns [2]
C57 How mathematics can be used in planning a journey [42]	C4 Why mathematicians sometimes disagree [22]	C43 Decorations on mats and handicraft made by market ladies [1]
	C33 Blunders and mistakes some mathematicians have made [21]	

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Numbers in square brackets indicate the ranking of the contexts by learners. 1 represents the lowest ranking.

