LEARNERS' MOTIVATIONS FOR PREFERRED CONTEXTS IN MATHEMATICAL LITERACY

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ABSTRACT

The National Curriculum Statement introduced mathematical literacy officially in 2006. Learners in general perform poorly at mathematics in South Africa but there is strong belief that learners should graduate from schools sufficiently literate to deal with the mathematical issues they will encounter in out-of-school situations. Based on this, this study is an investigation of the contexts, which grades 8 – 10 learners would prefer to engage with mathematics.

The aim of this study was thus to investigate mathematical literacy in relation to learners' motivations for the contexts they would prefer to deal with in mathematical literacy. The emphasis of the study is to concentrate on learner's written motivations for mathematical contexts. Data were collected using a questionnaire that deals with contexts for mathematics.

A sample of 120 learners in grades 8 to 10 were randomly selected from a bigger sample of 1077 learners of previously disadvantaged schools in the Western Cape and the motivations this sample of learners provided were qualitatively analysed.

An important finding of this study is that learners provide reasonably strong motivations for wanting to study mathematics and mathematically-related careers at higher education institutions as well as for technology, sport and culture.

The researcher suggests that mathematics educators and policy makers pay attention to the contexts preferred by learners to further stimulate learners' interest in mathematics.

DECLARATION

I declare that (**LEARNERS' MOTIVATIONS FOR PREFERRED CONTEXTS IN MATHEMATICAL LITERACY)** is my own work, that it has not been submitted before for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged as complete references.

Charlton Mark Hendricks November 2006

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Signed

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Since the introduction of a revised curriculum, mathematical literacy has become indispensable for South African learners. As a mathematics educator for the past 20 years and more, I wish to make a small contribution to this field, and this inspired me to conduct this study.

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Soli Deo Gloria

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KEYWORDS

Mathematical Literacy

Context in mathematics

Mathematical Modelling

Relevance of mathematics

Learner's interest in mathematics

ROSME

CHAPTER 1

Background and Motivation

Introduction

South Africa is currently in the process of major educational reform. The implementation of Outcomes Based Education (OBE) via the National Curriculum Statement is the major driver for this reform. Curriculum designers opted for a "Transformational OBE". This is the most radical and extreme transformation in education.

The National Curriculum Statement document stresses the need for major changes in education and training in South Africa to level the educational inequalities of the past and transform teaching and learning in all schools. Emphasis is placed on the necessity for a shift from the traditional aim-and-objectives approach, to an outcomes-based approach. This shift is for utmost importance for the achievement of the following vision for South Africa.

> A prosperous, truly, united, democratic and internationally competitive country with literate, creative and critical citizens leading productive, self-fulfilled lives in a country free of violence, discrimination and prejudice.
>
> (Department Of Education, NCS, 2003, 4-5)

There are seven critical outcomes proposed by SAQA (South African Qualifications Authority) with additional five outcomes, which support development. These outcomes aim to ensure that learners gain the skills, knowledge and values that will allow them to contribute to their own success, their communities, families and the nation as a whole.

These outcomes are the following:

Learners will

1. Identify and solve problems and make decisions using critical and creative thinking.
2. Work effectively with others as members of a team, group, organization and community.
3. Organize and manage themselves and their activities responsibly and effectively.
4. Collect, analyze, organize and critically evaluate information.
5. Communicate effectively using visual, symbolic and/or language skills in various modes.
6. Use science and technology effectively and critically showing responsibility towards environments and the health of others.
7. Demonstrate an understanding of the world as a set of related systems by recognizing that problem solving contexts do not exist in isolation. (DOE, NCS, 2003: 2-3)

In order to develop any learner to his/her full potential it must be the intention underlying any program of learning to make an individual aware of the importance of:

1. Reflecting on and exploring a variety of strategies to learn more effectively.
2. Participating as a responsible citizen in the life of local, national and global communities.
3. Being culturally and aesthetically sensitive across a range of social contexts.
4. Exploring education and career opportunities.
5. Developing entrepreneurial opportunities. (DOE, NCS, 2003: 2-3)

Despite the Department of National Education implementing the new curriculum, often the refrain from learners is heard: "Mathematics is boring and I cannot relate to the subject. What value will I gain from doing the subject?"

Learners, parents and politicians realize that Mathematics or Mathematics Literacy forms the cornerstone of most fields of study. Finding a link between mathematics curriculum topics and everyday social activities, this powerful cornerstone becomes an open-ended challenge.

It is a common phenomenon that if one is interested in a related topic one would excel or at least achieve in this particular topic. By introducing relevant topics for Mathematics and Mathematical literacy in grades eight, nine and ten an interest in mathematical empowerment could be kindled amongst learners.

1.1 Motivation

In my experience as mathematics educator over 20 years in socially economic deprived communities, the researcher seldom encountered more than 5% of a class of 40 average interested in mathematics. This is not statistically substantiated but a tendency which the researcher picked up over the years.

As educators in socially disadvantaged communities, we often walk the extra mile in terms of preparation and teaching. Often the end product in terms of pass rates does not reflect this positively when compared to economically well-established schools. The question that arises is: Does good planning or suitably qualified educators enhance good results?

Educationists have different views on how learners learn. Despite these views, our main focus should always be on the question of what effective and quality learning is. Teaching big classes, minimal dialogue and an approach where the educator is viewed as the only transmitter of knowledge and final authority is still predominant. From my experience, learners make their own interpretations and are selective on what or when they internalize knowledge. Active learners create knowledge as they encounter and engage with it.

From the researchers' teaching experience it is evident that learners have a perspective about mathematics and educators have a different perspective about teaching mathematics. In most cases the mathematics are driven by a syllabi or textbooks. It would be a mathematical curriculum breakthrough if educators could have insight into the learners' world of mathematics interpretation and interest.

Niss (1985:25-28) indicated that the problems in mathematics instruction gave rise to the demands of relevance. Relevance was interpreted by those involved as applicability (his emphasis) ranging from specific sectors and societal professions to school subjects and students' daily lives. The important point noted by Niss is the fact that from the "new Math" movement a few proponents were convinced that mathematics would be a powerful tool for understanding extra-mathematical problems because the fundamental structures of mathematics do not really provide a structural framework enabling people to analyze constructed situations. Swetz (1991:137) is in accordance with Niss when he calls for a curriculum also providing learners with skills to "apply the process of mathematical modeling to real-world problems" (p 137).

In South Africa, the Numeracy and Mathematics Committee of the National Department of Education defined mathematics as "The construction of knowledge that deals with qualitative and quantitative relationships of space and time. It is a human activity that deals with patterns, problem solving, logical thinking etc in an attempt to understand the world and make use of that understanding. This understanding is expressed, developed and contested through language, symbols and social interaction" (DOE 1996:6). The Task Team for the Review and Modernization (RAM) of Further Education and Training adds to this definition by including in their rationale for learning of mathematics in the Further Education and Training band the following: "…Problems of the real world are translated into variables and relevant operations for which solutions are found. These solutions are then translated into physical entities and tested in the real world" (RAM 2000:5).

Taken the above in consideration mathematics learning could be enhanced if from time to time learning experiences in the school situation are not separated from learners' interest.

1.2 Research Question

The main research question of this study is: What are learners' motivations for the contexts they prefer to deal with in mathematical literacy?

Mathematics is integrated and embedded in the learners' daily life and interests. It is important for learners to want the mathematics they are dealing with to relate to and be linked to their interest and concerns. The study concentrated on what these interests and concerns are.

Additional to the above statement, parents, educators and politicians want school mathematics to deal with:

(a) Mathematics as a discipline and heritage of humanity.

(b) Uses of mathematics in a variety of situations outside of mathematics.

(c) Making learners high achievers to enter high-status professions.

(d) Making learners productive and useful citizens.

In general, I would state that learners' idea of relevance is "How is the issue that I am dealing with or exposed to of interest to my life?"

1.3 Organization of the study

This study is organized into five chapters.

Chapter 1 deals with the introduction and background behind the study.

Chapter 2 discusses the literature review of Mathematical literacy, mathematics relevance and mathematical modeling integrated with my research topic of learners' motivations for preferred contexts in Mathematical Literacy.

Chapter 3 focuses on the research methodology for data collection and data presentation and analysis.

