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TEACHERS' VIEWS ON THE ROLE OF CONTEXT IN MATHEMATICAL LITERACY

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A research report submitted to the School of Science Education in the Faculty of Science, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science.

Johannesburg, March 2007

DECLARATION

I declare that this research report is my own unaided work. It is being submitted for the degree of Masters of Science in University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other institution.

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Themba M Mthethwa

_____ day of _____ 2007

ABSTRACT

This study focused on teachers' views on the role of context in Mathematical Literacy. The study falls within a constructivist framework. The research method used was a case study involving two teachers. The data for the study was collected from teachers through semi-structured interviews and was collected from learners through mathematical literacy tasks. In the analysis of the research data, five issues are identified and discussed: They are concerned with (a) the balance between content and context, (b) the relation between context and access to mathematics, (c) links between context and interest, (d) context and language and (e) context as a barrier in mathematics. The study concludes that real life context is very important and useful in teaching and learning mathematics. However, teachers need be careful in selecting context because inappropriate context can become a barrier to learning. The report concludes with recommendations for classroom practice, teacher education and further research.

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Dedication

To

my mother Daisy Mthethwa, my brother Nathi
and my sisters Sibongile and Nonhlanhla.

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Finally, I thank God who has given me power and wisdom to do all.

WitsETD

TABLE OF CONTENTS

DECLARATION ..... **II**

ABSTRACT ..... **III**

DEDICATION ..... **IV**

ACKNOWLEDGEMENTS ..... **V**

TABLE OF CONTENTS ..... **VI**

LIST OF FIGURES ..... **VIII**

LIST OF TABLES ..... **IX**

CHAPTER ONE: INTRODUCTION **1**

1.1 STATEMENT OF THE RESEARCH QUESTION AND CRITICAL QUESTIONS **1**
1.2 MOTIVATION FOR THE STUDY TO BE UNDERTAKEN **1**
1.2.1 Why choose this topic? *1*
1.2.2 Mathematical Literacy as a new subject *2*
1.2.3 Why focus on contexts in Mathematical Literacy? *3*

CHAPTER TWO: FRAMEWORK AND LITERATURE REVIEW **5**

2.1 THEORETICAL FRAMEWORK **5**
2.1.1 Contexts and understanding *6*
2.1.2 Links between contexts in Mathematics and contexts in Mathematical Literacy *9*
2.2 LITERATURE REVIEW **11**
2.2.1 Contexts in Mathematical Literacy *11*
2.2.2 What informs teachers' views? *17*

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY **20**

3. INTRODUCTION **20**

3.1 CONTEXT OF THE STUDY AND SELECTION OF THE CASE **20**
3.2 INSTRUMENT FOR DATA COLLECTION **21**
3.3 ADMINISTRATION OF THE INSTRUMENT **23**
3.3.1 Negotiating access to schools and teachers *23*
3.3.2 Entry point for interviews *24*
3.3.3 Confidentiality *25*
3.4 PILOTING **25**
3.5 DATA ANALYSIS **26**
3.5.1 Method for data analysis *26*
3.5.2 Inductive model for data analysis *26*
3.5.3 Typological model for data analysis *27*
3.5 CONCLUSION **28**

CHAPTER FOUR: RESEARCH PROCESS AND DATA COLLECTION **29**

4. BACKGROUND OF THE TEACHERS **29**

4.1 DATA COLLECTION **29**
4.1.1 Interviews *30*
4.1.2 Mathematical Literacy task. *32*
4.1.3 Examples of learners' responses *32*

WITSETD

4.2 CONCLUSION 35
5.1 INDUCTIVE ANALYSIS 36
5.1.1 Analysis of data from phase 1 ..... *36*
5.1.2 Analysis of data from phase 2 ..... *43*
5.1.3 The analysis of teachers' responses to the above questions *44*
5.1.4 The two phases linked together *51*
5.1.5 Teacher 1 ..... *51*
5.1.6 Teacher 2 ..... *52*
5.2 TYPOLOGICAL ANALYSIS 53
5.2.1 Category 1: Positive contributions of contexts in mathematics *53*
5.2.2 Category 2: Disadvantages of contexts in mathematics *55*
5.2.3 Category 3: Both advantages and disadvantages of using contexts in Mathematical Literacy. *56*
5.2.4 Category 4: What informs the teachers' views? *57*
5.3 Findings from data analysis. *58*
5.5 CONCLUSION 58

CHAPTER SIX: DISCUSSION OF FINDINGS 59

6.1 DISCUSSION ON ISSUE 1: BALANCE BETWEEN CONTENT AND CONTEXT. 59
6.1.1 Teachers' perspective *59*
6.2.2 Curriculum perspective *61*
6.3 DISCUSSION ON ISSUE 2: CONTEXT AND ACCESS TO MATHEMATICS 65
6.4 DISCUSSION ON ISSUE 3: CONTEXT AND INTEREST IN MATHEMATICS 68
6.5 DISCUSSION ON ISSUE 4: CONTEXT AND LANGUAGE 69
6.6 DISCUSSION ON ISSUE 5: CONTEXT AS A BARRIER TO MATHEMATICS 71
6.6.1 Theoretical perspective *71*
6.6.2 Teachers' perspective *73*

CHAPTER SEVEN: CONCLUSION 75

7.1 SUMMARY OF FINDINGS 75
7.1.1 Critical questions *75*
7.2 RECOMMENDATIONS 76
7.2.1 Recommendation for classroom practice *76*
7.2.2 Recommendation for teacher education *77*
7.2.3 Recommendation for further research *77*
7.3 LIMITATION 78

8. REFERENCES 79

9. APPENDICES 85

APPENDIX 1: INTERVIEW PROTOCOL 85
APPENDIX 2: LETTER OF CONSENT: TEACHERS 105

WITSETD

LIST OF FIGURES

Figure 1: The role of context in teaching and learning Mathematical Literacy……40

Figure 2: Positive contributions of contexts in Mathematical Literacy according to Teacher 1……54

Figure 3: Positive contributions of contexts in Mathematical Literacy according to Teacher2.....55

WitsETD

LIST OF TABLES

Table 2.1: Examples of contexts that are used in Mathematical Literacy..….9
Table 2.2: Context-free question……..….10
Table 2.3: example of real and cleaned context question …….10
Table 3.1: Themes for analysis ……. 27
Table 4.1: Interview dates …….30
Table 4.2: Interview questions Phase 1 …….30
Table 4.3: Mathematical Literacy task given to learners……31
Table 4.4: Interview questions for the Phase 2 ……. 32
Table 4.5: Learners' responses to the task…… 34
Table 4.6: Analysis of correct and incorrect responses…….. 35
Table 5.1: Balance between context and content ……..38
Table 5.2: Mathematical Literacy questions given to learners……43
Table 5.3: Balance between context and content- links between phases…….52

WitsETD

CHAPTER ONE: INTRODUCTION

The study investigated the role of the contexts in mathematics with special reference to Mathematical Literacy (grade 10). The purpose of the study was to determine the teachers' views on the role of contexts in mathematics. In this chapter, a statement of the research problem and critical questions are presented. Also presented are the motivation of the study and an outline of the research report.

1.1 Statement of the research question and critical questions

The general question for this study was: What is the role of context in Mathematical Literacy? The study was guided by the following critical questions:-

1.1.1 What are views of grade ten teachers on the role of contexts in Mathematical Literacy?

1.1.2 What informs teachers' views about the role of contexts?

1.2 Motivation for the study to be undertaken

1.2.1 Why choose this topic?

When South Africa became a democratic country in 1994, transformation and many changes were made in all departments including the department of education, to meet the ideals of the new constitution of the Republic of South Africa Act 108 of 1996. The new curriculum, which is Outcomes based, has been introduced in South Africa and it includes the Revised National Curriculum Statement (RNCS) in the GET Band (grades R-9) and National Curriculum Statement (NCS) in the FET Band (grades 10-12). In the *National Curriculum statement grades 10-12*, new subjects have been introduced which were not offered in the old curriculum (NATED 550). Mathematical literacy is amongst the new subjects that have been introduced in the FET band. As from January 2006, it was made compulsory that every learner should do either Mathematics or Mathematical Literacy at grade 10 (2006), grade 11(2007) and grade 12(2008).

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1.2.2 Mathematical Literacy as a new subject

Mathematical Literacy has been introduced in the South African Curriculum as a subject in grade 10 in 2006 for the first time. Christiansen (2006:6) notes that mathematical literacy internationally, refers to the competence of individuals. Christiansen (2007:91) further notes that in South Africa, mathematical literacy refers both to a school subject and to the competency of individuals. According to the Department of Education (2003):

> Mathematical Literacy provides learners with an awareness and understanding of the role that mathematics plays in the modern world. Mathematical literacy is a subject driven by life-related applications of mathematics (p.9).

According to DoE (2003) the inclusion of Mathematical Literacy as a compulsory subject in the Further Education and Training (FET) curriculum will ensure that future South African citizens are highly numerate consumers of mathematics. Christiansen (2007) argues that there are two main reasons for the introduction of Mathematical Literacy as a school subject for South Africa. According to Christiansen (2007) the reasons were: to reach the 200 000 learners leaving Grade 12 yearly without mathematics a every and 200 000 learners who fail mathematics in Grade 12 every year; and was to teach learners competencies and knowledge which would be in line with the overall intentions of the NCS. These reasons are supported by Venkatakrishnan and Graven (2006) who contend that the introduction of Mathematical Literacy in the FET was aimed at increasing the number of students taking mathematical courses at all levels.

There are four important abilities that Mathematical Literacy aims to develop. The DoE (2005a: 8) specifies the following:

(i) The ability to use basic mathematics to solve problems encountered in everyday life and in work situations.
(ii) The ability to understand information represented in mathematical ways.
(iii) The ability to engage critically with mathematically based arguments encountered in daily life.
(iv) The ability to communicate mathematically.

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Bowie & Frith (2006) value the importance of Mathematical Literacy in the new Curriculum. They assert:

> Mathematical Literacy has the potential to provide learners, who previously did not continue with mathematics beyond grade 9, with access to the kind of skills that are crucial in order for them to participate meaningfully in the modern world (p.29).

The above descriptions of the concept of mathematical literacy clearly indicate that it is an important subject that has the potential to enhance the competencies and abilities of learners leaving the school system. It is therefore important to know how teachers and learners cope with this subject. The question as to how far teachers are prepared to teach this subject is an issue of many discussions and debates. It is therefore essential that the teaching of this subject must endeavor to meet the purpose of this subject.

1.2.3 Why focus on contexts in Mathematical Literacy?

Teaching and learning in the new curriculum (NCS) is more driven by Outcomes, such as Developmental Outcomes (DO), Critical Outcomes (CO) and Learning Outcomes rather than content as it was the case in the NATED 550 curriculum, (DoE , 2003). For instance, Learning Outcome 1 in Mathematical literacy is "*Number and operation in context*". It is indicated in the subject statement for mathematical literacy that:

> Contexts are central to the development of Mathematical Literacy in learners. It by its very nature requires that the subject be rooted in lives of the learners (DoE, 2003:42).

There are several studies that have been carried out on contexts in mathematics education such as Blinko (2004), Cooper & Dunne (2000); Cooper & Harries (2002; Sethole (2004), Chacko (2004), Zevenbergen, Sullivan, & Mousley (2002) and Boaler (1993). My interest to study teachers' thinking on the role and views on contexts in mathematical literacy in particular, has been motivated by a study conducted by Julie (2006) on "Teachers' preferred contexts for Mathematical Literacy and mathematics for action". The study on teachers' preferred contexts for mathematical literacy and mathematics for

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action was carried out not only to find out what teachers prefer for learners to deal with in mathematical literacy but also to get sound reasons for their preferred contextual issues. The present study differs from Julie's study because it investigated teachers' views on the role of context in Mathematical Literacy and what informs their views.

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CHAPTER TWO: FRAMEWORK AND LITERATURE REVIEW

2.1 Theoretical framework

A theoretical framework provides lenses to view a phenomenon under study. The way people respond or make their arguments or view reality is informed, explicitly or implicitly, by their epistemological or philosophical positions. This study focused on the views of teachers on the role of contexts in Mathematical Literacy. The theoretical construct by which this study was informed advocates the role of contexts in mathematics. Mathematical Literacy posits that in teaching and learning Mathematical Literacy learners will be provided with opportunities to engage with real-life problems in different contexts, and so consolidate and extend basic mathematical skills (DoE, 2003:43). The new curriculum in South Africa puts the learner and his/her experiences at the centre of the learning process. There is a constructivist perspective underpinning this way of viewing learning in the new curriculum.

According to Ismat (1998), constructivism is a theory of learning which offers an explanation for how human beings learn. Cannella and Reiff (1994) assert that in constructivism individuals construct their own new understandings or knowledge through the interaction between what they already know and believe and ideas, events, and activities with which they come in contact. Von Glasersfeld (1987) defines constructivism as a theory of knowledge and contends that a constructivist view involves two principles, these are: active construction of knowledge by a learner and coming to know as a process of adaptation based on and constantly modified by the learner's experience of the world.

Ernest (1989) maintains that constructivism is more than a theory of learning. He argues that children construct their knowledge of mathematics over a period of time in their own, unique ways, building on their pre-existing knowledge (p.151). This view is supported by Simon & Blume (1998), who maintain the idea of social learning constructivism. They argue that students in constructivist classrooms get rich opportunities for understanding

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mathematics and create mathematics and determine its validity. Chacko (2004) conducted a study on the solution of real-world and standard problems by primary and secondary school students in Zimbabwe. She aligned her study with constructivism. She notes that in constructivist approach, the learner is an active participant in the learning process, constructing knowledge through social interaction, negotiation and cooperation (p.11)

Constructivist theory matches well with this study, as it embeds learning in realistic and relevant contexts (Honebein, 1996). A constructivist perspective has been used in this study to examine teachers' views on the role of context in Mathematical Literacy and to examine what informs these views. In this study, constructivist theory provides a framework in which teachers' views of the role of contexts are analysed and interpreted. Two key aspects of constructivism form the basis of analysis and interpretation of the findings:-

i) Knowledge constructed by human mind as a result of previous experiences/prior knowledge,

ii) Knowledge constructed by human mind as a result of social interaction.

Central to this study is the assumption that the way teachers view the role of contexts in mathematical literacy is bound to be shaped by their knowledge and experiences of mathematical literacy, in addition to the way they themselves understand what this subject means for themselves and for the learners in their classrooms.

A theoretical framework on contexts in Mathematical Literacy and understanding has been developed and discussed below.