Chapter 4 deals with the research findings.

Chapter 5 focuses on discussion of the study against the literature, conclusion of the study and some recommendations based on the findings of the study.

CHAPTER TWO

LITERATURE REVIEW

Introduction

This study deals with the concepts of relevance of school mathematics, mathematical literacy and mathematical modelling. These constructs were selected since they are primarily the domains where the use of contexts in mathematics comes to the fore.
The theoretical constructs are discussed under the following headings:

- Relevance of School Mathematics
- Mathematical literacy
- Mathematical modelling
- The use of these concepts in this study.

2.1 Relevance of school Mathematics

Many mathematical phenomena are difficult to define but I will attempt to define relevance via my own interpretations and readings. In the identification of relevance of school mathematics, the question arises to where does perception end and cognition begin. On what basis do we decide that a mathematics topic is no longer relevant and must be seen as irrelevant to school mathematics? Another question that begs an answer is who decides what type of mathematics is relevant and for how long it remains relevant. These are some of the important questions that a mathematics practitioner needs to investigate if he/she wants to have a good understanding of the relevance of mathematics.

Mathematics is regarded by government, industry, business, parent, educators and learners as one of the most important subjects in school. Yet, there exists a lack of consensus amongst these stakeholders regarding a number of issues related to the curriculum, for example the content of the curriculum to be taught, how the content should be treated and what the overall purpose of the curriculum must be. Most stakeholders express a genuine concern about the relevance of school mathematics, but also find it very difficult to effectively articulate what their understanding of it implies. This was further emphasise by our class meeting discussions where researchers grappled with the notion of relevance in mathematics education.

The Collins English dictionary (1992:985) describes the word relevance as "having direct bearing on the matter at hand, pertinent." Hence, in terms of this description, relevant school mathematics would mean that a particular sector needs to have a bearing on the mathematics taught at school. Whatever the interpretation, it is clear that curriculum planning must take into account the issue of relevance.

It taken into account the final outcomes of the study of mathematics based on learners' long-term needs of mathematics. Mathematics is needed to govern one's personal affairs and many vocations require the application of mathematics. The De Lange Commission's foundational assumption was that education policies be directly linked to economic development, and that such policies should be accountable in terms of 'relevance' (Kallaway 1984:33). In this regard, restoring the harmony between the schooling system and the labour market became a principal aim.

The De Lange Commission pleads for social stability that can be achieved if the academic-centered curriculum approach been substituted by a vocational focus that would produce an employable and compliant workforce.

The former state's reformism as embodied in the De Lange Commission's recommendations represents an attempt to relate education to the twin challenges of installing the necessary conditions for economic growth and securing and maintaining political stability (Unterhalter 1991:63-65). In order to be in a position to more effectively achieve the alignment of education with the economy and the depoliticisation of education, the report suggests that macro education policy-making be unified under a single ministry (Van den Berg 1981:13). The lack of sufficient skilled labour was presented as at the core of the economic crises. This led the De Lange Commission to suggest that education reform should be linked with the need to generate an educated workforce, which in turn would secure higher levels of productivity and consequently economic growth (Kallaway 1984:33).

It is the researcher's perspective that relevancy from the perspective of curriculum planners, politicians and educators is governed by the needs of the labour market.

The curriculum should also focus on mathematics literacy in an attempt to increase the level of mathematical knowledge needed to comprehend and interpret events mathematically in the world. The casual reading of newspapers and periodicals reveals much mathematics that is part of current issues and general news. Many aspects of good consumer awareness also require a fairly good knowledge and understanding of mathematics.

The idea that a good pass in mathematics opens doors for learners is one of the main driving and motivational forces for parents and learners choosing to do mathematics. Relevance of school mathematics is to a certain extent limited to two notions: Firstly, to follow the prescribed curriculum and secondly, to pass the subject well with the idea it will open opportunities.

The Minister of Education for the Western Cape, C. Dugmore, at a ceremony addressing 200 top matriculants in 2005, states the relevance or appropriateness of mathematics as follows:

> Government's position pertaining relevancy is to increase the number of learners to take mathematics on the Higher Grade in order to live with the increasing demands of our increasingly globalised economy and technological nature of society. Proficiency in numeracy and mathematics forms the basis of many of our further education and training fields in science, technology, engineering, business and accountancy.

Thus it appears that the relevance of mathematics as propagated by the government in most cases is linked to the enhancement and growth of the economy of the country. The general notion is if there are more skilled people in the fields where mathematics plays a crucial role, the economy will grow or become stronger.

2.2 Mathematical Literacy

Mathematical literacy is defined in various ways by different mathematics educationists. In essence all of them come to a sense of agreement that mathematical literacy cannot be

defined in terms of mathematical knowledge. Mathematical literacy entails the individual's competencies in using mathematical knowledge in a practical and functional way.

Many mathematics educationists define mathematical literacy as multidimensional (Cooper 1991; Romberg 2001; Steen 1991; Steen 1990; Usiskin 1997; Hawkins 1990; Ball & Stacey 2001). To a certain extent they differ in their definitions according to their different countries' needs and demands but there is more overlap than differences. The researcher would concentrate on the discussion by Kees Hoogland of Eva Jablonka's work from Freie Universität Berlin. Hoogland states that he personally prefers the definition of Jeff Evans given in the book entitled 'Adults' Mathematical Thinking and Emotion, a definition that revolves very much around the individual. "Numeracy is the ability to process, interpret and communicate numerical, quantitative, spatial, statistical, even mathematical information, in ways that are appropriate for a variety of contexts, and that will enable a typical member of the culture or subculture to participate effectively in activities that they value" (Evans, 2000).

Jablonka (2003:75-102) is of opinion that Numeracy refers to the numerical nature of mathematics whereas mathematical literacy entails a broader approach of mathematics with the understanding that the target audience is a group of individuals with a sound educational background. Steen (1990:1) regards Numeracy as important for a nation expecting to compete in the global economy fuelled by information technology. Furthermore, Steen posits that Numeracy is a mathematical skill that enables an individual to cope with the practical demands of everyday life.

Pugalee (1996:19-22) states that: "Both in the United States and abroad, the task of creating a coherent vision of what it means to be a mathematical literate has not been sufficiently

realised." Pugalee proposed that a basic model of mathematical literacy should include the following five processes through which learners obtain and use their mathematical knowledge:

- valuing mathematics
- becoming confident in one's ability to do mathematics
- becoming problem solvers
- communication mathematically
- reasoning mathematically.

Both Evans and Jablonka's (2003:75-102) interpretation link up with my research topic on the participation of learners in activities that they value. This view also links up with a South African context and my research topic where learners have to motivate and value their preferred contexts in mathematical literacy.

Global demands and transformation in mathematics education system addressing inequalities compelled South African curriculum developers to look at achieving a level of mathematical literacy. By introducing a curriculum of mathematical literacy, learners should have access to the international arena to pursue studies in mathematics or simply lift their levels of mathematical literacy to the same level as the international mathematics literacy market.

2.3 Realistic mathematics education

In order to promote mathematical literacy, Realistic Mathematics Education (RME) was developed in the Netherlands. The main focus of this group of mathematics educationists was to use mathematics in contexts. These contexts could be either the real world situations or the

imaginary world. This mathematics model was predominantly spearheaded by Freudenthal, et al (1973-1979).

Like Jablonka's view (2003:75-102), Freudenthal posits mathematics as a human activity which is relevant to society and has human value. RME focuses on problem solving in realistic contexts where learners develop strategies closely linked to the contexts. This mathematics model in a similar fashion like mathematics literacy creates the opportunity for learners not to merely receive ready-made mathematics but also actively participate in the learning process and socialize mathematically.

Furthermore Jablonka classifies different approaches to mathematical literacy into five categories. The approach will be directly linked with the goals of this research study. She categorizes the following approaches:

Mathematical literacy for developing human capital

Mathematical literacy for social change

Mathematical literacy for environmental awareness

Mathematical literacy for evaluating mathematics

Mathematical literacy for cultural identity.

I identify elements of my research topic in these categories of Jablonka. Learners have to motivate their preferred contexts in mathematical literacy.

By integrating these elements of mathematical literacy, the researcher wishes to pursue and investigate whether learners understand the mathematical aspects of everyday real life situations and make informed judgments.

2.4 Mathematical literacy in a South African Context

The current Revised National Curriculum Statement (RNCS) as implemented by the Department of Education in 2000 promotes literacy in mathematics in GET band. Furthermore, the RNCS substantiates their aim "Being literate in mathematics' is an essential requirement for the development of the responsible citizen, the contributing worker and the self-managing person. Being mathematically literate implies an awareness of the manner in which mathematics is used to format society and enables astuteness in the user of the products of mathematics such as hire purchase agreements and mathematical arguments in the media. Hence, the inclusion of mathematical literacy as a fundamental requirement in the RNCS curriculum" (RNCS, 2002:48).

2.5 Mathematical Modelling

Learning mathematics can be regarded as a continuous process. Applying mathematical skills, in a given scenario, requires what has been learnt in mathematics whilst mathematising requires discussion, rethinking and different explorations and investigations leading to the best possible solutions.

The researcher is of the opinion that mathematics educators realise that learning to apply mathematics is a very different activity form learning mathematics. Applying mathematics and mathematising requires a completely different skill than learning mathematics to execute procedures, reproduce mathematical concepts and producing mathematical proofs.

Mathematics modelling has several definitions. In essence the mathematics practitioners/modellers have to deal with a variety of real world problems and try to translate each problem into a mathematical form. This is to simplistic for modelling requires not just mathematical expertise, statistics or computer literacy. Additional skills, together with the following qualities are essential: clear thinking, a logical approach, a good feeling for data, an ability to communicate and lots of enthusiasm.

Many educationists lobby for the inclusion of mathematical modelling in the school mathematics curriculum. Various reasons are given for this inclusion. Blum and Niss (1991:85) identified five reasons why modelling and applications should be included in the school curriculum. The reasons are:

- Formative
- Critical experience
- Utility
- The picture of mathematics and
- Promoting mathematics learning.

In consideration of my research question the contexts learners have would like to deal with in mathematics, I can see a direct link between Blum and Niss' reasons. The research question is embedded in the "critical" and "utility" rationales above.

Usiskin (1991:123) also supports mathematical modelling when he states that incorporating mathematical modelling in mathematics teaching strongly relate to:

a) foster creative problem solving, attitudes, activities and competence generate a critical potential towards the use of mathematics in an applied context;
b) contribute to a balanced picture of mathematics; and
c) to assist in acquiring and understanding mathematical concepts.

According to Abrantes [as cited by Blum and Niss (1991)], working with mathematical modelling is considered a necessary way to develop appreciation of mathematics, understanding of its role in society and competence, confidence and a sense of criticism about its use.

Lately several South African curriculum documents propose the inclusion of mathematical modelling in the curriculum. In the document on the curriculum (Department of Education, 1997:3) phrases such as "Interpretation of Models", "Constitution of Models" and "Representation of real-life and simulated situations" is an indication towards the inclusion of mathematical modelling and applications in the school curriculum (Julie, 1997). The most recent policy document on the NCS for mathematics and mathematical literacy states that mathematical modelling in the FET-phase [grades 10 – 12] be included. The RNCS (2002: 9) states the following about mathematics modelling:

> Mathematical modelling provides learners with a powerful and versatile means of mathematically analysing and describing their world. Mathematical modelling involves identifying and selecting relevant features of real-world situations, representing those features in mathematical representations, quantitatively and qualitatively analysing the model and the characteristics of the situation, and considers the accuracy and limitations of the mathematical model. Mathematical

modelling allows learners to deepen their understanding of mathematics while expanding their repertoire of mathematical tools for solving real-world problems.

2.6 Summary and Conclusion

In this chapter, I discussed the relevance of mathematics, mathematics literacy and mathematics modeling. All three of the above mentioned concepts attempt to solve "real" world problems by applying mathematics knowledge to connect to the "real" world.

These three concepts relevance of mathematics, mathematics literacy and mathematical modelling are integrated since they are the domains where the use of contexts comes to the fore most prominently. It also links up directly with my research question: What are learners' motivations for the contexts they prefer to deal with in mathematical literacy?

In the next chapter, the research methodology is explained. Reasons are stated why a questionnaire format was used and describes the sample and research instrument used for this study.

CHAPTER 3

RESEARCH METHODOLOGY

Introduction

In this chapter the methodology and design of this research are documented by discussing the different paradigms and ascertaining the most appropriate methods which would provide the answers posed by the research question. The different kinds of methods for the research, the conditions or context under which the methods are employed for different kinds of data collection and they advantages are discussed.

3.1 The survey

For the purposes of this study, the researcher regard survey research as a procedure where variables are studied using a counting procedure in a systematic fashion to determine mathematics and other relevant variables.

There have been several calls for the British mathematics curriculum to be made more meaningful and relevant to young people's everyday lives. (Cockroft Report, 1982; Ling, 1987.) Similarly in a South African mathematics education context, there is an outcry to research and teach relevant topics that young people are interested in.

The ROSME project addresses this aspect of research. By means of a questionnaire survey, 1177 learners between the ages of 14 and 16 were surveyed on the context they would prefer to deal with in mathematics. For the purposes of the survey, schools of predominantly lower socio-economic status were targeted. The survey deals with data from urban, peri-urban and

suburban schools in the greater Western Cape. Both boys and girls learners were interviewed via the medium of English, Afrikaans and Isixhosa.

In particular a survey-questionnaire instrument was used since a large sample was targeted. Learners could also answer the questionnaire in a relaxed atmosphere with no mathematics anxiety phobia of: whether their answers are mathematically correct of incorrect? Furthermore, the questionnaire instrument was conductor friendly – even by educators with no mathematics background. A particular weakness with this study is that it does not address the mathematical interests of affluent young people attending socially advantaged schools. Another weakness of the research is that it has an absence of a follow-up survey of learners to determine whether the learners have declared their mathematical interests for which they really have an interest in.

A researcher should not draw conclusions based on the analysis of the learners of only one questionnaire. Comparisons need to be made between learners of the two types of education in South Africa. The term comparison should be stressed since survey research done on a single group often leads to conclusions about cause-and-effect relationships that lack validity.

Thaw (1967: 319) makes the following observations regarding survey research in general:

The errors and inadequacies of survey research in education appear at many points from the way problems are initially chosen and defined to the choice of the subject population, the selection of the sample, the design of the individual questions and the questionnaire as a whole, and the analysis of the resulting body of data.

Nonetheless if constructed properly and employed within a proper design, questionnaire and interview approaches can be used to great advantage.

Survey research can be regarded as simplistic, yet it can also be regarded as a useful technique in education. The value of the survey as a means of gathering data is not to be denied.

3.2 Instrumentation

The study of the relevance of mathematics in a South African context as experienced by learners, was inspired by the Science and Scientists project (Sjøberg, 2002) and its successor, the Relevance of Science Education project (Schreiner & Sjøberg, 2004). The instrument was developed by mathematics educators from South Africa, Zimbabwe, Uganda, Eritrea, Norway and a group of South African educators. In January 2003, when the project was initiated, it was named Relevance of School Mathematics Education – this was later abbreviated to ROSME. For the purposes of the rest of this study I will refer to the project as the ROSME project.

3.2.1 Contextual setting of ROSME in a South African context

When the project was launched, a group of masters' and doctorate mathematics education students, together with mathematics educators, identified clusters of contextual issues which they thought would be relevant within the South African context. The group was fortunate to have the input of a Ugandan doctoral student and the input of an Eritrean masters student. Thus cluster contributions were not merely a South African context but it had an African context. Furthermore, the project was guided by two mathematics lecturers of the University

of the Western Cape, professor C Julie and doctor M Mbekwa. Preliminary work for ROSME project was already done by these two academics in the latter half of 2002.

After much debate and discussions the group identified the following clusters as possibly relevant and interesting to learners in the age group 14 to 16: Mathematics, Mathematics' Practices, Health, Physical Science, Crime, Sport, Youth Culture, Politics and Agriculture.