2.1.1 Contexts and understanding

Van Den Heuvel-Panhuizen (2005) provides two different meanings for the term 'context'. The first meaning of the context is the leaning environment; this includes both the different situations in which learning takes place. The second meaning of the context is a characteristics of a task presented to the learner. In the context of this study, the term 'context' has been used to refer to the characteristic of the mathematical task.

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> Putting questions in to a context can go a long way to make abstract ideas more meaningful (Tandi Clausen-May, 2001 in Blinko 2004:3)

While there are different types of contexts in Mathematics, Du Feu (2001) identifies the following five categories or types of contexts: These types of contexts are also appearing in Mathematical Literacy curriculum.

(i) Context-free,

These include simple questions with one-step arithmetic computations (e.g. 5 – 2) to long multifaceted proofs. These can be viewed as real contexts where the context is mathematics.

(ii) real,

These are real contexts with real problems. They involve real names of individual, institutions, organisations or product (e.g. a question can be set based on the data obtained from Telkom about telephone call charges. Learners can then interpret data given to make relevant calculations)

(iii) cleaned,

These are similar to real contexts, but the only difference is that the mathematical model has been simplified in order to make the question accessible to the user (e.g. a distance between Johannesburg and Durban is 550 km. How long will it take for a car from Johannesburg to reach Durban if a car travels at 100km/h?). In this example it is assumed that the car will move at a constant velocity (irrespective of road blocks, robots, traffic etc)

(iv) parable

These are fictitious contexts. Names used in these contexts are not real (e.g. John Mathe has R90 00 to invest. He has chosen one relatively safe investment fund that has an annual return of 10% and another, riskier, one that has a 15% annual return. How much must he invest in each fund if he would like to earn R10 00 in one year from his investment?)

(v) Contrived.

These contexts are invented to fit a particular mathematical point, irrespective of how appropriate these are to the real life. In most cases some may have a context which has

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been constructed with no reference to the real world or is in conflict with it (e.g. Thabo buys cattle and sheep at a total price of R5 380. He buys 100 animals, the cattle at R73 each and sheep at R25 each. How many of each kind has he bought?). This problem can be solved mathematically but in real life situation you cannot buy a sheep for R25-00.

Du Feu further notes that 'by setting mathematics in context, the student is encouraged to accept the consequences of the context' (p3). Such a claim is further supported by Mudaly (2004) who contends that besides the ideal of showing learners how mathematics is related to the real world it also serves to increase interest in the subject matter (p.37).

Boaler (1993) who also seems to support the use of contexts in mathematics discusses the role of contexts in a mathematics classroom. She argues that the context in which the mathematics is placed seems to be a factor in determining mathematical procedure and therefore performance. She contends that using real world, local community, and even individualized examples which students may analyze and interpret, is thought to present mathematics as a means with which to understand reality (p.13).

Nicol and Crespo (2005) also emphasise that 'the contexts in which mathematics is studied play an important role in helping students understand not only how, when, and why particular concepts, procedures, and skills are used, but also what makes them significant and worth knowing (p.240). Zevenbergen et al. (2002) reflect on their experiences on the role of contexts in mathematics, they suggest that the use of contexts in mathematics education can enhance the learning for the learners (p.1).

The arguments presented above indicate that contexts in mathematics promote understanding. The following points are mentioned:

i) Context makes mathematics meaningful and accessible
ii) Context increases learner's interest in mathematics
iii) Context enhances learning for the learners.

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2.1.2 Links between contexts in Mathematics and contexts in Mathematical Literacy

An assumption is made that contexts may also promote or facilitate understanding in Mathematical Literacy. Various contexts are used in Mathematical Literacy to attain Learning Outcomes (LO's) Assessment Standards (AS) for Mathematical Literacy. These contexts are related to the principle of National Curriculum Statement (NCS) such as issues arise in health (HIV/AIDS), human rights, inclusivity, environmental and socio-economic justice (DoE, 2003). Specific contexts that are used in Mathematical Literacy have been identified in Teacher Guide Document for Mathematical Literacy (DoE, 2006), see table 2.1. Most of these contexts match with those that were identified by mathematics educators from South Africa, Zimbabwe, Uganda, Eritrea and Norway (Julie and Mbekwa, 2005:33).

Table 2.1 Examples of contexts that are used in Mathematical Literacy

Main Cluster of contexts	**Clusters and examples**
Health	Contexts that deal with HIV/AIDS issues and Body Mass Index (BMI)
Finances	• Contexts deal with banking related issues such as accounts (eg, Mzansi), investment, loans, interest (simple and compound) and ATM's • Contexts that deal with marketing related issues such as income and expenditure, selling price, profit, and breaking even • Contexts that deal with budgeting
Municipal tariffs	Contexts that deals with water, electricity and sewerage costs (monthly charges)
Transport and communications	• Contexts that deals with Telkom telephone cards and charges and cell phones; • Contexts that deals with mailing or mailing (ordinary and fast mail) envelope sizes and postcard etc. • Contexts that deals with travelling e.g. a trip with Shosholoza Meyl
Sports	Contexts deals with Soccer World Cup (soccer stadium and tickets) and Athletics
Mathematics	Contexts that deal with mathematics content like linear equations and algebraic graphs
General	• Contexts that deal with baking and cooking. • Contexts that deal with bicycle gears

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Adopting van den Heuvel-Panhuizen's second meaning of contexts, the contexts of Mathematical Literacy presented in Table 2.2 fall within those categories of contexts in mathematics described by de Feu (2001). The following exercises were taken from Teacher guide for Mathematical Literacy (DoE, 2006: 43) are context-free (according to de Feu, 2001), see table 2.2 below:

Table 2.2 Context-free question

Solve for a

(a) 2 X a – 5 = 19

(b) 2 X (a + 5) = 18

(c) 6 + 2 X a = 21

(d) (a + 4) ÷2 = 24

There are also tasks in Mathematical Literacy that can be categorized as real context task, cleaned and parable context task, see an example in table 2.3 below (DoE, 2006: 40).

Table 2.3 example of real and cleaned context question

Deposit amount	R300	R400	R500	R600	R700	R800
Mzansi transaction fee	R8,00	R8,00	R8,00	R8,00	R8,00	R8,00
Bronze transaction fee	R5,59	R6,12	R6,65	R7,18	R7,81	R8,24

Q. ***Up to how much cash can you deposit into a bronze account at the bank and pay less in transaction fees than for the corresponding transaction with an Mzansi account?***

It is noted that while there are different contexts that are used in Mathematical Literacy but all these contexts can be categorized into those categories identified by de Feu (2001). It follows that contextual issues that may be foregrounded in Mathematical Literacy may differ from those in Mathematics but there is link between contexts categories in both Mathematics and Mathematical Literacy.

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2.2 Literature review

Literature reviews add much to an understanding of the selected problem and help place the study in a historical perspective (Schumacher & Macmillan, 1993). The present study intended to answer two specific questions: (i) what are views of grade ten teachers on the role of contexts in Mathematical Literacy? (ii)What informs teachers' views on the role of contexts in Mathematical Literacy? The review of the literature for this study is guided by these research questions.

2.2.1 Contexts in Mathematical Literacy

The first critical question concerned exploring teachers' views on the role of contexts in Mathematical Literacy. A review of the South African Journals indicates that research in mathematical literacy is just emerging. This is due to the fact that Mathematical Literacy as a subject in the South African curriculum has been introduced just a year ago in 2006. Recently, there are studies that have been done in South Africa on Mathematical Literacy (see, Webb and Webb, 2004; Julie and Mbekwa, 2005; Vithal & Bishop, 2006; Christiansen, 2006; Mbekwa, 2006; Bowie and Frith, 2006; Frith & Prince, 2006; Brown & Schäfer, 2006; Vithal, 2006; Julie (2006) and Venkatakrishan & Graven, 2006).

Mbekwa (2006) studied teachers' views on Mathematical Literacy and on their experiences as students of the course. This study was undertaken at the University of Western Cape with a class of 32 in-service teachers who had completed six months of an Advanced Certificate in Education (ACE) course in Mathematical Literacy in 2004. Evaluation questionnaires were used to collect data. Participants (Teachers) were asked to respond to the question on their common sense conception of Mathematical Literacy. The study reveals two important findings about teachers' views: (i) the view which regards Mathematical Literacy as that type of mathematics that finds application in people's lives; (ii) the view that Mathematical Literacy is a simplified or an easier version of the mathematics that learners do at school (p. 29). The study also reveals that there is a common agreement amongst teachers that Mathematical Literacy has to do with real life

WitsETD

application of mathematics; however, the study does not present any findings on teachers' views about contexts in Mathematical Literacy.

Christiansen (2006, 2007) presents an important analysis of the issue of Mathematical Literacy as a school subject. Christiansen (2006) interrogates two ways in which the Mathematical Literacy curriculum justifies itself; firstly, it is through claims of utility and secondly through claims that it will provide learners with awareness and understanding of the role that mathematics plays in the modern world (p. 6). She further distinguishes different perspectives on Mathematical literacy, namely with respect to their proclaimed goals and their views on its context relatedness or situatedness (Christiansen, 2007:91). She argues that the goals of Mathematical Literacy are theoretical rather than practical. Christiansen (2007:91) writes:

> The curriculum is saturated by the myth of mathematics utility to everyday practices, while the curriculum is largely organized around mathematics-mathematics which is often not utility in everyday practices. Yet many of the contexts invoked are too simple to get insight into complex phenomena or to handle complex problems.

Christiansen (2006) argues that although contexts are foregrounded in Mathematical Literacy, Mathematical Literacy content is distinctly mathematical (p.10). She contends that teachers of Mathematical Literacy must posses enough mathematics knowledge for them to cope with the demands of teaching Mathematical Literacy. She asserts that:

> A teacher of Mathematical Literacy would have to know enough mathematics and enough about applications of mathematics, misuses of mathematics, and effects of using mathematics to further learners' awareness and understanding of the role that mathematics plays in the modern world, help them develop the ability and confidence to interpret and critically analyze social, political and practical situations using mathematical skills transferred from one context to another (Christiansen, 2007:101).

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Christiansen presents important arguments and discusses relevant issues about Mathematical Literacy but very little has been said about the role of contexts in Mathematical Literacy.

Venkatakrishnan and Graven (2006) studied overlaps and contrast between Mathematical Literacy in South Africa and Functional Mathematics in England. Their study reveals among other things; that in both subjects/courses emphasis is on the use of relevant, realistic and increasingly complex contexts, interpreting texts, modeling situations and problem solving. They found that integration of context and content is also emphasized in both subjects/courses. Venkatakrishnan and Graven however argue that documents (for Mathematical Literacy) are not clear about the issue of contexts. They write:

> It would appear that there are mixed messages within the Department of Education's documentation for Mathematical Literacy. Whether educators will give more emphasis to context-specific problem solving using mathematics, or to the mathematics involved in solving contextual problems remains unclear at this stage.

While Venkatakrishnan and Graven (2006) acknowledge that contexts are emphasized in Mathematical Literacy, their study does not reveal much on the role of context in Mathematical Literacy.

Bowie and Frith (2006) conducted a study on concerns about Mathematical Literacy curriculum. Their study focuses on the importance of distinguishing between mathematics and Mathematical Literacy. They explore among the other things the difficulties and importance of a proper understanding of contexts used to teach Mathematical literacy. They draw largely from their experience of material development to argue that develop Mathematical Literacy materials is problematic because in order to mathematise a context one needs to have a good understanding of the context itself (p.33). Bowie and Frith (2006) further argue that Mathematical Literacy teachers will face many challenges to teach Mathematical Literacy, as they are required to understand more than mathematics (content) but also various contexts used in Mathematical Literacy, such as HIV/AIDS, financial issues, mortgages, voting systems etc.

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It appears that although Bowie and Frith appreciate the inclusion of some contextual issues like personal finance in Mathematical Literacy, they raise concerns about learners' understanding of contexts. They argue that both teachers and learners need to develop a good grasp of different contexts used in Mathematical Literacy. Such concerns are noted in Vithal (2006) who writes:

> A particular challenge in teaching and learning of contextualized mathematics is that the teacher has to ensure that neither learners' understanding of the mathematics or that of the context gets compromised (pp. 40-41).

As can be seen, Bowie and Frith's study discusses important issues concerning Mathematical Literacy, but it does not empirically present teachers' perspectives on the issue of contexts in Mathematical Literacy.

The study by Julie (2006a) on teachers' preferred contexts for Mathematical Literacy and mathematics for action was carried out not only to find out what teachers prefer for learners to deal with in mathematical literacy but also to explore reasons for the contexts they preferred. The study sample consisted mainly of teachers attending a continuing professional development teacher education course at the University of the Western Cape and other teachers in the Western Cape (n =149). Questionnaires were used to collect data. Teachers were given twenty items and they had to indicate their preferences on a four-point scale with '1' indicating strongly disagree and '4' strongly agree. They were also requested to select three of the items they would definitely prefer for use as contexts and three they would least prefer and reasons for their choices.

The results showed that teachers consider situations from the background of learners and those that will not conflict with teachers' personal pedagogical ideologies as important and useful contexts to be used in Mathematical Literacy.

Julie (2006b) discusses constructs emanating from the literature linked to what the goals of Mathematical Literacy should be. He identifies and discusses the following constructs:

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the teachability of Mathematical literacy, Mathematical Literacy and an action component, the dilemma of contexts for Mathematical Literacy and resilience of people's qualitative improvised strategies to solve quantitative dilemmas (p. 62). One of these constructs (i.e. the dilemma of contexts for Mathematical Literacy) is particularly relevant to the present study. Julie argues that to determine which contexts to use in Mathematical Literacy is a complex issue. Julie (2006b: 67) asserts:

> The crux of the question of desirable contexts to be used in Mathematical Literacy is a major dilemma facing mass schooling and education, and can be captured as "what are the contexts and situations within which school-learning activities should be embedded so that they will appeal to all learners to be constructively engaged in the learning to be fostered by these contextually-embedded activities?

Julie considers a situation in which a teacher has to decide on the relevant contexts to be used in teaching Mathematical Literacy as a dilemma. The arguments being presented by Julie are appropriate. For instance, in a class in which students come from different socio-economic background or environment, a teacher may use contexts that are not relevant to one group of students, while being relevant to the other group and vice visa. He further contends that teaching Mathematical Literacy is more difficult than teaching mathematics. Julie's study does not fully present any findings on the teachers' responses on contexts used in Mathematical Literacy.

It is noted that there are some gaps in the literature on the issue of contexts in Mathematical Literacy, in particular teachers' views on the role of contexts in Mathematical Literacy. A need for a further research on teachers' views on the role of contexts in Mathematical Literacy was recognized.