3.2.2 Questionnaire

After the ROSME group identified the above clusters the opportunity was given to the learners to voice their interests embedded in mathematics topics. Group members each took two clusters as topics and tried to ascertain by means of interviews what the interest of learners are towards specific clusters. This data was brainstormed amongst masters and doctoral students at another session in 2003. After the conditional input of learners on different clusters the group could start off with refining a questionnaire. The final questionnaire was finalized after 3 attempts. The issue of using descriptors from 1 to 4 for not all interested, a bit interested, quite interested, very interested was also discussed at length to make it user friendly.

It needs to be mentioned that extreme caution was taken semantically. In finalizing the final questionnaire, the group took into consideration that learners come from socially disadvantaged communities. Some of their reading skills might have been at a level where they could not understand instructions clearly. Therefore the idea developed to make the questionnaire learner-reader friendly and not to frighten learners when they encounter the word mathematics. In essence learners could indicate their interest and preferences for contexts to be used in mathematics in a user-friendly questionnaire. (See appendices A, B, C

indicating how the questionnaire developed from the beginning stage until the final questionnaire.) To make the questionnaire even more learner friendly, words like "me", "my" and "person" were used in order to reel learners in and create an atmosphere of "I can" in order to identify with the statement under discussion. Furthermore a major advantage of the final questionnaire is the fact that it caters for no mathematical right or wrong answer – thus encouraging learners to complete the questionnaire in a conducive atmosphere.

Additional to the 61 questions posed to learners and interpreted as quantitative data, further questions were posed in which learners were required to indicate 3 issues they were very interested in learning about the use of mathematics in these issues. Also does the questionnaire pose additional questions about mathematics integration with other school subjects, the media and drawings of a mathematician at work. This data calls for a qualitative approach which the researcher will make use of in order to address under the section of sampling and data selection. Appendices A, B and C present these data.

3.2.3 Administration of the Questionnaire

The questionnaire was administered by the master's and doctoral students involved in the project and teachers in other schools. During administration the following points were taken in consideration and explained to respondents:

- The purpose of the study: Learners were anxious to know what the data are to be used for to satisfy their intellectual curiosity and negate any doubts that participation in the survey will threaten their privacy or reputation.
- The protection afforded the respondent: Learners were informed how their privacy and confidentiality will be treated.

- Endorsement of the study: Because learners will be more secure if they know that recognized institutions are behind the study a letter from the University of the Western Cape was submitted to each participating school.
- Legitimacy of the researcher: The researcher identified himself and his position as researcher.
- Opportunities for debriefing: That learners can obtain the results of the study or its purpose at some later date they were informed likewise.
- Request for cooperation: The questionnaire constitutes an appeal from the researcher for the learner's help.
- Special instructions: The questionnaire was self-administering. Learners were also cautioned against omissions.

3.2.4 Additional instruments used in order to collect data

3.2.4.1 Interviews

Arksey and Knight (1999:152) state that interviewing is a powerful way of helping to make explicit things that have hitherto been implicit – to articulate tacit perceptions, feelings and understandings. Cohen and Merriam (1997:38) point out that the interview can serve a number of distinct purposes. Firstly, it can be used as the means of gathering information about a person's knowledge, values, preferences and attitudes. Secondly, it can be used to test out a hypothesis or to identify variables and their relationships. Thirdly, it can be used in conjunction with other research techniques.

Gray (2004:47) argues that semi-structured interviews allow the researcher to probe for more detailed responses where the respondent is asked to clarify what they have said. Responses have been documented by note taking from tape recordings of the interviews.

3.2.4.2 Tape Recorder

Tape recordings were done during various interviews. The use of a tape recorder permits the interviewer to concentrate on the process of listening, interpreting and re-focusing the interview. Permission to conduct and record the interview was obtained from the respondents. Respondents were also informed of their right to turn off the tape recorder at any time should they wish do so. Arksey and Knight (1999:163) claim that validity of semi-structured interviews can be strengthened by:

- Using interview techniques that build rapport and trust; thus giving informants the scope to express themselves.
- Prompting informants to illustrate and expand on their initial responses.
- Construction interviewing schedules that contain questions drawn from the literature and from pilot work with respondents.

Accurate transcriptions of the tape recordings were done by the researcher.

3.2.4.3 Field notes

When making field notes the researcher will focus on certain events. Babbie (1983:63) lists six of these events (a) acts (b) activities (c) meanings (d) participation (e) relationships (f) settings.

While having the interviews the researcher kept notes on what he observed, what he thought he observed and the responses or possible responses of the learners. It is important that the researcher record what he/she considers as relevant and important to his/her research.

According to Hopkins (1989:23) keeping field notes have the following advantages. It:

- provides good ongoing record; used as a diary they give good continuity.
- provides first hand information which can be studied in the educators own time.
- acts as an aide memoir.
- helps to relate incidents, explore emerging trends.
- is very useful if the educator intends to write a case study.

Field notes as a single instrument could usually do injustice to a research project. In order to avoid this the author supplemented this instrument with tape recordings, interviews and the primary instrument, the questionnaire.

3.3 Sampling and Sample

The learners involved in the survey were from socially disadvantaged communities in urban and peri-urban areas in the Western Cape. Many of these learners, educators and parents are faced on a regular basis on what issues learners are very interested in and the use of mathematics in dealing with contexts that they prefer.

The sample consisted of 120 learners, all taken from a bigger sample of 1177, which represents all the schools in the survey. Learners from grade eight to ten were participated. The sample consisted of learners who had English, Afrikaans and Isixhosa as primary language.

Approximately ten percent of the participants of the entire cohort of 1177 were randomly selected for this study. The sample was stratified in terms of gender and school grades. The demographic data appears in Tables 3.3.1 and 3.3.2 below.

Grade	Number	Percentage
8	260	22,1
9	526	44,7
10	391	33,2
Total	1177	100,0

Table 3.3.1: Spread of respondents for the entire cohort.

Gender	Number	Percentage
Girl	627	53,3
Boy	550	46,7
Total	1177	100,0

Table 3.3.2: Spread of respondent's gender for the entire cohort.

Grade	Number of respondents	Percentage of respondents
8	27	22,5
9	53	44,1
10	40	33,3
Total	120	100,0

Table 3.3.3: Spread of sample of respondents used to determine their interest in context to be used mathematics.

Hitchcock and Hughes (1995:78) state that random selection would not necessarily provide a balance between girls and boys and emphasize that this element should be carefully considered. This study therefore relied on stratified sampling in terms of gender and grade level of the learners. Literature reveals that there is no clear-cut answer for the correct sample size but it can be dictated by the purpose and the nature of the research.

3.4 Analysis techniques / Rationale

This research deals with the motivations learners offer for contexts they would like to deal with in mathematics. These reasons were free responses and thus qualitative analysis techniques were employed.

Qualitative research implies an understanding of the meaning of many realities that can be constructed socially. The researcher is concerned with perceiving the meaning that the participants create from their experience of the world. Mason (2002:3) describes qualitative research as concerned with how the world is interpreted, understood, experienced, produced or constituted.

Patton (cited in Merriam, 2001:491) argues that in qualitative research, researchers seek to describe and explain the world as those in the world experience it. Communicating the meaning made from the participants' perspective therefore is a crucial component of qualitative research (Merriam 2001:496).

Specific qualitative methods are used to enable the researcher to gain direct access to the reality of the learners, as this is not information that is readily available to outsiders. The aim is to explore the understandings, processes of reasoning and the social norms that participants live by (Mason, 2002:86).

A common element underlying any qualitative research is that the data are collected in as natural a setting as possible (Silverman, 1993:52-63). In order to preserve the uniqueness of the context and the interactions that take place within it, disturbance to the natural setting in qualitative research is limited. The primary aim of the research is to create and report a full understanding of the situation. The engagement of the researcher with the participants varies from complete involvement to mere observation. Mason (2002:97) stresses that "your chosen method will have an influence on you setting and the interaction within it, jus as your presence does."

Qualitative research is frequently considered useful as a means of gaining in depth insights, as a follow up to a quantitative study. The research was a follow up to the quantitative research conducted by the Masters-students group at the University of the Western Cape in 2004.

3.5 Data analysis and interpretation

Once data have been collected the next step will be to make meaning of the data. Gray (2004:53) states that analysis involves the process of breaking data into smaller units to reveal their characteristic elements and structure. Through the process of analysis we want to interpret, understand and explain data. McMillan and Schumacher (1993:86) describe a list of general principles and practices for qualitative analysis:

1. Analysis begins as soon as the first set of data is gathered and runs parallel to data collection because each activity informs and drives the other activities.
2. Data analysis proceeds in a relatively orderly manner and requires self-discipline, an organised mind and perseverance.
3. Attending to data is a reflective activity that usually produces a set of analytical notes or memos that guide the process.
4. Data are segmented, that is divided into relevant parts and chunks of meaning, within a holistic perspective.
5. Data segments are categorized according to an organizing system of topics predominantly derived from data themselves.

The main intellectual tool of analyses is comparison. This includes being able to identify data segments, naming a topic/category and grouping each data segment into a topical

category. The aim is to identify similarities and differences in the responses of the learners. Marshall and Rossman (1995:83) maintain that qualitative data analysis is a search for general statements about relationships among categories of data. Gray (2004:56) identifies content analysis as one of the most common approaches to analysing qualitative data. This involves the making of inferences about data by systematically and objectively identifying special characteristics within them. In the case of this study the phenomena was the interests of grade 8 to 10 learners embedded in mathematics.

The recorded interviews are transcribed by the researcher in order to identify differences and commonalities in the responses offered by the participants. May (1993:127) points out that transcribing the open-ended replies associated with semi-structured interviews is helpful for developing a familiarity with the data. This process requires a need for discipline, analytical focus, selection and simplifying the responses of the participants. The data collected during the interviews were then analysed and are clustered according to the responses of interviewees to each of the interviews questioning.

Having analysed the patterns and commodities the researcher compared the responses of the study to current research tends with a view to drawing conclusions.

3.6 Ensuring validity and reliability

Invalidity is a pitfall that must be avoided at all cost during the process of research. Internal validity refers to the degree to which the explanations of phenomena match the realities. It is the degree to which the interpretations and concepts have mutual meanings between the participants and researcher (McMillan and Schumacher, 1993:92). Threats to external validity for a qualitative study are those that limit its usefulness: comparability and

translatability (McMillan and Schumacher, 1993:103). Comparability is the degree to which the research design is adequately described so that researchers may use the study to extend the findings to other studies.

Reliability is the extent to which independent researchers could discover the same phenomena and to which there is agreement on the description of the phenomena between the researcher and participants. Bogdan and Biklen (1992:37) regard reliability as a fit between what researchers record as data and what actually occurs in the natural setting that is being research, ie a degree of accuracy and comprehension of coverage.

The aim of the researcher has been to ensure the validity of this study by reflective n the research. O' Connel, Davidson and Layder (1994:112) contend that the researcher should continually monitor his/her assumptions throughout the research process. They claim it will result in better research and has the potential to pre-empt and so reduce bias and distortion.

3.7 Ethical Considerations

The researcher is solely responsible to uphold research ethics. Since the researcher was welcomed in the personal space of the research participants, it was imperative that the researcher promised total anonymity and confidentiality. Generally, the ethical guidelines specified by Babbie and Mouton (2001:58) as well as Bak (2002:89) were followed. Names of schools and interviewees will not be used in the study. Participants were informed that they were at liberty to verify the data collected and that they were free to terminate participation in any of the activities should they require to do so.

3.8 Data analysis

The analysis will be presented in two sections, one dealing with the responses of learners to the interview questions, second with the responses to the questionnaires. Literature reveals that there is no definite or best way of analyses, but that the process will depend on nature and aim of the research. Miles and Huberman (1994) suggest that the researcher should be asking the following questions when researching responses:

- What patterns and common themes emerge in the responses?
- Are there any deviations from these patterns?
- What interesting stories emerge from the responses?
- Do any of these patterns or findings suggest that additional data need to be collected?
- Do the patterns that emerge corroborate the findings of any corresponding qualitative analyses that have been conducted?

The process of analysis for this study aimed identifying similarities and special characteristics in the responses of learners with regard to their interests in mathematics and their motivations for these preferences. The section that follows deals with the interview data.

3.9 INTERVIEWS

3.9.1 Interviews – Transcripts of recordings of learners' interests on topics linked with mathematics

Semi-structured interviews were conducted with 8 learners. The 8 grade 8 learners comprised of 4 boys and 4 girls to ensure that the study represent gender representation. Interviews were conducted in a relaxed atmosphere in a vacant classroom. The learners were

chosen randomly. Learners were isolated from the rest of the class and had no contact with other respondents.

The researcher explained the aim and the significance of the research to the respondents. The intention of the interview was to allow the researcher to probe for detailed responses in what mathematics topics interest learners. Each respondent was assigned with a questionnaire and interviewed according to their responses on the questionnaire. Each interview lasted for approximately 10 minutes to ensure minimum disruption of teaching time. Data collected during the interviews were analysed and are clustered according to the responses of respondents to each of the interviews questions.

3.9.2 Hiccups during interviews

The availability of soundproof extra classrooms for interviews was a constraint. The researcher experienced a high internal interference of the tape recorder while recording. Some respondents spoke inaudibly and respondents had to be re-recorded.

3.10 Summary

In this chapter the research methodology, data collection, sampling and analysis techniques were presented.

The researcher is of the opinion that the chosen approach was the most appropriate to achieve the aims of the study to gain an understanding of the learners motivations for contexts they would find interesting to deal with in mathematics.

CHAPTER 4

RESEARCH FINDINGS AND DISCUSSIONS

Introduction

This chapter contains the research findings related to the contexts that mathematics learners from disadvantaged schools in the Western Cape would like to deal with. For the purpose of this discussion, schools will just be referred to as schools to ensure that they remain anonymous. Data collection mostly followed a quantitative approach as outlined in Chapter 3, although for the latter part of the questionnaire the data were qualitative. I concentrated specifically on this qualitative data in determining the motivations learners provided for contexts they would find interesting.

The process of analysis for this study aims to identify similarities and special characteristics in the responses of learners with regard to contexts to which they most definitely wanted to deal with in mathematics and their motivations for these preferences. The section that follows deals with the interview data.

4.1 Findings emanating from the analysis of the interviews

Learners were asked to motivate why they were interested to learn about why mathematicians disagree on problemsolving. Their responses are given in table 4.1.1 below.

Learner 1	Want to know in example $3x^2$ why the put the 2 on top and not at the bottom of the x.
Learner 2	I didn't know mathematicians disagree.
Learner 3	Mathematicians come with different conclusions and the compare answers. Want to know how they debate about their different conclusions.
Learner 4	One person is writing what the other person isn't; wants to find out which one is the right one.
Learner 5	There can't be two right answers; if they disagree then it means there are (mathematicians who give) wrong answers.
Learner 6	We disagree – what if they disagree, I can learn form their disagreements.

Table 4.1.1: Learners' motivations for their interest in disagreements amongst mathematicians

The motivations of the six learners can be classified into three categories. Firstly, there is a curiosity category (Learner 1, 2, 3 and 4). This curiosity deals with notation and how mathematical notational forms are developed. Learners 2, 3 and 4 are curious but their curiosity has more to do with the kind of discussions mathematicians engage and how they negotiate and convince one another about the correctness of mathematics.

The motivation given by learner 5 is somewhat different. She/he is more assertive about the existence of a single correct answer and essentially expresses a belief that there cannot be disagreements and thus seemingly has an interest in this aspect of mathematical practice to resolve this personal dilemma. Learner 6, on the other hand accepts that there can be disagreements. He/she attaches it personally and sees it as an opportunity to learn.

On the question of why learners are interested in the work mathematicians do, their responses are given in the table 4.1.2.

Learner 1	I'm not a bright student, so I want to know more about the work they do (could learn from that).
Learner 2	I want to work in the medical field. I know it involves a lot of mathematics, so I need to know (how mathematicians do their work).
Learner 3	I need to know how mathematicians do things so that I can learn from them.
Learner 4	Because I can choose from that – what I want to do.

Table 4.1.2: Learners' motivations for their interest in the work that mathematicians do

The four motivations can be classified into 3 categories. Firstly, there is a curiosity but definite interest category regarding work that mathematicians do (Learners 1 and 4). These learners are uncertain but have the notion that mathematicians are "bright" and knowledge about this can guide them regarding a career. Learner 3 also has an uncertainty, but definitely wants to know how things are done in order to learn. Learner 2 has a more positive approach and is of the opinion that mathematics will be applied in his/her work, thus he/she does not have uncertainty.