There are studies carried out in South Africa and abroad, that focus on contexts in Mathematics. In most studies that have been carried out, the focus is on the role of real world problems for learners to achieve mathematics (See, for example, Nicol & Crespo, 2005; Chacko, 2004; Van Den Heuvel-Panhuizen, 2005; Mudaly, 2004; Blinko, 2004; and Yosh,Verschaffel, and Corte, 1997). While it is important to note that these studies

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provide important findings on the role of contexts in mathematics, it is observed that in most of these researches, little is said about teachers' views on the role of contexts in mathematics.

Blinko (2004) studied contexts in Mathematics by involving fourteen Year 5 pupils from four different schools. The children chosen were of average ability as determined by their teachers. The aim of the study was to determine the extent of the influence of context, in particular illustrations in questions. Four sets of questions were prepared to show the learners. Each set contained 5 or 6 questions both in and out of context. The questions were presented to each child in random order and they were asked whether or not they thought they might want to do the questions. The learners sorted the questions in order of their preferences. It was found that learners preferred questions set in context, in this case questions with illustrations. Blinko (2004) argues that the friendlier a question looks, the more accessible it seems to the children. The study provides perspectives to view the role played by contexts in promoting mathematical achievements to the learners.

Some studies however, have shown that using of contexts in mathematics does not always promote mathematical proficiency in the learners (See, for example Yoshida, Verschaffel and De Corte, 1997; and Verschaffel, De Corte, and Borghart, 1997). Yoshida et al. (1997) conducted the a study which compared Japanese and Belgian elementary school pupils' activation of real world knowledge during the understanding and solving of arithmetic word problems in school context. The findings of the study reveal that both Japanese and Belgian children have a strong tendency to neglect commonsense knowledge and realistic considerations during their solution of word problems. This implies that context did not play a significant role in promoting mathematical thinking to the pupils. Similarly, in the study on pre-service teachers' conceptions and beliefs about the role of real-world knowledge in mathematical modeling of school word problems, the results revealed a strong tendency among student-teachers to exclude real-world knowledge from their own spontaneous solutions of school word problems as well as from their appreciations of the pupils' answers (Verschaffel et al., 1997).

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Sethole (2004) in his case study describes the experiences of two teachers, Bulelwa and Kevin, who attempted to take on board the notion of incorporating the everyday into mathematics. The aim of study was to highlight the different ways in which teachers handle the expectations of using contexts to teach mathematics; and to reflect on reasons why they handle the contexts (in the teaching of mathematics) in the way they do. Sethole found that both teachers attempted to incorporate the every day into the mathematics teaching. However, Bulelwa used Aids as a context and foregrounded the social concerns over mathematics while Kevin foregrounded mathematics skills over social concerns. It is evident that both teachers had different views on the role of contexts in mathematics. Drawing from Bowie and Frith (2006) who contend that the Mathematical Literacy curriculum looks too much like Mathematics, assumption is made that Mathematical Literacy teachers have different views on the role of contexts in Mathematical Literacy, and have different views on how to use contexts in teaching and learning of Mathematical literacy.

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2.2.2 What informs teachers' views?

The second critical question for the research was: What informs teachers' views about the role of contexts in Mathematical Literacy? There is an assumption being made in the above question that the way the teachers view the role of contexts in Mathematical Literacy should be informed by amongst other things, their experiences, knowledge, training that includes in-service training and personal philosophies or beliefs. Below, I discuss teacher knowledge, beliefs and views as important aspects in teaching and learning

Teacher knowledge in mathematics has been the subject for debates and discussion (see Ball, Lubienski and Mewborn, 2001; Shulman, 1987; Brodie, 2001; Brodie and Long, 2004; and Hill, Rowan; and Bell, 2005). Shulman (1987) outlines seven categories of knowledge namely: Content knowledge; general pedagogical knowledge; curriculum

knowledge; pedagogical content knowledge; knowledge of the learners and their characteristics; knowledge of educational contexts; knowledge of educational ends, purposes, and values; and their philosophical and historical grounds.

A study by Hill et al (2005) on effects of teachers' mathematical knowledge for teaching on student achievement revealed that teachers' mathematical knowledge was significantly related to student achievement. It is evident that teacher knowledge, pedagogical content knowledge (PCK) in particular, is imperative for his or her practices. However, Ernest (1994) argues that knowledge is important, but it alone is not enough to account for the differences between mathematics teachers. He notes:

> Two teachers can have similar knowledge, but while one teaches mathematics with a problem solving orientation, the other has a more didactic approach.

Ernest's argument suggests that it is more than any form of knowledge e.g. PCK; that informs classroom practice, there are other contributing factors like beliefs. Attempts have been made to investigate the effect of teachers' beliefs, views and attitudes on classroom practice (see, Barnes, 1992; Hampton, 1994; Wilson & Cooney, 2002; and Web and Webb, 2004). Considering teachers' views, beliefs and attitudes; and what informs their practice, Hildebrand (1999:9) maintains that 'teachers' pedagogical practices are informed by the learning models they use as referents.' When considering the frames of reference that influence teachers' practice, 'of central importance is the teacher's conception of what constitutes learning'(Barnes, 1992:20). In support of the above claim, Hampton (1994) notes that teachers' beliefs or personal constructs determine how they approach their teaching.

With regard to impact of teachers' thinking and beliefs, Andy Hargreaves and Michael Fullan in Yero (2002) make a claim that it is what teachers think, what teachers believe and what teachers do at the level of classroom that ultimately shapes the kind of learning that young people get. This claim suggests strong links between teachers' beliefs or views and teachers' practice. Webb and Webb (2004) studied Eastern Cape teachers' beliefs of the nature of mathematics. Their study investigated a sample of Eastern Cape teachers' beliefs about the nature of mathematics; how such beliefs were linked these teachers'

WiSETD

beliefs about teaching and learning; and whether espoused beliefs were demonstrated in classroom practice. The results show that the participating teachers' espoused beliefs of the nature of mathematics tended to be innovative, and correlated with innovative views of teaching and learning. The study however, reveals that these views were not reflected in their practice.

The literature that was reviewed presents different perspectives about the contexts in mathematics and Mathematical Literacy. These perspectives can be summarized as it follows:

- Contexts facilitate teaching and learning;
- Contexts affect teaching and learning;
- A dilemma (for a teacher) in choosing appropriate or relevant contexts and what to foreground, whether social concerns or mathematical proficiency.

The literature presents different perspectives on what informs teachers' views. These perspectives are:

- Teachers' knowledge;
- Teachers' personal beliefs
- Academic and professional experiences

These perspectives about the role of contexts and teachers' views necessitated the need to investigate teacher's views on the role of context in Mathematical Literacy.

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CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3. Introduction

This chapter presents the research design and research methodology that was used in conducting the study. I used a qualitative approach case study that involved grade 10 mathematical literacy educators. According to Worchel and Shebilske (1989) the advantage of a case study is that it is a convenient method of gathering information in a short time. Bell (1993) confirms this when he writes:

> The case study is particularly appropriate for individual researchers because it gives an opportunity for one aspect of a problem to be studied in some depth within a limited time scale (p 8.)
>
> .

According to Opie (2004), a case study does not necessarily require many subjects or participants to be involved in the study; it may involve one participant, class or a school but, still obtain rich data. Given the advantages of a case study, a case study was an appropriate research design to be used; and again considering the statement of my research problem and critical questions on the views of teachers on the role of contexts in mathematical literacy, a case study method was indeed relevant to afford opportunities to carry out an in-depth study within a short time.

3.1 Context of the study and selection of the case

The focus of the study was on the teachers' views on the role of contexts in Mathematical literacy, with a special reference to grade 10 Mathematical Literacy. The study involved two educators from two different schools in the Obonjeni District of Kwa-Zulu Natal Province. A non-probability sampling, specifically purposeful sampling was used in the selection of the participants. Schumacher and Macmillan (1993) note:

> In purposeful sampling (sometimes called purposive, judgment, or judgmental sampling) the researcher selects particular elements from the population that will be representative about the topic of interest (and) on the basis of researchers knowledge of the population, judgment is made about which subjects should be selected to provide the best information to address the purpose of the research

WisETD

They further assert that purposeful sampling usually assures high participation and that receipt of needed information is less costly and time-consuming.

At the time of the study, in KZN, grade ten(10) mathematical literacy teachers were involved in two types of training programmes, one which was run by the KZN Department of education (compulsory for all grade ten educators) NCS Mathematical literacy and the one run by the Nelson Mandela Metropolitan University ACE (mathematical Literacy). The NCS mathematical literary training is run for one week and ACE program is designed for two years. Drawing from my knowledge of the mathematical Literacy teachers in the district, I selected the potential teachers to be involved in the case study. Having participated in teacher training programmes (as KZN Province NCS facilitator), I was able to identify five teachers who had shown interest in Mathematical Literacy and interest to participate in the study. For the main study I selected one teacher who attended the NCS Mathematical Literacy training (workshops) only and the other teacher who attended both NCS and ACE programmes. I selected two for the pilot study and the other one was selected in the event that one participant withdrew his participation. Fortunately, all participants had no problem in participating actively in the project.

3.2 Instrument for data collection

Opie (2004: 8) points out that research which seeks to obtain softer facts, and insights into how an individual creates, modifies and interprets the world in which they find themselves, an anti-positivistic approach, would employ qualitative techniques. In this case interviews and participant-observation would predominate. Opie suggests the use of interviews and/or participant observation as the instruments for data collection in the case study. For this study, interviews are the primary source of data collection. Interviews have many advantages than any instrument for data collection. Interviews with the teachers can be conducted at any time, on the weekend, holiday and even after school as long as there is an agreement between interviewer and interviewee. Sax (1979) describes the interview is more than exchange of small talk (but) it represents a direct attempt by researcher to obtain reliable and valid measures in the form of verbal responses from one

WitsETD

or more respondents. Sax further outlines the advantages of interviews. He asserts that interview is useful in collecting personal information, attitudes, perceptions or beliefs by probing for additional information (pp.232-233).

Amongst other advantages of interview as the most appropriate instrument for data collection compared with other instruments like questionnaires is that it allows the participant to describe what is meaningful or important to him or her using his or her own words rather than being restricted to predetermined categories. Thus participants feel more relaxed and candid. I argue and foreground the merit of the interview as a research instrument that it allows for greater depth than other methods of data collection. It can be argued that interviews allow the interviewer to probe for more details and ensure that the interviewees are interpreting questions the way they were intended.

The success of interview however, depends on the skills used by interviewer. Guion (2001) points on the important skills and attributes for the interviewer that a skilled qualitative interviewer should be someone who is a good listener, able to notice and react to nonverbal clues, flexible, open minded, and willing to release power and control (p.2).The skills mentioned were demonstrated in the interviewing process for this study.

Bondy and Maunders (1999) identify four forms of research interview in qualitative research, namely standardised, unstructured, semi-structured and focus group interviews. I identified semi-structured interviews to be most suitable for this study. Semi-structured interviews fall between structured and unstructured interviews and have more advantages than disadvantages. Opie (2004) contends that semi- structured interviews are more flexible thus facilitate analysis than structured interviews. Opie (2004) encourages novice interviewers (like Masters Students) to use semi-structured interviews than unstructured interviews in their research projects.

A Mathematical Literacy task was also designed and given to grade 10 learners to write. There were two main reasons for including a Mathematical Literacy task in research

WitsETD

design: Firstly, to see how learners construct knowledge in a real context and context-free questions and to match their responses with teachers' views on the role of contexts in Mathematical Literacy. Secondly, responses to the task were used to contextualise interviews for the second phase of data collection. Learners' responses therefore were analysed and used to design contextualised interview questions for the second phase of data collection.

3.3 Administration of the instrument

To administer an interview requires some procedures and a protocol. There are some problems that may arise during the process of interviewing, such as failing to get access and failing to maintain confidential information about the names of the participants. It is upon the responsibility of the researcher to be aware of the ethical issues that may arise while conducting the research. This study involved two teachers who are located in schools. All the necessary steps were followed in getting access to the participants. The administration of the instrument was carried out as follows:-

3.3.1 Negotiating access to schools and teachers

It is upon the responsibility of the researcher to be aware of the ethical issues that may arise while conducting the research. Having sought permission from the University of the Witwatersrand to conduct this study as a Masters student of the university, I received an ethics clearance letter from the Ethics Committee in Education from the Faculty of Humanities (Wits). I then negotiated access to schools and teachers. This study involved two teachers and grade 10 learners who are located in schools. Gaining access and permission to these schools and teachers was made possible by following the protocol as described below.

Hitchcock and Hughes (1989: 58) state:

> The researcher cannot enter a scene unannounced and begin to conduct interviews. All researchers have to plan and prepare their work carefully; part of this preparation involves securing access and permission to enter the scene being investigated.

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I ensured that before I went to the specific schools where I was interviewing the teachers that I followed all relevant procedures, and I had contacted all the stakeholders concerned. Walker (1980: 49) suggests the protocol:

> To gain access to school, you need first to approach the local education authority; to gain access to the staff, you need to approach the head; to gain access to the pupils, and you need to approach the staff.

I wrote three letters, one to the District, one to the Principals of the two schools and one to the two teachers who were involved in the study. In the letters, I highlighted the purpose of the study and reasons for conducting the study.

3.3.2 Entry point for interviews

There were two focus questions for the study. The first question was: what are the teachers' views on the role of contexts in Mathematical literacy? The second question was: What informs teachers' views on the role of contexts in Mathematical Literacy? There were two phases for data collection. The first phase was directly addressing the first focus question and the second phase was mainly addressing the second focus question. As an entry point for the first interviews in the first phase of data collection, I designed open-ended interview questions for both teachers. Questions that were designed allowed the interviewees to provide as much information as possible.

For the second phase of data collection, a Mathematical Literacy task was designed and given to grade 10 learners to write. The task had five questions. The first three questions were more real-life context based and the last two were predominantly mathematics context based. There was an assumption that real life contexts would play a significant role in helping learners to answer these questions correctly. The reason for putting questions of different contexts was to investigate learners' responses (performance) to these different questions.

Learners' responses to the Mathematical Literacy task and teachers' responses in the first interviews were used to design interview questions for the second phase of data

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collection. Questions were designed on the bases of the themes that emerged in the first interviews and the learners' responses.

3.3.3 Confidentiality

I ensured that the teachers who participated in the interview participated willingly without feeling threatened. Schumacher and Macmillan (1993: 193) note:

> The investigator should inform the subjects of all aspects of the research that might influence willingness to participate and answer all inquires of subjects on features that may have adverse effects or consequences.