Learners' responses on the question why they are interested to learn about how mathematicians made their discoveries are given in table 4.1.3 below.

Learner 1	I also want to make my own discoveries. If I see something then I want to explain it to myself.
Learner 2	I told my father there is no more mathematics to be discovered. My father believes that there are. (Learning about their discoveries will shed light on the issue.)
Learner 3	It will give me an idea on how they work, and that will assist me (in my mathematics).
Learner 4	Because I can also learn how to make discoveries.
Learner 5	It seems impossible to discover mathematics and I would want to know how they came up with the things we learn today in mathematics.

Table 4.1.3: Learners' motivations for their interest to learn about how mathematicians made their discoveries

The five motivations can be classified into 3 categories of discoveries. Learners 1 and 4 are of the opinion that knowing about mathematical discoveries can lead them to make mathematical discoveries and explain such discoveries mathematically. These learners thus have a personal interest to advance their own mathematical work. Learners 2 and 3 motivate that they are interested in the methods involved in making discoveries. They are more interested in the systematic approach in order to make sense of the discoveries. Learner 5 is completely overwhelmed by the history of mathematics. According to this learner he/she definitely wants to know why "past" mathematics had such a huge impact on the mathematics taught today.

The learners' responses on the personal life stories of mathematicians are given in table 4.1.4 below.

Learner 1	wants to study their mindset
Learner 1	wants to study how they come up with their conclusions.
Learner 1	wants to study how they work out things.
Learner 2	wants to study how they think.
Learner 2	I like mathematics and want to see how it started

Table 4.1.4: Learners' motivations for their interest on the personal life stories of mathematicians.

The five motivations can be classified into 2 categories. Firstly, there is a philosophical interest in the life stories of mathematicians. Both learner 1 and 2 are interested to study the "mindset" of mathematicians. They are fascinated by the life stories of great mathematicians – yet they are also aware that it is difficult to study the "mindset" of people.

Secondly both learner 1 and 2 are interested in real mathematical calculations as they experience it. They have a feeling that past mathematicians "started" their current mathematics.

The data collected from the interviews indicate that learners have a sense of mathematics curiosity. Furthermore they are aware that mathematicians can influence their personal life's and shape their future careers.

4.2 Analysis of learners' written motivations on topics embedded in mathematics

An analysis of learner's motivations based on the questionnaire reveals certain commonalities and trends in respect of contexts that learners identified should be dealt with in mathematics. The motivations, which the learners provided can be divided into six clusters. Some of the

clusters are a direct replication of the items contained in the ROSME questionnaire whilst others resulted from a consideration of what respondents have written.

4.2.1 Study mathematics at higher education institutions

In this cluster there were various subcategories, which are presented together with the statements of the learners in table 4.2.1.

Subcategory	Motivations of learners
Love for and interest in mathematics	It interests me Geniet getalle, syfers en berekeninge Om kennis van wiskunde te verbreed om dit beter te verstaan Want to know more about mathematics Wil moontlik ‘n wiskundige word Hou baie van wiskunde en wil verder daarin leer Wil meer uitvind omtrent wiskunde Very nice, must do geometry Like figuring things out, adding and mathematical terms
Role of mathematics on learners’ lives	Mathematics plays an important role Gebruik wiskundiges as rolmodelle Kan verder kom in lewe met wiskunde
The importance of mathematics for work opportunities	Om beter op Kollege te doen en beter werksgeleenthede Wil professionele wiskundige wees met eie besigheid Want to have knowledge of mathematics, earn lot of money Use mathematics at work

Table 4.2.1: Learners’ motivations to study mathematics at higher education institutions.

From the above motivations it is evident that most learners indicated as preference “doing mathematics at higher education institutions” due to an interest and love for mathematics. This links up with the notion of an interest in mathematics as a discipline as also researched by the TIMSS 2003 study. It indicates that 56% of the grade 8 cohort of South African sample agreed a lot with the statement “I enjoy learning mathematics”. (Mullis, I V S; Martin, M O; Gonzalez, E J and Chrostowski, S J, 2004). In the subcategory role of mathematics on learners’ lives it is heartening to note the motivation “Gebruik wiskundiges

as rolmodelle" [Use mathematicians as role models]. This indicates that mathematicians are held in high esteem and can have an impact on learners' lives. Learners regard mathematics as a vehicle to shape their future. They have the belief that mathematics is important for future careers and work opportunities. This can possibly be a result of the high emphasis placed on mathematics and science for economic growth in the country. The emphasis is supported by the National minister of education, Ms Naledi Pandor, in her budget speech on 19 May 2006. She suggests that in order to give our nation value for this investment universities must develop effective academic development programmes and must promote enrolment in key disciplines of science, engineering, technology and commerce.

4.2.2 Careers that learners' regard mathematics as a prerequisite

From this cluster two subcategories also emerged as tabelled in table 4.2.2

Subcategory	Motivations of Learners
Highly professional careers	Mediese beroep, om siek mense te help Wil professionele wiskundige wees met eie besigheid Wil 'n dokter word of in bankwese werk Want to be a professional, engineer Want to prescribe the correct amount of medicine Like to become a marine biologist or vet Wil vir vlieënier gaan leer Want to be an engineer, want to know how to draw triangles, squares
Artisan and Designer career	Would like to be a mechanic Want to become a clothing designer

Table 4.2.2: Motivations for careers that learners regard mathematics as a prerequisite

Under the cluster of careers learners indicated that mathematics plays an important role as access instrument to high level careers such as medicine or engineering. There is a perception amongst learners that should they excel or perform above average in mathematics their career opportunities will increase. They realise that above average school mathematics

performance would give them access to career opportunities offered by tertiary institutions. More comforting was the idea that some learners considered context relevant to traditional stereotyped careers like mechanics and clothing designers. This is an indication that career-choices are not only for the so-called high-level careers. Other careers are within the interest fields of learners from lower socio-economic backgrounds.

4.2.3 Electronic Technology

Table 4.2.3 illustrates learners' motivations for an interest in electronic technology. Two subcategories namely knowledge and interest as well as decoding transpired from the questionnaires.

Subcategory	Motivations of Learners
Knowledge and interest	Want to know how things work and to do programming on computers Fitting more data on Compact Discs – that is things you do everyday Die stuur van sms, selfone en e-mails
Decoding of data	Cracking codes, combination codes and playstation Know much about computer games: playstation and Television games, secret codes, pin numbers for Auto Teller Machine, very interested in it.

Table 4.2.3: Learners' motivations for interests in electronic technology

From the subcategory knowledge and interest one can sense a need of wanting to obtain knowledge about the workings, and by implication the underlying mechanisms, of electronic gadgetry. This is the realistic world of the learners. As one learner puts it "Fitting more data on Compact Discs – that is things you do everyday". The subcategory decoding of data reveals how much learners are interested in understanding how much codes can actually contribute to their daily leisure activities with computer games and playstations and an everyday activity such as withdrawing from an Auto Teller Machine.

4.2.4 Culture and sport

In the cluster of culture and sport the following two subcategories came up acquire knowledge and love and interest, came through.

Subcategory	Motivations of Learners
Acquire knowledge	Meer uitvind van musiek Want to know more about sport and math skills Interested in soccer and computer games
Love and interest	Like to associate with designer clothes – like to listen to overseas music Hou van dans, musiek, sing en stoor van musiek op Compact Discs Hou van popmusiek Hou van dans, musiek, sing en babas

Table 4.2.4: Learners' motivations for interests in culture and sport

From both subcategories one can deduce that learners have a need to acquire knowledge about sport and culture. It is therefore important to meaningfully understand how mathematics can be applied to sport and culture. The author is of the opinion that learners have the idea that they can apply mathematics to excel in sports. This might uplift their status in their communities or peer groups should they achieve in sport and culture. They are interested in dancing new patterns and are curious to learn about such matters.

4.2.5 Construction and entrepreneurship

Under this cluster construction and entrepreneurship the categories are integrated.