They further note that the researcher must ensure that information obtained about the subjects must be held confidential unless otherwise agreed on, in advance through informed consent. In the consent letter that they had signed, I indicated how the information they provide would be used. Tuckman (1978:239) also suggests:

> At the meeting, the interviewer again should brief the respondent as to the nature or purpose of the interview and attempt to make the respondent feel at ease.

To ensure confidentiality, many researchers do not use the real names of the participants and institutions like school (see, Sethole, 2004; Julie and Mbekwa, 2005; Mbekwa, 2006 and Mwakapenda, 2004 to count a few). Sethole (2004) in the case study of two teachers, he did not use their real names. I adopted Sethole's approach not to use the teacher's name. I used the codes: Teacher 1 and Teacher 2, respectively. Both teachers were comfortable with that.

3.4 Piloting

The interview questions were piloted using the same criteria outlined in the selection of participants. The piloting was carried out during the June 2006 holidays. Piloting was meant to check the duration of the interview, and the strengths and weaknesses in questions. I discovered that the 30 minutes which were originally set for the interviews was not enough to get all questions answered appropriately. As a result of piloting the duration of the interview was adjusted from 30min to 40 minutes.

WitsETD

3.5 Data analysis

Data collected in two phases through interviews were transcribed from audio tape to transcripts to facilitate initial analysis. Learners' responses to Mathematical Literacy task were analysed by using three levels, completely correct (CC); partially correct (PC) and completely incorrect (CI).

3.5.1 Method for data analysis

Data analysis is an ongoing and iterative, that is, nonlinear process in qualitative research. Hatch (2002) presents five models of qualitative data analysis, namely Typological, inductive, interpretive, political and polyvocal analysis .Inductive and typological models were used in data analysis. Inductive model of data analysis allows the researcher to identify themes that emerged from the data. In inductive model, themes emerged from the data not from predetermined categories. In typological model, themes or categories are predetermined. Typological analysis involves dividing the data into categories or groups. Typological data analysis as according to Hatch (2002):

> Starts by dividing the overall data set into categories or groups based on predetermined typologies (p.153).

Having considered the instrument I was using for data collection, time frame and experience in data analysis, I regarded inductive and typological models for data analysis more convenient than other models.

3.5.2 Inductive model for data analysis

After the first interviews with the teachers were conducted, audio responses were transcribed. The researcher noted that there were common themes that were mentioned by both teachers. The transcripts were initially analysed by coding the common themes from both transcripts, for teacher 1 and teacher 2. After the analysis of the transcripts, six (6) themes were identified, see table 3.1.

WitsETD

Table 3.1 Themes for analysis

i) Theme 1: Balance of content and context
ii) Theme 2: Easy mathematics vs. difficult mathematics
iii)Theme 3: Meaningful mathematics
iv) Theme 4: Helpful mathematics
v) Theme 5: Interesting mathematics
vi) Theme 6: Practical mathematics

These themes were used in designing the interview questions for the second phase of data collection.

3.5.3 Typological model for data analysis

I had predetermined four categories for data analysis. These categories were predetermined as an attempt to address critical questions of this study.

***Category 1*:** Positive contributions of contexts in mathematics

This category covered all information that indicated the benefits of using contexts in teaching and learning of mathematical literacy.

Category 2: Disadvantages of contexts in mathematics

This category covered all information that indicated the negative impact of using contexts in teaching and learning of mathematical literacy.

***Category 3*:** Advantages and disadvantages of using contexts in mathematical literacy

This category covered all information that indicated both advantages and disadvantages of using contexts in teaching and learning of mathematical literacy.

Category 4: What informs teachers' views?

This category covered all the information that indicated what informs teacher' views on the role of contexts in mathematical literacy.

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3.5 Conclusion

This chapter has presented the research design and research methodology that was used in conducting the study. In chapter four the research process and data collection process are discussed.

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CHAPTER FOUR: RESEARCH PROCESS AND DATA COLLECTION

The focus of the study was on the teachers' views on the role of context in mathematical literacy. Interviews were the main source of data collection. Data was collected from the two teachers who were teaching Mathematical Literacy in Grade 10.

4. Background of the Teachers

There were two teachers involved in the study. To ensure anonymity they were coded Teacher 1 and Teacher 2. Both were male teachers of ages between 30 to 35 years. Both teachers had been teaching mathematics at grades 10-12 for more than 5 years. Teacher 1 has acquired a Diploma in Education (M+3) and Mathematics certificate from University of South Africa (UNISA) Teacher 1 had been involved in teacher development programmes and professional organisation such as The Association for Mathematics Education of South Africa (AMESA). He attended NCS workshops that were organised by KZN Provincial Department of Education, for both Mathematics and Mathematical Literacy. During the time of the interviews, he was doing Advance Certificate in Education, that is, ACE (in Mathematical Literacy). Teacher 2 had acquired a B Sc degree and a teaching diploma (M+4). Teacher 2 is also actively involved in teacher development programmes. He attended NCS workshops for Mathematics and Mathematical literacy. He was appointed and trained as a facilitator for a program offered by Nelson Mandela Metropolitan University (NMMU). This program was a two year course that led to an Advance Certificate in Education (Mathematical literacy).

4.1 Data collection

Data was mainly collected through interviews. A Mathematical Literacy task with five (5) questions was designed and given to the grade 10 learners to write.

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4.1.1 Interviews

After gaining access to conduct the research in the two identified schools, I made an appointment with the two teachers who were involved in the study. I met them on different dates and agreed on the dates for interviews. There were four (4) interviews that were conducted. Each teacher was interviewed twice. I called these interviews phases, which are phase 1 and phase 2 of data collection. The first two interviews fall under Phase 1 and the last two interviews fall under the Phase 2 of data collection, see table 4.1.

Table 4.1. Interviews dates

INTERVIEW NO	DATE	Phase: Teacher
01	27 Sept. 2006	Phase 1: Teacher 1
02	28 Sept 2006	Phase 1: Teacher 2
03	30 Oct.2006	Phase 2: Teacher 1
04	31 Oct.2006	Phase 2: Teacher 2

In the first phase, the main focus question was on the teachers' views on the role of context in Mathematical Literacy. The following questions were used:-

Table 4.2 Interview questions: Phase 1

Questions
1. a) What is your understanding of Mathematical Literacy? (b)What are your experiences in Mathematical Literacy? 2. Mathematical Literacy seems to contextualize mathematics. What contexts are commonly presented or used in Grade 10 Mathematical Literacy textbooks that you are using? 3. What do you think could be the possible reason for inclusion of contexts in Mathematical literacy? 4. How would mathematical literacy look like if contexts were not included or emphasized? 5. How do you find using contexts in teaching and learning Mathematical Literacy? 6. If you were involved in curriculum design for Mathematical literacy, what will be your suggestions about structure or nature of Mathematical Literacy for grade 10?

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In the second phase the focus was on what informs teachers' views on the role of context in Mathematical Literacy. The learners' responses and teachers' responses in the first interviews were used to design interview questions for the second phase of the interviews. Questions were designed on the basis of the themes that emerged in the first interviews and the learners' responses to the task.

A Mathematical task was designed such that two types of questions were included. One type of questions was real life context based (question a, b & c) and the other type of questions (d & e) was mathematics context based or context-free (Du Feu, 2001).

Table 4.3 Mathematical Literacy Task given to the learners

***1*. Real life context based questions**

a) Six oranges cost R12, 00. How much will nine oranges cost?

b) If two learners go out from the class after every four minutes. After 10 minutes how many learners will have gone out of the class?

c) Three cups cost R4.50. How many cups can be bought for R12.00?

2. Mathematics context based questions

d) Solve for X: $4x = 12$

e) If $3y = 6$ then $5y =$ ……..

Based on the task in Table 4.3 and based on the responses from the first interviews, teachers were asked the following questions in Table 4.4

WiSETD

Table 4.4 Interview questions for the Phase 2

1. Questions from the first interviews
i) How much is the context and content in these questions?
ii) How do you determine the percentages of context and content?
iii) Why should there be a balance between content and context?
2. Questions based on the learners' responses
iv) What do you think could be an appropriate approach to solve these problems?
v) Do you think these were easy or difficult questions?
vi) Do you think the inclusion of contexts makes these questions easy or difficult?
vii). Do you think there is something interesting for the learners in these questions?

In both phases of data collection interviewing method was semi-structured and the question format was open-ended. Responses were recorded by interviewer (digital recorder) then later; responses were transcribed into text for data analysis.

4.1.2 Mathematical Literacy task.

The Mathematical Literacy task in Table 4.3 was designed and given to fifteen (15) grade 10 learners to write. Learners were selected from Physical sciences and mathematics field, Human and social sciences (HSS) field and economic and management sciences (EMS) field. Each field was represented by five learners. Ages for the learners range between 15 to 18 years. These learners were of different cognitive abilities and they spoke iSiZulu as their first Language. The learners' responses were marked and analysed by the researcher in order to design appropriate questions for interviews in the second phase.

4.1.3 Examples of learners' responses

The learners' responses were categorised into three levels. First level is completely correct (CC). In question (a) for instance, the correct answer is R18-00. It is procedurally accepted if the learner can start by calculating that each orange costs R2-00, then 9

WitsETD

oranges will cost R18-00. Some learners were providing only the final answer without showing all calculations; such answers were considered completely correct (CC) as long as they are correct.

The second level is partially correct (PC). If the learner had given a part of the solution but not the complete solution, then that answer was considered as partially correct. In the first question (a), some learners were calculating the price for each orange but not the price of nine oranges. In question (c) where the learners were asked to calculate the number of cups that can be bought for R12.00; some learners were able to calculate that each cup costs R1-50, then they stopped or they continued but made wrong calculations. In question (e) learners were expected to calculate the value of 5y if 3y is equal to 6. Some learners were able to calculate that y = 2 but failed to calculate 5y. Such answers were considered partially correct.

The third level is completely incorrect (CI). If the learner gave an answer which was totally irrelevant to the question, the answer was considered completely incorrect. In question (d) for instance, learners were supposed to calculate the value of x in 4x = 12; the expected answer was x = 3. Some learners were giving irrelevant answers like, x = 6. Some learners were giving a single answer without any calculations shown on the script, unfortunately only to find that the answer given is incorrect. All such answers were considered completely incorrect (CI).

After marking all the responses, the answers were then analysed and presented in table 4.5 below.

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Table 4.5 Learners' responses on the task

Learner	Field	Item a	Item b	Item c	Item d	Item e
1	Science	**CC**	**CC**	**CC**	**CC**	**CC**
2	Commerce	**CC**	**CI**	**CI**	**CC**	**CC**
3	Commerce	**CC**	**CI**	**CC**	**CI**	**CC**
4	Humanities	**CC**	**PC**	**CI**	**CI**	**CC**
5	Humanities	**CC**	**CI**	**CI**	**CI**	**CC**
6	Science	**CC**	**CC**	**CC**	**CC**	**CC**
7	Science	**CC**	**CC**	**PI**	**CC**	**CI**
8	Humanities	**PI**	**CC**	**CI**	**CC**	**CC**
9	Humanities	**CC**	**CC**	**CC**	**CC**	**CI**
10	Humanities	**CI**	**PI**	**CC**	**CC**	**CC**
11	Commerce	**CI**	**CC**	**CI**	**CC**	**CC**
12	Science	**CC**	**CC**	**PI**	**CC**	**CI**
13	Commerce	**CC**	**CC**	**CC**	**CC**	**CI**
14	Science	**PI**	**CC**	**CC**	**CC**	**CC**
15	Commerce	**CC**	**CC**	**CC**	**CC**	**PI**

The codes **CC** Completely Correct**, PC** Partially Correct **CI** Completely incorrect were used.

The responses were further analysed according to the number of correct, partially correct and completely incorrect responses. The table 4.6 below presents information about the number of correct and incorrect responses.

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Table 4.6 Analysis of correct and incorrect responses

Item	Number of CC	Number of PC	Number of CI
(a)	11 (73.4%)	2 (13.3%)	2 (13.3%)
(b)	10 (66.7%)	2 (13.3%)	3 (20%)
(c)	8 (53%	2 (13.3)	5 (33.3%)
(d)	12 (80%)	0 (0%)	3 (33.3%)
(e)	10(66.7%)	1 (6.7%)	4 (26.6%)

On the basis of information from the above tables and specific responses from learners, the questions in Table 4.4 were designed for teachers. Teachers were not shown the learners' scripts and these tables at first, but they were shown the questions, then later on, they were shown the learners' responses. This was done in order to get teachers' views without any external influence and the learners' responses were shown to the teachers to determine whether teachers' views would be shaped by the learner' responses or not.

4.2 Conclusion

This chapter has provided information on how data was collected. The next chapter provides information on data analysis.

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CHAPTER 5: DATA ANALYSIS

This chapter presents analysis of data. The data was collected in two phases, phase 1 and phase 2 from two Mathematical Literacy teachers respectively, through interviews. Two models for data analysis were used to analyse interviews transcripts. Since two teachers were interviewed, codes Teacher 1 and Teacher 2 were used for anonymity. The first part of this analysis, presents inductive analysis, and the second part presents typological analysis. In both models of data analysis constructivist theory was used to view how teachers construct their views and to view that which informs their views, on the basis of their prior knowledge and social interaction (Ismat, 1998 and Richardson, 1997). In the conclusion, issues for discussion are raised.

5.1 Inductive analysis

5.1.1 Analysis of data from phase 1

Data was collected through interviews. Two teachers who were teaching Mathematical Literacy in grade 10 were interviewed. The purpose of the interviews was to collect information on teachers' views of the role of contexts in Mathematical Literacy. In the analysis of the responses from both Teacher 1 and Teacher 2, six (6) themes with regard to the role of contexts in mathematical literacy emerged. These were:

i) Theme 1: Balance of content and context
ii) Theme 2: Easy mathematics vs. difficult mathematics
iii)Theme 3: Meaningful mathematics
iv) Theme 4: Helpful mathematics
v) Theme 5: Interesting mathematics
vi) Theme 6: Practical mathematics

i)Theme 1: Balance between content and context

Although both teachers responded differently when considering the role of contexts in mathematical literacy, they both emphasised the need for a balance between content and

WiSETD

context. When teacher 1 was asked to suggest how he would design content and context in mathematical literacy, he gave the following response:-

> **Researcher:** If you were involved in curriculum design for Mathematical Literacy, what will be your suggestions about structure or nature of Mathematical literacy for grade 10?
> **Teacher 1**: The percentage of context and content, the way I look at it, it is not balanced. Right now the context is about 70% and the content is about 30%, so it makes it difficult, actually currently learners can not do some or certain calculations–because others they do understand what is said, what is required, but they lack basic fundamentals that will enable them to treat the problem. So my suggestion is of 50% content and 50% context, which can make learners to be able to acquire basic fundamentals that will make them to treat problems. In most cases learners, they do understand that it is that and that and, but then you find that they lack those basic fundamentals that can be used to treat the problems.

According to Teacher 1, in order to consider content and context to be balanced, there should be 50% content and 50% context in Mathematical Literacy. He argues that if the content is 50% and the context is also 50 % that will make Mathematical Literacy balanced. Drawing from his experience, learners do not know to solve some mathematical problems because they do not have enough content. Teacher 1 considers the present curriculum not balanced. He contends that there is a lot of context but little content. From the above response, it does not show any indication of the role of context in Mathematical Literacy. It appears that the teacher is more concerned with the mathematics content knowledge that should be acquired or mastered by the students in order to solve mathematical problems. According to Teacher 1, the fact that learners lack basic fundamentals is due to the imbalance of content and context in the Mathematical Literacy curriculum.

Teacher 2 also did not see the current NCS Mathematical Literacy curriculum balanced. When responding to the question based on the inclusion of context in mathematical literacy, Teacher 2 indicated the percentage that he would consider it will make Mathematical literacy balanced.

> **Researcher**: How would mathematical literacy look like if contexts were not included or emphasized?
> **Teacher 2**: It was not going to be more meaningful-if the context was not included because content goes hands in hands with context. So context makes it more interesting.

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> At the present moment the content is about 60% and context 40%. I feel it would be better if the context was 60% and content 40%.

According to Teacher 2, balance between content and context dos not mean equal, but means more contexts (e.g. 60%) and less content (e.g. 40%). However in this context, Teacher 2 links balancing context and content with meaningful mathematics and the other themes that emerged from the responses, like interesting mathematics.

From this response it is evident that Teacher 1 and Teacher 2 see Mathematical Literacy differently. Teacher 1 considers more contexts, that is 70 % while teacher 2 considers less context, that is 40 % in the mathematical literacy curriculum. Teacher 2 considers more contexts will make Mathematical Literacy balanced. Mathematically 60 % and 40 % are not equal. Teacher1 suggests that the context should be 50% while teacher 2 recommends that the contexts should be 60 %.

Table 5.1 Balance between context and content

Teachers	**Present Grade 10 Mathematical Lit**	**Recommended contexts**	**Foregrounded**
Teacher 1	70% Contexts 30% Content	50% contexts 50 % content	Mathematics content knowledge
Teacher 2	60 % content 40% contexts	60% context 40 % content	Mathematics in real life Context

In the above table (Table 5.1) it is evident that both teachers have different views about the NCS mathematical literacy and have different views about how content and context should be balanced in the curriculum. The above shows that Teacher 1 foregrounds mathematics content knowledge than mathematics in real life context while for Teacher 2 it is the opposite.

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ii) Theme 2: Easy mathematics vs. difficult mathematics.

Both teachers indicated that inclusion of contexts in Mathematical Literacy makes mathematics easy. They both contend that mathematics has been perceived as a difficult subject because it has no relevance to the real life situation, thus Mathematical Literacy has been structured such that it relates to everyday real-life situation through the inclusion of contexts. They maintain that contexts do not only make mathematics easy but also assist in making the teaching of mathematics easy.

Researcher: What about in teaching and learning?

> **Teacher 1:** It makes it easy because, actually I would like to go back again, the problems that are dealt with are the problems related to the real life situations. So, that is why it is easy, although sometimes there are some problems there and there, like lesson planning and time. Most of the exercises are time consuming.

Teacher 1 considers the contexts that are based on real life situation as facilitating effective teaching and learning. Although he maintains that contexts in mathematical literacy make teaching easier he also contends that designing mathematics lessons which are contexts based requires a lot of time.

> **Researcher**: What do you think could be the possible reasons for inclusion of contexts in mathematical literacy?
> **Teacher 2:** Well, I think that could be a difficult issue for learners, so there should be both context and content. Normally in the past what made mathematics to be difficult was that it was based on content only. So the inclusion of context now, the learners can see what they are doing. It helps a lot because we teach learners what they can see, actual practical thing- it is easy for them to understand if you teach them what they can see.

Teacher 2, drawing from his personal experiences and his personal beliefs about mathematics, maintains that contexts in Mathematical Literacy are included in order to make mathematics more practical. He asserts that in the past learners experienced difficulties in learning mathematics because it had little of that was related to real life situations, hence learners could not see what they were doing.

Considering the above responses from both teachers, it is evident that they both value contexts in Mathematical Literacy; however Teacher 1 also indicated that designing activities which are context based requires a lot of time and resources. Teacher 2 links

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practical mathematics with easy mathematics. He contends that contexts make mathematics more practical and thus make mathematics easy.

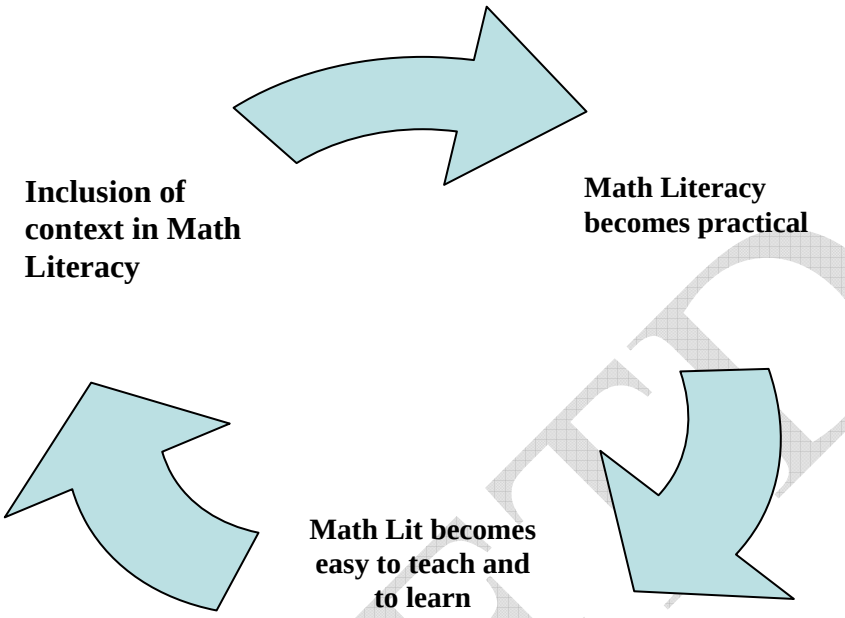


Fig 1 The role of contexts in teaching and learning Math Lit

iii) Theme 3: Meaningful mathematics

Both teachers have indicated that the inclusion of contexts in Mathematical Literacy makes Mathematical Literacy more meaningful. They maintain that if contexts were not included in Mathematical Literacy, Mathematical Literacy would not be meaningful.

> **Researcher:** How would Mathematical Literacy look like if contexts were not included or emphasized?
>
> **Teacher 1:** If we take out the context from Mathematical Literacy, so Math Lit will be less meaningful because really Math Lit will not create or develop that interest to the learners to do Mathematical Literacy. Like in the case of mathematics most of the things are not contextualized, it is just pure Mathematics. I can say mathematics is too abstract and learners fail to understand or to make sense out of it. Mathematical Literacy to me or the way I look so it. So the inclusion of context in Mathematical Literacy is so important because it makes it more meaningful.
>
> **…**

WitsETD

> **Teacher 2:** It was not going to be more meaningful-if the context was not included because content goes hands in hands with context. So context makes it more interesting.

Both teachers posit that the inclusion of contexts in Mathematical Literacy makes mathematics more meaningful and enables learners to access mathematics. Teacher 1 also maintains that the inclusion of contexts makes mathematics sensible while Teacher 2 maintains that it makes mathematics interesting. Learners are able to attach meanings to the mathematics they are learning if mathematics has been contextualised to what they experience in everyday real-life situations. Teacher 1 considers mathematics as abstract (because it does not include contexts).

iv) Theme 4: Helpful mathematics

Teacher 1 and teacher 2 recognised positive contributions of contexts in mathematics. Their responses indicate that contexts help learners in two ways: (i) it helps learners to solve mathematical problems in school mathematics; (ii) it helps the learners to solve problems in real world situations, in day to day experiences. The inclusion of contexts in mathematical literacy also contributes to effective teaching of Mathematical Literacy.

> ***Teacher 1:*** It helps me a lot, …. We are able to plan or to predict what will happen in future, if at the present moment we have this situation. So it is helping a lot and to learners as well.
>
> **…**
>
> **Teacher 2:** It helps a lot because we teach learners what they can see, actual practical thing- it is easy for them to understand if you teach them what they can see.

It appears that Teacher 1 considers that contextualised mathematics helps both teachers and learners to use or apply mathematics in real life situations that could be even out of school while Teacher 2 considers contextualised mathematics helpful for learners to understand mathematics (in a classroom situation).

From both responses, teachers linked 'help' with 'easy' and understanding. They contend that contexts help to make Mathematical Literacy easy and understandable for both teachers and learners. Teacher 1 indicated that some of the contexts used in Mathematical Literacy, e.g., financial matters, help them to understand budgets and loans in real-life situations.

WitsETD

v) Theme 5: Interesting mathematics

Teacher 1 indicates several times that contexts make Mathematical Literacy interesting. Teacher 1's comment implies that if the context is about something that learners know or live with, they get interested in doing Mathematical Literacy.

> **Teacher 1:** If we remove real life context from Mathematical Literacy, so Mathematical Literacy will be less meaningful because really Mathematical Literacy will not create or develop that interest to the learners to do Mathematical Literacy.

Teacher 1 asserts that contexts develop interest in learners. He maintains that what makes mathematics not interesting to learners is because it does not have contexts. Teacher 2 did not say anything about how contexts make Mathematical Literacy interesting to learners.

vi) Theme 6: Practical mathematics

Another important point Teacher 2 makes is that contexts make mathematical Literacy practical. He links 'practical' with 'something that you can see'. Teacher 1 did not say anything about 'practical mathematics' but has indicated that mathematics is abstract because it does not have contexts.

> **Teacher 2:** So the inclusion of context now, the learners can see what they are doing. It helps a lot because we teach learners what they can see, actual practical thing- it is easy for them to understand if you teach them what they can see.
> **Teacher 2:** Yaa! The way Mathematical literacy been structured, it has moved away from away from theory to practical. So students can solve thing that they see than solving x and y. so context first then content…

Teacher 2 links 'practical' and 'easy'. He contends that learners will find mathematical literacy easy if it is presented as practically as possible, through the inclusion of contexts.

The analysis of the first phase of interviews reveals that both teachers interviewed recognise the role of contexts in Mathematical Literacy. They have mentioned some of the contexts that are commonly used in Mathematical Literacy such as financial issues, health issues, bills (telephone, water etc) cell phones etc. They maintain that contexts in Mathematical Literacy help both learners and teachers in two ways: Firstly, it helps in

WitsETD

accessing mathematics in school, and secondly, it helps in the application of mathematics in every day situations. Teacher 1 however indicates two disadvantages of contexts in Mathematical Literacy: (i) too much contexts in Mathematical Literacy will deny the learners' access to basic mathematical concepts, consequently, learners will not be able to solve mathematical problems (ii) to design mathematical activities which are context based requires a lot of time and resources.

5.1.2 Analysis of data from phase 2

The focus question in the first phase of data collection was: "What are teachers' views on the role of contexts in mathematical literacy?" The analysis revealed the themes presented in the first section of this chapter. In this section, the analysis is based on follow up interviews, whereby the focus question was: "What informs teachers' views of the role of contexts in mathematical literacy?" Themes that emerged in the first phase of interviews were used in the follow-up interviews. The mathematical literacy tasks were set for grade ten learners and teachers were asked to comment on the questions (tasks) and learners' responses. Based on the themes that emerged in the first phase of the interviews, the following questions were asked:-

Consider the following questions that were given to grade ten learners.

Table 5.2 Mathematical Literacy questions given to learners

a) Six oranges cost R12, 00. How much will nine oranges cost?
b) If two learners go out from the class after every four minutes. After 10 minutes how many learners will have gone out of the class?
c) Three cups cost R4.50. How many cups can be bought for R12.00?
d) Solve for X: $4x = 12$
e) If $3y = 6$ then $5y =$ ……..

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The correct response to question (a) is R18 but one learner said “18 oranges”. The correct response to question (b) is “5 learners” but one student responded “40 learners”. The correct response to question (e) is 5y = 10, but one learner said “2/5”. At first, teachers were not shown these learners’ responses but they were required to comment on questions and to suggest how learners would respond to these questions. Later, the teachers were shown the learners’ responses and were required to comment on the effect of contexts on learners’ responses. They were asked the following specific questions:

i) How much is context and content in these questions?

ii) How do you determine the percentages of context and content?

iii) Why is it necessary that there should be a balance between content and context?

iv) Do you think these were easy or difficult questions?

v) Do you think there is something interesting for the learners in these questions?

vi) Do you think the context has an influence in answering these questions?

5.1.3 The analysis of teachers’ responses to the above questions.

i) How much is the context and content in these questions?

In the first phase of interviews teachers responded differently on how much contexts and content is in the current NCS Mathematical literacy (grade 10). With respect to the amount of context and content in questions on table 4.3, teacher 1 and teacher 2 responded differently.

> **Teacher 1**: The way I look at it the context is not too much because mostly it involves division and multiplication.
> **Teacher 1**: I can say the content and context are balanced, that is **50%** and **50%** (respectively)
> **Teacher 2**: The context is almost **60 %** and the content is **40 %.**

Since both teachers have different views about the amount of contexts and content in these questions, their responses gave rise to the next question as to how do they determine the amount of context in any given task

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ii) How do you determine the percentages of context and content?

It is important to know how the two teachers determined the percentages of the contexts and content. The analysis reveals that the two teachers have different ways of determining the amount of contexts and content.

> **Teacher 1:** I look at the question itself. Like the first question, the statement is simple and the question is simple, and there few calculations that are to be made. There are no complications in as far as content and context.
>
> **…**
>
> **Teacher 2:** I look at the questions as a whole, the way they have been structured. The first three questions are context based and the rest are content based, so it is **3/5 = 60%** most of the things they are context based, so these ones are also context based.

Teacher 1 considers all questions as having a content and context though the first three are more real life context based and the last two are more mathematics content based. He then gives the overall percentage. Teacher 2 counts the number of questions and divides the questions either context based or content based (not both). That is why he gets 60 %.

iii) Why is necessary that there should be a balance between content and context?