Subcategory	Motivations of Learners
Construction and Entrepreneurship	Want to make computer games – and apply mathematics Maak van rekenaars, opbou van enjins, brue te versterk – wonder hoe mense so vindingryk is Geometry – show how structures and many other things are build Show how structures and many other things are build Learn more games, make money, modifying cars, trains, etc

Table 4.2.5: Learners' motivations for interests in construction and entrepreneurship

In this cluster, direct application of mathematics is important to learners. Learners have a gut feeling that mathematics is applied in construction. They are simply fascinated by the multiple applications of mathematics in real world objects. One learner claims "Maak van rekenaars, opbou van enjins, brue te versterk – wonder hoe mense so vindingryk is." [Construction of computers, constructing engines, reinforce bridges – wonder how people are so innovative]. Perhaps he/she wants to be so innovative and design his/her own computers, engines or bridges. The learner is inspired by former engineers or designers and wants to apply it in his/her life.

The learner, who promotes entrepreneurship via a mathematics motivation, links up with international supply and demand. The learner is aware of daily commodities such as high technology and transport modes. He/she sees this need as a market demand to which mathematics matters and making "more gadgets" would serve his/her economic interest.

4.2.6 Social responsibility towards society

The following two subcategories were identified in this cluster applications of mathematics to invest in human capital and social mobility.

Subcategory	Motivations of Learners
Applications of mathematics to invest in human capital	Mediese beroep om siek mense te help In tye van werkloosheid en armoede – wil wiskunde aanwend om mense te red in tye van nood
Social responsibility	Meer geld te verdien om na ouers om te sien

Table 4.2.6: Learners' motivations for social responsibility towards society

From the first subcategory it is quite interesting to note that learners would like to learn mathematics, which will allow them to play a compassionate role in society. Unlike the general notion by the larger society, which labels mathematics as a cold uncompassionate subject, they believe mathematics can be compassionately applied via their desired careers.

Under the subcategory of social responsibility only one student motivated that he/she wants to earn money to care for his/her mother. Although only one learner motivates this argument The author is of the opinion that he/she represents the dreams of most disadvantaged communities where the research was done. It is quite common in disadvantaged communities that educated children care for their parents financially. This student believes that mathematics in his/her career can fulfill this caring dream.

4.3 Further implications and findings

The researcher believes learners should have an opportunity to see a broad expanse of mathematical applications so that they can find links between their interests and aspirations and their mathematics coursework.

From the motivations provided by learners in this research it is clear that learners have interests in a variety of topics within which they want mathematics to be embedded. Since learners were exposed to a larger set of contexts, many of them could relate these contexts to their interests.

Although there exists a perception amongst educators, learners and broader society that learners want to stop studying after compulsory schooling, the research has shown the contrary. From the qualitative data and the Kendal, W. Mean ranking, I deduce that most learners identified the importance of studying mathematics in higher education institutions.

It could be argued that why would learners who do not usually excel show such a major interest in mathematics. When the questionnaires were completed learners did it under a classroom situation. Thus no parental or educator influence could have influence their interests or motivations. It could not be researched via the questionnaire, but I believe learners were exposed to an environment where society (parents, educators, career opportunities) puts an emphasis on the doors that mathematics open to the labour market and tertiary institutions. Against a socially deprived background most of these learners might not have been exposed to mathematically-based professions in their social or family environment.

Despite the lack of exposure to professionals learners still expressed a high preference for studying mathematics in higher education institution. This indicates that generally learners' perceptions around mathematics remains constant irrespective of socio-economic conditions that could be interpreted as constraints.

The author is of the opinion learners were influenced directly or indirectly by the concept of social mobility. They believe that mathematics can transfer them to a world of wealth and comfort. As one learner puts it "Wants to be a professional mathematician, running my own business". The results of the research could not conclusively demonstrate this but my inference is that learners did not express their interest in mathematics explicitly. What they did express is how an interest in mathematics could be beneficial to social mobility.

4.4 Conclusion

The major finding from the research indicates that learners had a high motivation to study mathematics that will allow them to further their careers at tertiary institutions. Furthermore the research reveals that learners are generally will motivated but some were unable te articulate their motivations and articulate such preferences coherently. Applications of mathematics in the technological world eg manufacturing of Compact Discs, compact games, Auto Teller Machines and cell phones are also high on learners' interests and preferences.

Furthermore learners perceive mathematics as a means to improve performance in sport for example planning defensive formations in terms of numbers/angles running in sport etc. Mathematical knowledge required to write specific patterns in pop-music/rap culture scene is also high on learners' interest.

While such perceptions have resulted in an improved understanding of the interest shown in mathematics literacy and relevance it does not follow that more learners will automatically excel in mathematics as a learning area.

CHAPTER 5

Discussion, limitations and recommendations

The problem

Grade 8 tot 10 learners at selected disadvantaged schools in the Western Cape provided motivations for contexts they would find interesting and would like to deal with in mathematics. The overall research question is: What motivations do grade 8 to 10 learners provide for contexts they prefer to deal with in mathematics? The learners were drawn from similar socio-economic backgrounds.

Findings from the written motivations of learners

It was found that the predominant written motivations for learners' preferences were studying mathematics at tertiary institutions, sport and culture, electronic technology, careers via mathematics, construction and entrepreneurship.

Limitations of this study

It was found that the predominant motivations to do mathematics and mathematically-related careers at higher education institutions, sports and culture, electronic technology, career and construction was not as much related to attitudes to mathematics, as it was related to embedded mathematics as a vehicle to social mobility.

It must be stressed that these results only apply to grade 8 – 10 learners at selected socially disadvantaged schools in the Western Cape. No generalization to other learners and in other demographic areas are claimed.

The results of this study were not controlled by another independent method. It must therefore be admitted that construct validity may be under suspicion.

It is my opinion that there is a disjuncture between the reasons provided for learners' interests in mathematics and their aptitudes and capabilities to actually do mathematics.

The reason for this disjuncture could be twofold. Firstly the focus of the research instrument was on interest and not aptitude or capacity to do mathematics. It is always easy to inflate interest, as this is not measurable, hence it is difficult to distinguish between real interest and proclaimed interest.

The second reason is the fact that mathematics is viewed as a means to an end. Learners are aware that mathematics is regarded as a high status learning area. It can "open doors", provide highly professional careers and lucrative job opportunities. These are what learners aspire to do so that their proclaimed interest in mathematics stems more from their desire to attain social mobility through mathematics than as purely academic interest in mathematics.

An analysis of the association between mathematics as a learning area and the material benefits that one can supposedly gain from it in terms of career opportunities later is a powerful factor in determining interest of learners. This phenomenon has resulted in the fact that even learners with very limited mathematical capabilities insist that they want to do mathematics or that they are interested in mathematics.

5.4 Suggestions and recommendations for future research

Since research was only conducted at previously disadvantaged schools in the Western Cape I would recommend that additional research be done at socially advantaged schools as well in order to obtain a much representative picture of the contexts learners would prefer to deal with in mathematics in South Africa.

Although much emphasis has been put on simple language, learners struggled to express their motivations in written form. I would claim this could be due to a lack of literacy. In this regard I would suggest that mathematics and language educators collaborate in order to integrate language and mathematics literacy. Learners should be able to express and motivate themselves mathematically in a meaningful way.

Since the study revealed that learners have a definite interest for various topics educators should capitalise on this interest. I suggest educators form clusters and tap on learners' interests every two years by means of a questionnaire. These interests can be categorised and integrated in mathematical literacy in order to stimulate the learning area and learners.

5.5 Conclusion

Motivations provided by learners for their mathematical preferences have the potential to make a difference to the teaching of mathematical literacy in South Africa. Thus the motivations of learners' preferences have to be taken in consideration and implemented in classroom practice.

Mathematics literacy is a new learning area and there is a dire need for qualified mathematics educators to teach this learning area. The integration of learners' motivations for preferential

mathematical contexts could improve the quality of mathematical literacy teaching. The necessity for educators to base mathematical literacy on learners' interest for preferred contexts has not yet been grasped by all mathematical literacy educators.

Fortified with the knowledge of learners' motivations for preferred mathematical contexts, educators would be in a position to make informed and responsible decisions, acting as mathematics practitioners in collaboration with their learners.