In the previous interview, teachers indicated that there should be a balance between context and content. They were asked if they consider the questions (a-e) as having a balance. They were asked why there should be a balance between contexts and content.

> **Teacher 1**: At the early stages like this in grade 10, I think content and context should be balanced so that learners will be interested as they read the questions, so they find that the content and context are balanced, they become interested in such things. If the content is more than the context or the context is more than the content there will be some problems
> **Teacher 1**: Yah, if it is balanced, the content and context, then it becomes easier for the learners to solve the questions
>
> **…**
>
> **Teacher 2**: I think the reason is being that some of the learners are actually…. since this is the new subject they should get used to it. There is a need for a balance because some are used to the old style. So if the context and content is balanced, the learners will be covered, get context and a bit of content.
> **Teacher 2**: I think there is a need of having both content and context but dominated by the Context.

From these responses, it has been revealed that the two teachers have different interpretations about 'balance' regarding context and content. Teacher 1 considers a balance between content and context if the two are equally represented, say 50% content

WitsETD

and 50% contexts. He argues that if either context or content is dominated there will be some problems, e.g. if there is a little content learners will not be able to acquire basic mathematical concepts. On the other hand, teacher 2 considers a balance between contexts and content if the context is dominant. They both agree with each other that contexts are very important in making mathematical literacy '*easy*'.

iv) Do you think these were easy or difficult questions?

According to the responses that teachers gave with regard to balance between context and content, it is evident that both teachers consider the given tasks on table 4.3 balanced. If that is the case, it is interesting to see how the teachers had responded to the above question with respect to *easy* or *difficulty*.

> **Researcher**: Do you think these were easy or difficult questions?
> **Teacher 1**: Yah, if it is balanced, the content and context, then it becomes easier for the learners to solve the questions
>
> **Teacher 2**: I can't say they were easy or difficult but I can say they were up to the standard, especial learners who listen when the teacher is…….!
>
> **Researcher**: Do you think the inclusion of contexts makes these questions easy?
> **Teacher 1**: Yah, as compared to (d) and (e), because here in number (d), the learners just look 4x = 12, they just look, what is 4x, there is nothing that come s to their mind before solving the problem or finding the value of x
>
> **Teacher 2**: Yes, like question (c), this has to do with budget, like if you buy cups at Three cups cost R4.50, then for R12.00 you get …

Teachers (1 & 2) claim that since these questions (a-e) are balanced, learners would be able to solve them. Teacher 1 referred to question (d) that when solving for x in $4x = 12$, there is little for the learner to understand what we mean by $4x = 12$, and there is little that could help the learner in determining the answer. But when putting the same question in context, the learner can relate it to the real situation and be in the position to solve the problem. $4x = 12$ can be solved by using mathematical procedures and requires a specific mathematical knowledge or background. If the very same problem $4x = 12$ has been structured such that it involves real life context, like four oranges cost R12, how much will nine oranges cost? The learner may have alternative ways of finding the solution, sometimes unaware that he/she is applying mathematical procedures.

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Teacher 2 considers the questions balanced, that is, neither easy nor difficult, however he recognises the questions dominated by the contexts to be easy for the learners because they talk about what learners are used to, that is, the money.

v) Do you think there is something interesting for the learners in these questions?

In the previous interviews teachers indicated that contexts make mathematical literacy interesting. It is also interesting to understand what they mean by 'interesting' and how do they determine the interesting mathematics. With regard to the above question, the teachers responded this way:-

> **Researcher**: Do you think there is something interesting for the learners in these questions?
> **Teacher 1:** Yes, especially with the first three questions, such questions enable learners to think constructively and logically, taking it from the real situations and then using the content to solve the problem. When the problem is in the real world situation, it is much easier for the learners to solve than when it is not contextualised.
> **…**
> **Teacher 2**: Yes, like question (c), this has to do with budget, like if you buy cups at Three cups cost R4.50, then for R12.00 you get …!
> **Researcher:** Do you think learners would prefer questions with contexts?
> **Teacher 2**: Yes, because it is something that they can discuss, and set examples, but in terms of these ones like 4x =12 they are solving for x which they do not know what x is all about- the question with a context is more practical. So they will find these very interesting.

Both teachers maintain that the first three questions are interesting and they hope that the learners would prefer to do them or would do better in these questions. According to the teachers, what they consider as 'interesting' is what the learner is used to, for example in these questions what is interesting to the learners could be money, fruits etc.

vi) Do you think the context has an influence in answering these questions?

All the teachers' responses that have been presented above were not influenced by learners' responses. Some of the learners' responses were presented to the teachers with an aim to see if their views about the role of the contexts will be shaped by the learners' responses. It was expected that teachers might see either positive or negative or even both

WiSETD

effects of contexts on mathematical literacy, especially when learners are answering questions.

One learner responded to the first question (a) in an unexpected way. The learner responded "18 *oranges*". The researcher asked the teachers the following question:-

> **Researcher**: Let's look at some of the learners' responses. In the first question (a) the expected answer is R18. What would you say if the learner says 18 oranges instead of R18?
> **Teacher1**: Yah, that one can be taken as an answer but not given full credits, because the learner might have forgotten that what he/she is calculating is the money not oranges. The method is correct but the answer is not correct.
> **…**
> **Teacher 2** I think that can happen, it is the matter of understanding, whether he/she did or did not understand what the question requires. Because some of the learners they take this for granted. 6 oranges R12 than 9 will be 18, without understanding. I think we need to teach our learners to understand the question before they attempt answering any question.

At this stage teachers did not necessarily see the impact of the contexts on this answer. Teacher 1 considered the incorrect answer (*18 oranges*) as an error or minor mistake. Teacher 2 thought that the learner did not understand the question. In the previous responses he had made he indicated that contexts enable learners to understand the problem. In order to make both teachers reflect directly on the effects of the context on this answer given by the learner, the researcher asked the following question:-

> **Researcher**: Don't you think the context was the cause or had an influence in this answer?
> **Teacher 1**: Yes, the context might have had the influence, because some of our learners have some problems, let me say the language barrier, so which is giving us a lot of problems.
> **Teacher 2**: Yes it is a barrier because they need to understand.

The responses given by both teachers respectively indicate that sometimes contexts do not help the learners to solve problems without any difficulty. It was clear that sometimes context may have a negative impact in mathematical literacy. Teacher 1 raised the issue of language. He contends that problems or tasks with contexts have linguistic demands considering that most of the learners are not native speakers of English which for them is the second language..

WitsETD

To determine if the learners' responses to the tasks would shape teachers' views on the role of the contexts, the following question was asked to see how the teachers would respond:

> **Researcher**: So should we move away from context because it is a barrier for the students to access mathematics?
> **Teacher 2**: No, we should not run away from the context but we need to explain to the learners thoroughly that this is what they need to understand-when they attempt any questions.
> **…**
> **Teacher 1**: From what I have seen, I feel maybe more context should be included maybe 55-60%, because we have this problem of language barriers, so in most of the problems here not that learners can not solve these problems but it is just that they are not used to such questions.
> **Teacher 1**: More contexts should be included so that the learners will be acquainted with the uses of the contexts.

Although there were some learners who could not find the correct answers to questions (see Table 4.5), even those questions which are context based, teachers still maintained that real life context is very important in mathematical literacy. Teacher 2 pointed to the responsibility of the teacher to teach learners to try to understand a question before answering it. Teacher 1 suggested that more contexts should be included in class activities so that the learners will be exposed to contextualised mathematics. He also maintained that contexts enable learners to relate mathematics to real life situation. Besides the contexts, Teacher 1 also sees language as a barrier in teaching and learning mathematical literacy.

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The issue of language arose several times. The researcher wanted to find out what would be the teachers' views on the issue of language and contexts. The following question was asked and the response was as follows:-

> **Researcher:** Is there any way to solve the language problem.
> **Teacher 1**: Right now I can not come out with the answer, but what I can suggest, the learners must be exposed to the questions which have lot of contexts
> **…**
> **Teacher 2**: Yes, language is a barrier, a big problem especially to our learners.
> **Teacher 2:** I think the problem that we are having is us teachers, we intend to teach in the home language and we expect the learners to answer questions in English. No one who will interpret for them in the examinations. If we can teach it (Math Lit) in English, then the learners will be able to answer questions

WITSETD

Teacher 1 suggested that one way to solve the problem of a language as barrier is by exposing learners to a lot of mathematical activities or tasks which are context based. Teacher 2 sees a problem on the teachers who are normally used to code switching excessively when teaching Mathematical Literacy. He suggests that teachers should teach in the language of learning and teaching.

In this section, teachers' responses with regard to the role of contexts in mathematical literacy have been analysed. Two most important aspects have been taken into consideration. The first aspect of this analysis is to analyse teachers' views on the role of context in mathematical literacy. The second aspect is to determine that which informs teachers' views on the role of contexts in Mathematical Literacy in grade 10.

The analysis of the first interviews i.e. in the first phase of data collection has revealed that both teachers interviewed had a strong belief that contexts play a major role in Mathematical Literacy. Amongst the other things they mentioned are: Balance of content and context, easy mathematics vs. difficult mathematics, meaningful mathematics', helpful mathematics, interesting mathematics and practical mathematics.

The analysis of the data collected in the second phase of data collection has revealed amongst other things that teachers have unique ways of looking at one thing. Although they both agreed that questions (a)-(e) were balanced, they had different interpretations of what is meant by 'balance'. They both maintained that contexts are very important in mathematical literacy, for they make mathematics easy, practical and interesting. They acknowledged that sometimes contexts might not help learners to access mathematics or to solve mathematical problems, however, they argue that the language in which the problem is presented has a great effect. They maintain that learners are battling with the second language which is the language of learning and teaching (LoLT). A suggestion made is that teachers should try to minimise code switching as excessive use of code switching may disempower learners.

In the next section, I present the analysis on the links between the two phases that have been presented above in section 1 and section 2.

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5.1.4 The two phases linked together

In the first phase of data collection the focus question was: "What are teachers' views on the role of contexts in Mathematical Literacy? In the second phase the focus question was: What informs teachers' views of the role of contexts in Mathematical Literacy? It is important to explore the possible links in responses made in the first phase and in the second phase. In response to this, I have considered the responses made by individual teachers in the first and second phases. I have paid more attention to how the learners' responses shape the teachers' responses.

5.1.5 Teacher 1

In the first phase of data analysis Teacher 1 maintained that there should be a balance between the content and contexts. According to teacher 1 'balance' is 50%:50% respectively. He was concerned with the present curriculum that it is not balanced; it has ±70 % contexts and ±30% content. He suggested that adjustments should be made. In the second interview he continued to maintain 50 % contexts, and he claimed that questions (a)-(e) were representing 50% contexts and 50% content. It is surprising however that after having seen learners' responses he changed his mind suggesting that there should be more contexts (60%) than content (40%).

> **Teacher 1**: From what I have seen, I feel maybe more context should be included maybe 55-60%, because we have this problem of language barriers, so in most of the problems here not that learners can not solve these problems but it is just that they are not used to such questions.

Learners' responses seem to have to a certain extent influenced teacher's responses. Most importantly, a new theme on language issue emerged. In the first interviews Teacher 1 did not talk about the effect of language in relation to the contexts.

With respect to the other themes that emerged in the first interviews, there is a close relation between those responses and responses Teacher 1 made in the second phase of the interviews. However, it is noted that in the first interview Teacher 1 never said precisely that the contexts may sometimes be a barrier to the learners; but in the second interview there were statements whereby he indicated clearly that contexts may become a barrier for learners. Two aspects of constructivism theory are applicable to Teacher 1(see

WitsETD

chapter two). In the first phase Teachers' views were informed by prior knowledge of contexts in Mathematical Literacy. In the second interview, his views on the role of contexts were shaped by learners' responses (interaction with learner's responses) to Mathematical Literacy task (Cannella & Reiff, 1994)

5.1.6 Teacher 2

In the first interview in the first phase of data collection, Teacher 2 indicated that the current Mathematical Literacy curriculum is not balanced, that is 60% content and 40% contexts. He recommended that contexts should be 60% and content be 40%. According to Teacher 2 'balance' is when context is dominant over content. He maintained that contexts help the learners to do Mathematical Literacy easily. In the second interview, Teacher 2 continued to maintain that contexts should be 60% and content be 40%. After having seen some of the learners' responses he acknowledged that contexts may have had a negative impact on learners' responses. He however contends that language has more negative impact on learners when answering questions.

There was a close relationship between responses made in the two phases, especially with regard to the role of contexts in Mathematical Literacy; it makes mathematics interesting, practical and easy. For Teacher 2, learners' responses had a little influence on his views on the role of context.

Table 5.3 Balance between context and content links between phases

Teachers	**Present Grade 10 Mathematical Lit**	**Recommendations Phase I**	**Recommendations Phase II**	**Fore grounded**
Teacher 1	70% Contexts 30% Content	50% contexts 50 % content	60% contexts 40 % content	Content knowledge
Teacher 2	60 % content 40% contexts	60% context 40 % content	60% context 40 % content	Context

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5.2 Typological analysis

5.2.1 Category 1: Positive contributions of contexts in mathematics

This category covered all information that indicated the benefits of using contexts in teaching and learning of Mathematical Literacy.

> **Researcher**: From your experience how do contexts help you as a teacher as well as learners?
> **Teacher 1:** It helps me a lot, like because now I am able to understand, like for an example the way they charge to post a letter at the post office, I am able to know that if I am having such an envelop, this is what they are going to charge me. Like if I am investing money at a certain interest rate then I know that after a period of let say 10 years this is how…., the amount I am going to get. We are able to plan or to predict what will happen in future, if at the present moment we have this situation. So it is helping a lot and to learners as well.
> **Teacher 1:** So, the context will be in the position to help, because those problems are in real life situations that are happening so that's why more contexts are included so that learners will be interested in doing it.

From these responses, Teacher 1 contends that real life context in mathematical literacy makes mathematics interesting to the learners. It is interesting for one to find out how contexts make mathematics interesting and to find out as to what extent context makes mathematics interesting.

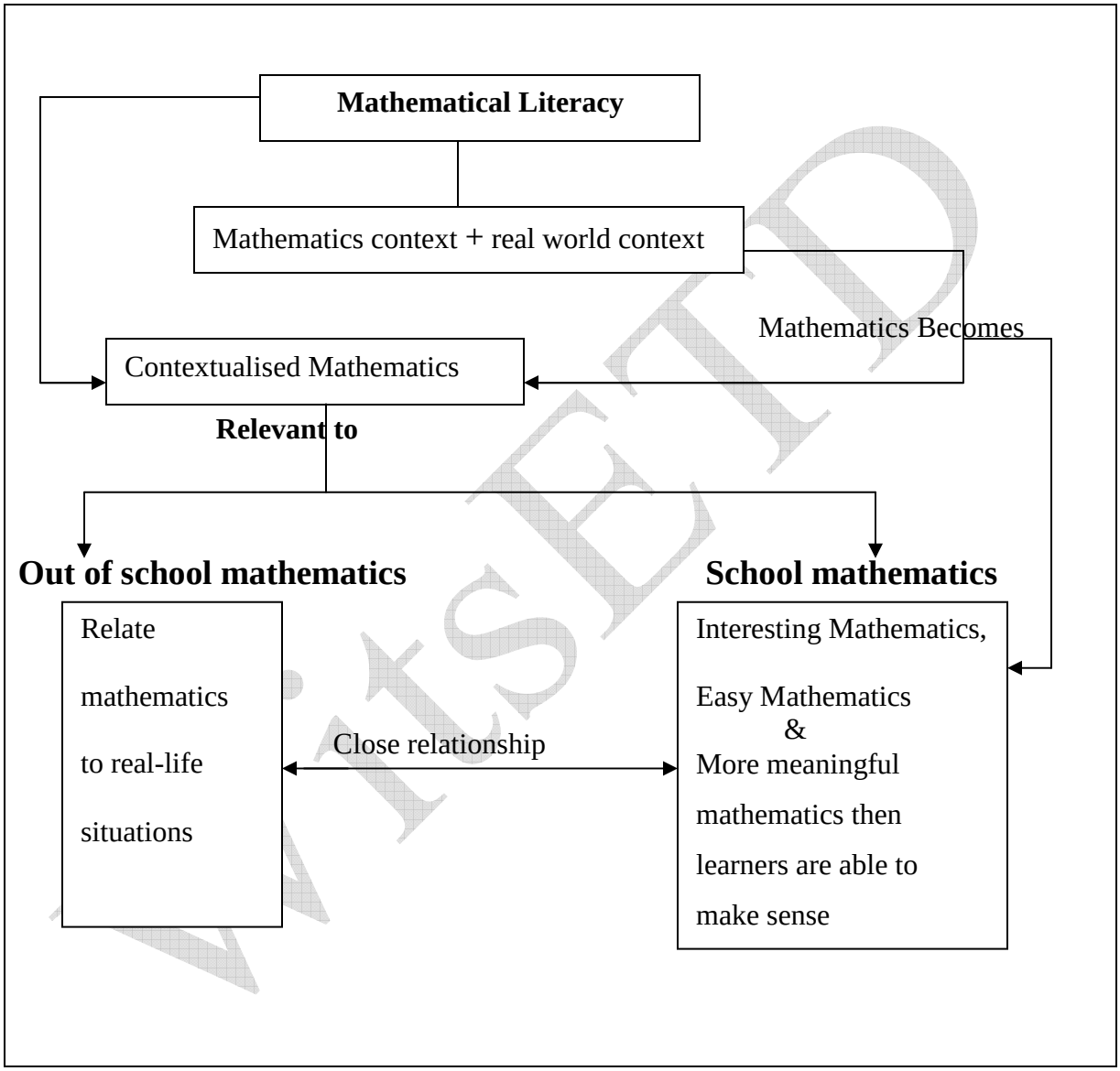
> **Researcher:** What about in teaching and learning?
> **Teacher 1:** It make it easy because, actually I would like to go back again, the problems that are dealt with are the problems related to the real life situations. So, that is why it is easy, although sometimes there are some problems there and there, like lesson planning and time.
> **Researcher:** How would Mathematical Literacy look like if contexts were not included or emphasized?
> **Teacher 1:** If we remove the real life context from Mathematical Literacy, so Math Lit will be less meaningful because really Math Lit will not create or develop that interest to the learners to do Math Lit. Like in the case of mathematics most of the things are not contextualized, it is just pure Mathematics. I can say mathematics is too abstract and learners fail to understand or to make sense out of it. I-Math Literacy to me or the way I look so it. So the inclusion of context in Mathematical Lit is so important because it makes it more meaningful.
> **Teacher 1:** Especially with the first three questions, such questions enable learners to think constructively and logically, taking it from the real situations and then using the content to solve the problem. When the problem is in the real world situation, it is much easier for the learners to solve than when it is not contextualised.

From the above responses that were given by Teacher 1, it appears that teacher 1 considers the positive contributions of contexts in Mathematical Literacy. The aspects of

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the contexts raised by the Teacher 1 are interesting, meaningful, easy and sensible. The contributions can be presented as follows on **figure 2**

Figure 2 Positive contributions of contexts in Mathematics according to Teacher 1.



The above figure shows how Teacher 1 views the role of real life context in mathematical literacy.

…

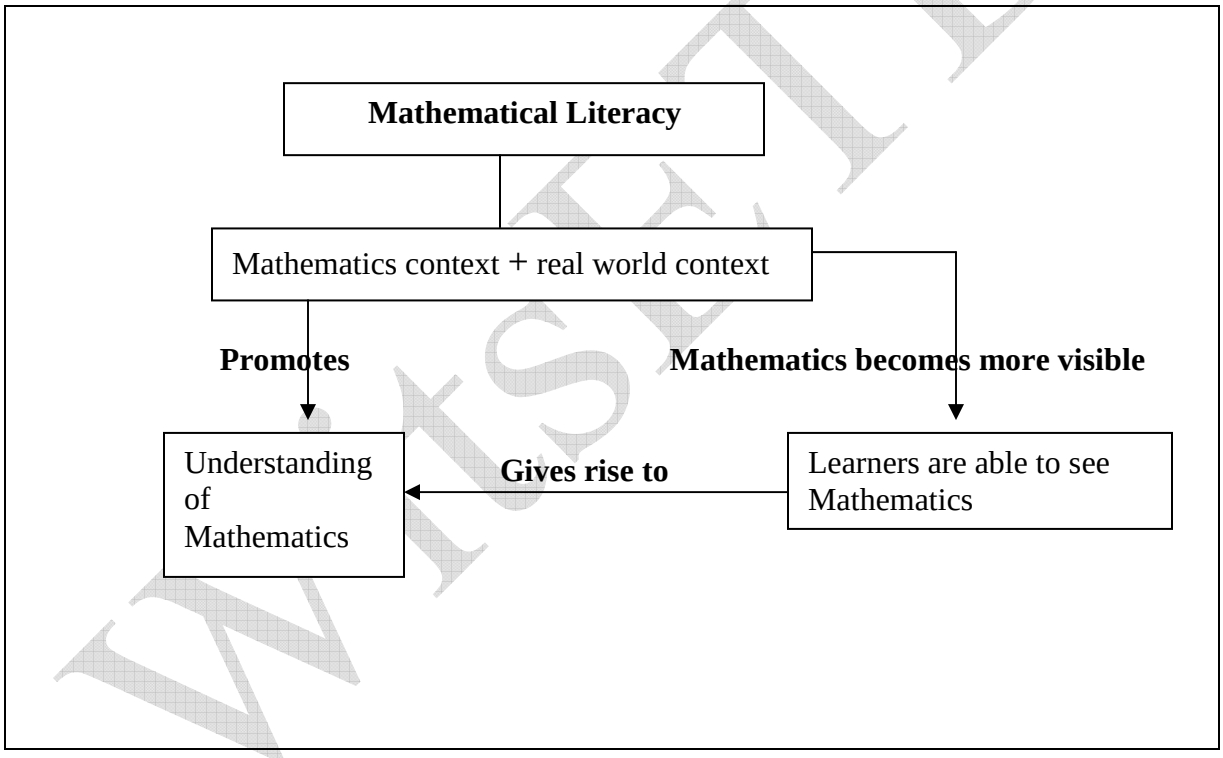
Teacher 2: It is very important when you are teaching the learners something that they can see. It is easier for them to understand or compare to something that they do not know, as I highlighted before that even…. It will be good for the DoE to put more contexts so that learners will be able to do the tasks even at home on daily basis.

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Researcher: When you look at the context you are saying the learners will be able to do maths at school and out of the school?
Teacher 2: Yah!
Teacher 2: Well, I think that could be a difficult issue for learners, so there should be both context and content. Normally in the past what made mathematics to be difficult was that it was based on content only. So the inclusion of context now, the learners can see what they are doing. It helps a lot because we teach learners what they can see, actual practical thing- it is easy for them to understand if you teach them what they can see.

Teacher 2 also points out that contexts play a major role in Mathematical Literacy. The key points he has raised are practical mathematics (something that you can see) and understandable mathematics. His views are presented in figure 3.

Figure 3: Positive contribution of contexts in Mathematics according to teacher 2.



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5.2.2 Category 2: Disadvantages of contexts in mathematics

This category covers all information that indicates the negative impact of using contexts in teaching and learning of mathematical literacy.

> **Teacher 1:** The percentage of context and content, the way I look at it, it is not balanced. Right now the context is about 70% and the content is about 30%, so it makes it difficult, actually currently learners can not do some or certain calculations–because others they do understand what is said, what is required, but they lack basic fundamentals that will enable them to treat the problem. So my suggestion is of 50% content and 50% context, which can make learners to be able to acquire basic fundamentals that will make them to treat problems. In most cases learners, they do understand that it is that and that and, but then you find that they lack those basic fundamentals that can be used to treat the problems.
> **Teacher 1**: Yah, it does create some problems, especially time, to design tasks with contexts is time consuming but on the other hand it really helps the learners.
> **Researcher**: Can you comment on the effect of the context in this question and answer?
> **Teacher 1**: yah, the problem is the context.

Although Teacher 1 strongly believes that contexts play a major role in mathematical literacy, he also contends that contexts also have some disadvantages. He points to two issues: time to design contextualised tasks and basic mathematics concepts or principles. He is concerned that too much real life contexts in mathematical literacy may result in a situation where learners lack mathematical concepts or basic fundamentals of mathematics knowledge.

> **Researcher:** Don't you think the context was the cause or had an influence in this answer?
> **Teacher 2**: Yes it is a barrier because they need to understand.

Teacher 2 also raises concerns about contexts in mathematical literacy. He asserts that contexts may become a barrier to the understanding of mathematics for the learner.

Both teachers raise the issue of language as a concern. They both maintain that some learners are not competent enough to understand English language, yet most contextualised tasks have some elements of linguistic demand. In that case, contexts work as a disadvantage from the learner's point of view because they need to understand and interpret the text before they can respond to the question.

5.2.3 Category 3: Both advantages and disadvantages of using contexts in Mathematical Literacy.

This category covers all information that points to both the advantages and disadvantages of using contexts in the teaching and learning of mathematical literacy.

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Researcher: Don't you think the context was the cause or had an influence in this answer?
Teacher 1: Yes, the context might have had the influence, because some of our learners have some problems, let me say the language barrier, so which is giving us a lot of problems.
Teacher 1: Yah, it does create some problems, especially time, to design tasks with contexts is time consuming but on the other hand it really helps the learners.

The response given by teacher 1 has an element of uncertainty. There is a significant doubt about whether the context had had good or bad influence in learners' responses. The second response shows that contexts have both advantages and disadvantages.

Researcher: Do you think these were easy or difficult questions?
Teacher 2: I *can't say* they were easy or difficult but I can say they were up to the standard, especial learners who listen when the teacher is…….!
Researcher: what do you think will happen to the learners when answering these questions? Do you think they will prefer a, b and c or they will prefer d and e; or both?
Teacher 2: I think they will go *for both* depending on the learner what question she prefers.

The above responses from teacher 2 indicate that contexts in mathematical literacy have both advantages and disadvantages.

5.2.4 Category 4: What informs the teachers' views?

This category covers all information that indicates what informs teachers' views on the role of contexts in mathematical literacy.

Teacher 1*: Yah! At first, this was not highlighted the aim of Math Lit, like* when we *attended the first workshop last year,(…) But this year in the workshops, … {training}*
Teacher 1 : *Yah, the way I look at it*….{ epistemological and ontological positions}
Teacher 1: *Ya! My understanding* of ... {personal knowledge/understanding}
Teacher 1: *I look at the question itself*. Like the first …… {Personal philosophy}
Teacher 1: *From what I have seen,* I feel maybe more… …{practical experience}

From the above responses it is evident that the views that teacher 1 has are informed by a number of things. Amongst the things that inform his views are: training, positionality (epistemology and ontology), practical experiences, personal beliefs or philosophies and personal understanding.

Teacher 2: Eeh!!.., Math Lit *actually with the understanding that I have*…{personal knowledge/understanding}

Teacher 2: What *is in my mind is*….{personal knowledge/understanding}/ Personal philosophy}

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Teacher 2: … normally *in the past what made mathematics.*……{practical experience}
Teacher 2: *What I have observed,* many learners…{practical experience}

From the above responses it is evident that the views that teacher 2 has are informed by practical experiences, personal beliefs or philosophies and personal understanding.

5.3 Findings from data analysis.

Constructivist theory is used to analyse teachers view on the role of contexts in Mathematical Literacy. The Analysis reveals that both teachers value the role of contexts in Mathematical Literacy. They point to some advantages of using real-life contexts in teaching and learning Mathematical Literacy. They both recommend that real life contexts should be 60% and content be 40%. They, however contend that contexts also have some disadvantages in teaching and learning mathematics for both teachers and learners. They both raise the issue of language as a barrier which may affect the role of contexts especially for the learners whose language of learning and teaching is different from their home language.

5.4 Issues for discussion.

The analysis above has given rise to some issues for further discussions. The following issues have emerged from data analysis and they will be discussed in details in the next chapter.

(i) Issue 1: Balance between content and context,
(ii) Issue 2: Real life context as a barrier
(iii) Issue 3: contexts and interest
(iv) Issue 4: contexts and access to mathematics
(v) Issue 5: contexts and language

5.5 Conclusion

In this chapter data analysis has been presented. Findings from data analysis are presented. Five issues for discussion have been raised. In chapter six findings and issues that have been raised in chapter five are discussed in details.

WitsETD

CHAPTER SIX: DISCUSSION OF FINDINGS

This study focuses on teachers' views on the role of context in Mathematical Literacy. To determine teachers' views on the role of context in Mathematical Literacy, a case study of two Mathematical Literacy teachers was carried out. Semi-structured interviews with two teachers were conducted. Mathematical Literacy task was designed and given to grade 10 learners. Responses were analysed and were used to design interview questions for the second phase of data collection. Results from analysis of the teachers' responses have shown that both teachers contend that contexts play a considerable role in Mathematical Literacy. Both teachers also raise their concerns with regards to the negative effects of contexts in Mathematical Literacy. The teachers' views on the role of context in Mathematical Literacy raise issues that are subject to the present discussion.