In conclusion it would be recommended that learners' preferred contexts and interests as motivated by them need to be considered by educators, curriculum planners, business and government if meaningful changes are to be made to promote mathematical literacy. In search of the most appropriate preferences for learners in mathematics, this study wishes to highlight the relationship between interests and contexts.

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Appendix A

KEY FOR EXPLANATION OF CODES	
1.	Not Interested – NI
2.	Slightly Interested – SI
3.	Interested – I
4.	Very Interested – VI

In the questionnaire below you have to make a choice by crossing out the appropriate box for each question. See the example below:

I would like to like to learn more about the mathematics of:	NI	SI	I	VI
computers	1	2	~~3~~	4

I like sports; Soccer most expensive.

I would like to like to learn about the mathematics involved in:	NI	SI	I	VI
the defensive strategies developed by sport coaches	1	2	3	(4)
setting up a knockout sport tournament	1	2	(3)	4
determining fitness levels	1	(2)	3	4

- Soccer tournaments involved.
(1) does not bother me – check out;

I am interested in learning to describe in mathematical format:	NI	SI	I	VI
pop music	1	2	3	(4)
choral music	1	2	3	4
the storing of music on CD's	1	2	3	(4)

~~1111~~ How – they beats; Rhythm – fits in with the words
(2) Not interested.
(3) Very interested – music out that – how it – tape same – how done.

I would like to like to learn about:	NI	SI	I	VI
the personal life stories of famous mathematicians	1	(2)	3	4
what kind of work mathematicians do	1	2	(3)	4
how mathematicians make their discoveries in mathematics	1	2	(3)	4
why mathematicians sometimes disagree	1	(2)	3	4

(1) just want to see
(2) Interested – more involved – level – higher → how did they get in their head →
(3) How – do they tickle 2 and and 3 on top.
(4) SI – why would they disagree – only disagree when they like – put at the bottom.

Appendix B

CODE:.....

RELEVANCE OF SCHOOL MATHEMATICS EDUCATION (ROSME)

October 2003

Things I'd like to learn about in Mathematics

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

I am ..... years old

I am in Grade .....

What would you like to learn about in mathematics? Some possible things are in the list 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.

For office use		Things I'd like to learn about in Mathematics	Not at all interested	A bit interested	Quite interested	Very interested
YC2		Mathematics linked to designer clothes and shoes	1	2	3	4
G4		Mathematics of a lottery and gambling	1	2	3	4
T1		Mathematics involved in making computer games for play stations and TV	1	2	3	4
C3		Mathematics involved in setting up a crime barometer for my area	1	2	3	4
MP4		Why mathematicians sometimes disagree	1	2	3	4
H1		Mathematics used to predict the growth and decline of epidemics such as AIDS; tuberculosis	1	2	3	4
MP1		The personal life stories of famous mathematicians	1	2	3	4
PS1		Mathematics used in making aeroplanes and rockets.	1	2	3	4
A4		How to estimate and project crop production	1	2	3	4
LS2		Mathematics to predict whether certain species of animals are on the brink of extinction	1	2	3	4
P1		Mathematics political parties use for election purposes	1	2	3	4
M5		Mathematics that is relevant to professionals such as engineers	1	2	3	4
H4		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
TD1		Mathematics involved in designing delivery routes of goods such as delivering bread from a bakery to the shops.	1	2	3	4
A2		Mathematics needed to work out the amount of fertilizer needed to grow a certain crop	1	2	3	4
T6		Mathematics involved in secret codes such as pin numbers used for withdrawing money for an ATM	1	2	3	4
P3		Mathematics used to calculate the taxes people and companies must pay to the government	1	2	3	4
A1		Mathematics involved for deciding the number of cattle to graze in a field of a certain size	1	2	3	4
G5		Mathematics of inflation	1	2	3	4

PLEASE TURN OVER

PS3	Mathematics about renewable energy sources such as wind and solar power	1	2	3	4
H3	Mathematics involved in determining the state of health of a person	1	2	3	4
G1	Mathematics to assist in the determination of the level of development regarding employment, education and poverty of my community	1	2	3	4
H2	Mathematics to prescribe the amount of medicine a sick person must take	1	2	3	4
M4	Mathematics that will help me to do mathematics at universities and technikons	1	2	3	4
C2	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
SPRT2	Mathematics involved in crowd control at a sport meeting	1	2	3	4
T2	Mathematics involved in making complex structures such as bridges	1	2	3	4
MP2	The kind of work mathematicians do	1	2	3	4
M2	Geometry	1	2	3	4
TD3	Mathematics involved in packing goods to use space efficiently	1	2	3	4
MP3	How mathematicians make their discoveries	1	2	3	4
C1	Mathematics involved in designing a warning system for the presence of undesirable persons in an area	1	2	3	4
YC3	Mathematics linked to South African pop music	1	2	3	4
P2	Mathematics used to calculate the number of seats for parliament given to political parties after elections	1	2	3	4
G3	Mathematics involved in assigning people to tasks when a set of different tasks must be completed	1	2	3	4
MP5	Blunders and mistakes some mathematicians have made	1	2	3	4
M1	Algebra	1	2	3	4
PS2	Mathematics about the age of the universe	1	2	3	4
A3	Mathematics involved in working out the best arrangement for planting seeds	1	2	3	4
LS3	Mathematics to determine the number of fish in a lake, river or a certain section of the sea	1	2	3	4
YC4	Mathematics linked to music from the United States, Britain and other such countries	1	2	3	4
T5	Mathematics that air traffic controllers use for sending off and landing planes	1	2	3	4
YC1	Mathematics linked to rave and disco dance patterns	1	2	3	4
G6	Mathematics involved in making pension and retirement schemes	1	2	3	4
T4	Mathematics of the storage of music on CD's	1	2	3	4
T3	Mathematics linked to decorations such as the house decorations made by Ndebele women	1	2	3	4
M6	Mathematical ideas that have had a major influence in world affairs	1	2	3	4
M3	Numbers	1	2	3	4
TD2	Mathematics involved the sending of messages by SMS, cellphones and e-mails	1	2	3	4
G2	Working out financial plans for profit-making	1	2	3	4
SPRT1	Mathematics involved in my favourite sport	1	2	3	4
C4	Mathematics involved in dispatching police to a crime scene with a helicopter	1	2	3	4
G7	How repayments (instalment) for things bought on credit are worked out	1	2	3	4
LS1	How to predict the sex of a baby	1	2	3	4

Thank for your co-operation

Appendix C

CODE:.....

RELEVANCE OF SCHOOL MATHEMATICS EDUCATION (ROSME)
January 2005

Things I'd like to learn about in Mathematics

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

I am in Grade .....

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

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

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

Thank you for your co-operation!

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

C14	Mathematics needed to work out the amount of fertilizer needed to grow a certain crop	1	2	3	4
C15	Mathematics involved in secret codes such as pin numbers used for withdrawing money from an ATM	1	2	3	3
C16	Mathematics used to calculate the taxes people and companies must pay to the government	1	2	3	4
C17	Mathematics involved for deciding the number of cattle, sheep or reindeer to graze in a field of a certain size	1	2	3	4
C18	Mathematics of inflation	1	2	3	4
C19	Mathematics about renewable energy sources such as wind and solar power	1	2	3	4
C20	Mathematics involved in determining the state of health of a person	1	2	3	4
C21	Mathematics to assist in the determination of the level of development regarding employment, education and poverty of my community	1	2	3	4
C22	Mathematics to prescribe the amount of medicine a sick person must take	1	2	3	4
C23	Mathematics that will help me to do mathematics at universities and technikons	1	2	3	4
C24	Mathematics involved in the placement of emergency services such as police stations, fire brigades and ambulance stations so that they can reach emergency spots in the shortest possible time	1	2	3	4
C25	Mathematics involved in making complex structures such as bridges	1	2	3	4

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

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

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

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

(a) .....

(b) .....

(c) .....

Why are you interested in these issues?

.....

.....

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

YES .....

Why? .....

.....

.....

.....

NO .....

Why not? .....

.....

.....

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

YES .....

Why? .....

.....

.....

NO .....

Why not? .....

.....

.....

C65 Make a sketch or drawing of a mathematician working.