The following issues have received a special attention in this discussion. The issues on balance between context and content, access to mathematics, interest, barrier and language are discussed in the next section.

6.1 Discussion on issue 1: Balance between content and context.

6.1.1 Teachers' perspective

The analysis of teachers' responses has revealed that both Teacher 1 and Teacher 2 are much concerned with the balance between content and context in mathematical literacy. It has been observed that the two teachers view "balance" differently. The analysis of the data that was collected in the first phase of data collection has shown that Teacher 1 considers balance between content and context when context is 50% and the content is also 50%, while Teacher 2 considers Mathematical Literacy being balanced if the context is 60% and the content is 40%. In the second phase of interviews it was noticed that Teacher 1 changes his view on how he views a balance in Mathematical Literacy. From the view of 50 % context and 50 % content, he asserts that a balance between content and context in Mathematical Literacy should be 60% context and 40% content. Such a change was to a certain extent brought by learners' responses to a Mathematical Literacy task. Learners performed generally well. However there were cases where some learners could

WitsETD

not solve problems which are real life context based. Teacher 1 suggests that more context based tasks should be given to learners so that they will have more exposure to context based activities. This is evident because immediately Teacher 1 was shown learners' responses to the task; he modified his previous position on the balance between content and context. Teacher 2 who in the first phase of interviews maintained that context should be 60% and a content 40%; was seen to be consistent with his view even in the second phase of interviews.

While it is interesting to see how both teachers view a balance between context and content, it is again surprising to see how both teachers determine the percentages of content and context. Mathematical task (see on Table 4.3) which was given to grade ten learners was then given to both teachers to comment on. It was discovered that both teachers determine the percentages of content and context in different ways and this confirms constructivist view that people construct ideas or knowledge in a unique manner (Ernest, 1989). In determining the overall percentages of context and content, Teacher 1 uses a summative evaluation (which is more generalising). He considers five sub questions as one question (with 50% content and 50% context). He does not consider each question separately from the other questions but he combines all questions as a single unit. He considers five questions integrated, that is, each question has both context and content.

Teacher 2 uses what I call formative evaluation (very specific) in determining the percentages of content and context. Each sub question is considered as either context based or context based. To him, there are strong boundaries amongst the sub questions and between context and content (strong classification). According to Teacher 2 three questions (a-c) are context based and the last two (d-e) are content based.

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Why balance?

Both teachers are very much concerned with the balance between content and context, although they view *balance* differently. They both point to the importance of balance in making mathematical literacy meaningful. They make reference to the old mathematics curriculum NATED 550, saying it was not balanced since it was dominated by content with little or no real life context. They suggest that such imbalances are probably the cause for poor learner performance in mathematics hence both teachers envisage that learners will perform better in Mathematical Literacy. They both contend that learners' success in Mathematical Literacy depends on the balance between content and context.

While both teachers emphasise the need for a balance between the content and context, it is noted that Teacher 1 is more concerned with mathematical knowledge to be acquired and applied in real life situation, and Teacher 2 is more concerned with real life situation to be used to acquire mathematical knowledge.

Teachers' views about balancing content and context and its relation to learners' performance in mathematical literacy raises issues for discussion and further research. Research on the extent and ways in which balance between content and context promotes learners' performance and achievement in mathematical literacy is necessary.

6.2.2 Curriculum perspective

In an attempt to support Mathematical Literacy teachers, the National Department of Education has developed four documents that give teachers insight into how mathematical literacy is expected to develop (DoE, 2006). The documents are: Mathematical Literacy Subject Statement, Subject assessment Guidelines, Learning Programme Guidelines and Teacher Guide.

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(i) Mathematical Literacy Subject Statement

This document is a policy document divided into four chapters. The first chapter describes the principles and the design features of the National curriculum Statement grades 10-12 (General). The second chapter describes the definition, purpose, career links and Learning Outcomes of Mathematical Literacy. The third chapter contains the Assessment Standards for each Learning Outcome, as well as content and context for Mathematical Literacy. The last chapter, that is chapter four, deals with the generic approach to assessment being suggested by the National Curriculum Statement.

This Document policy foregrounds the use of contexts in Mathematical Literacy. DoE (2003) asserts:

> Context are central to the development of Mathematical literacy, by its very nature, requires that the subject be rooted in the levels of the learners (p.42)

The approach suggested by the Department to develop Mathematical Literacy is one that involves the use of contexts in teaching and learning. DoE (2003:42) states:

> The approach that needs to be adopted in developing Mathematical Literacy is to engage with contexts rather than applying Mathematics already learned to context.

The Department envisages that the appropriate use of relevant contexts in Mathematical Literacy can help to attain the assessment Standards of Mathematical Literacy. Relevant contexts according to the Department are those related to the principles of National Curriculum Statement such as human rights, inclusivity, health (HIV/AIDS) and indigenous knowledge systems.

(ii) Subject assessment Guidelines: Mathematical Literacy

The purpose of this document is to provide guidelines for assessment in the National Curriculum Statement Grades 10-12(General) (DoE, 2005b). Most importantly, it provides information on continuous assessment, number and forms of assessment required for programmes of assessment in grades 10 to 12, recording and reporting on the

WitsETD

programme of assessment, moderation of the assessment tasks in the programme of assessment and Mathematical Literacy assessment taxonomy, rating codes and marks.

This document is relevant to this study because it provides guidelines on how context in Mathematical Literacy should be used in teaching and learning. The Department states clearly about the content and context (DoE, 2005b) that:

> When teaching and assessing Mathematical Literacy, teachers should avoid teaching and assessing mathematical content in the absence of context. At the same time teachers must also concentrate on identifying in and extracting from the contexts the underlying mathematics or content. That is, avoid teaching and assessing contexts without being deliberate about the mathematical content (p.7).

The Department further asserts that learners must be exposed to both mathematical content and real-life contexts to develop competencies (p.7).

With regard to tasks used in assessment, it is indicated that assessment tasks should be contextually based, that is, based on real life contexts and use real-life data, and should require learners to select and use appropriate mathematical content in order to complete the task (DoE, 2005b).

From the above, it is evident that according to the Education Department's perspective, content should go together with context. Although there are no statistical figures that indicate the proportions (percentages) for each component (context and content), it is observed that context and content must be central for any given task in mathematical literacy.

(iii) Learning Programme Guidelines (LPG): Mathematical Literacy

This document assists teachers to plan for sequenced learning, teaching and assessment in Grades 10 to 12 so that all four Learning Outcomes in Mathematical Literacy are achieved in a progressive manner (DoE, 2005a). In Learning Programme guidelines document there are three phases of planning that are recommended:

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a) Phase 1- Subject Framework for grades 10-12
b) Phase 2- Work Schedule for each grade, e.g. grade 10
c) Phase 3- Lesson Plans

LPG document provides information on how to use contexts in all these three phases of planning in order to achieve Learning Outcomes. In order to achieve Learning Outcomes teachers should choose meaningful contexts to embed the content gleaned from the Assessment Standards in clusters across the Learning Outcomes (DoE, 2005a). The use of contexts is emphasised in the LPG document:

> The lesson Plans should include authentic learning, teaching and assessment activities that reflect real-life contexts (p.15).

(iv) Teacher Guide : Mathematical Literacy

In the Teacher Guide document (DoE, 2006) there are twenty six learning units, each unit being expected to take between five and ten days of classroom time. Each unit is intended to develop the mathematical knowledge, skills, attitudes and values that characterise a mathematically literate person (p.3). The department further asserts that to achieve the intensions of each learning unit, each learning unit is based on real-life situations (contexts). The challenge posed to the Mathematical Literacy teachers is:

> To use situations or contexts to reveal the underlying mathematics while simultaneously using the mathematics to make sense of the situations or contexts, and in so doing develop in students habits or attributes of a mathematically literate person (p.4).

From the above, it is evident that according to the Education Department's perspective content should go together with context. Although there are no statistical figures that indicate the proportions (percentages) for each component (context and content), it is observed that context and content must be central for any given task in mathematical literacy. Venkatakrishnan & Graven (2006) argue that these documents have mixed messages for Mathematical Literacy. They state:

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> Overall, therefore, it would appear that there are mixed messages within the Department of Education's documentation for Mathematical Literacy. Whether educators will give more emphasis to context-specific problem solving using mathematics or to the mathematics involved in solving contextual problems remains unclear at this stage. (p.20).

In conclusion, both teachers and the Education Department contend that a balance between context and content is essential in Mathematical Literacy. The above arguments however raise some issues on the role of context in Mathematical Literacy; whether the context extends greater opportunities for learners to access mathematics or denies access to mathematics. In the next section the issue of the role of context in accessing mathematics is discussed.

6.3 Discussion on issue 2: Context and access to mathematics

There have been some debates on whether the inclusion of context in mathematics really makes mathematics more accessible or not (see Boeler (1993), Mudaly (2004), Van Den Heuvel-Panhuizen, 2005; Yosh et al (1997); Nicol & Crespo, 2005; Sethole, 2004; Zavenbergen, Sullivan & Mousley , 2002 and Du Fue, 2001).

Du Feu (2001) recognises the role of context in mathematics in making mathematics more accessible to learners. He writes:

> Many justifications have been given why it is beneficial for students to have mathematics burdened with contexts. They include, for example, ease of access (p.3).

Zevenbergen et al (2002) drawing from their experience also support the idea that contexts make mathematics more accessible to students. They argue that the use of contexts in mathematics education can enhance the learning for students (p.1).

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Sethole (2004) argues that while mathematics remains a uniquely distinct entity, the non-mathematical everyday realities may be used as a platform to access it. Blinko (2004) who conducted a study on the use of contextual questions in national tests claims that without the context, the problem could be considered to be more purely mathematical, and less accessible to pupils (p.3). Adler (2000:214) suggests that context is beneficial, provided it does not distract learners from mathematics.

The analysis of the teachers' responses has revealed that both teachers maintain that contexts play a significant role in mathematical literacy. According to the teachers' real life contexts make mathematics more practical thus learners are better able to respond appropriately. Similar confirmation of the positive influence of context in mathematics is given by Van Den Heuvel-Panhuizen (2005) who maintains that context in mathematics enhances accessibility of the problem.

Mwakapenda (2004:28) observes that understanding is one of the most important traits associated with the attainment of educational goals. The inclusion of context is considered by both teachers as playing a role in helping the learners to understand mathematics.

The above arguments raise further concerns with regard to the extent to which contexts make mathematics accessible to learners. An apt question to be posed is: How does context make mathematics more accessible? Van Den Heuvel-Panhuizen (2005) provides a claim that partially answers the above question. Van Den Heuvel-Panhuizen (2005) claims that contexts contribute to the transparency and elasticity of problems. She further maintains that contexts suggest strategies that could be used to solve the problem.

From teachers' responses on the role of context in one of the questions given to learners, $4x = 12$; Teacher 1 claimed that there is little that could help the learner in finding the solution to the above question. The question itself seems to be generally easy for 'mathematicians' but a non mathematician can hardly solve this problem. It is likely to

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happen (as it happened to some grade ten learners) that one would try to get rid of 4 in 4x by using inappropriate methods and wrong operations, like:

4x = 12

4x – 4 = 12-4

X = 8

It is obvious that this solution x = 8 would not be obtained if this problem was contextualised in real-life situations. If the same question is contextualised in a real life situation many learners if not all, can access the problem and devise the strategy to solve it. For example:

Four oranges cost R12 all together; determine how much each orange costs?

It is not only mathematicians who can solve this problem; non mathematicians can also access this problem. They can use mathematical operations to solve this problem sometimes unaware of the mathematical methods involved in solving this problem. The study on mathematics in the streets and in school (Carraher, Carraher and Schheman, 1985) reveals that a number of children who had difficulties in making appropriate calculations in school mathematics experienced no problems when selling candies at the market.

The inclusion of context in Mathematical Literacy therefore is seen in one way or another as loosening or breaking boundaries between mathematical and non mathematical discourses, thus extending more opportunities for everyone to access mathematics.

The idea of including contexts in Mathematical Literacy has many advantages for learners. DoE (2005b:8) observes that:

> Learners will often meet problem situations in their adult lives for which there are no ready made formulas or procedures to provide solution.

Learners should be exposed to mathematical problems which are contextualised to real-life situations.

While noting that both teachers maintain that the inclusion of context in mathematical literacy makes mathematics accessible and understandable, they further assert that it

WitsETD

makes Mathematical Literacy interesting. In the next section an issue on context and interest in mathematics is discussed.

6.4 Discussion on issue 3: Context and interest in mathematics

The influence of context in arousing interest in learners has received attention in mathematics education (see Bowman, 1997; Mudaly, 2004 and Gerdes, 1985). Both teachers maintain that context makes mathematics meaningful hence learners became interested in doing mathematics. This raises a question for discussion as to how context makes mathematics interesting to learners.

Mudaly (2004) shares the same view with both teachers with regard to the role of real life context in arousing interest to learners. Mudaly (2004) observes that besides the ideal of showing learners how mathematics is related to real world it also serves to increase interest in the subject matter (p.37). Thorndike (1932) cited in Mwamwenda (1995) explains the importance of interest in learning. He asserts that interest determines learners' work on a given task; if their interest is greater then they work harder and the lower their interest the less hard they will work (p.201). Considering interest in relation to how learners construct knowledge, Piaget (1958) asserts that an individual constructs new knowledge on the basis of actions which are of his or her interest. Drawing from experience, Browman (1997) states that after allowing his students to work with real-world problems in his class, the level of student interest increased to the extent that they were especially excited about being able to solve a mathematics problem that even the so-called math geniuses in calculus could not solve (p.8). This confirms that real world context has a potential to increase interest in the learners.

Teachers commented on one of the questions given to learners:-

$$\boxed{If\ 3y = 6 \quad then\ 5y = ?}$$

They maintain that this question is not contextualised to real life therefore it is meaningless to the learners. They argue the learners would not have any interest in this

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question because it is not related to real life situation. If the same question was contextualised to real life situation learners could have interest, for example:

If three learners got six apples then many apples will five learners get?

The above problem is related to real life situation hence there is a great possibility that learners would be interested in modelling the problem and eventually coming out with the solution.

While in one hand acknowledging the positive contribution of the real life context in increasing interest in learners, on the other hand the language issue arises, particularly in a multilingual classroom. In the next section the issue of context and language is discussed.

6.5 Discussion on issue 4: context and language

'Context' in the context of this study refers to the characteristic of a task presented to the students; refers either to words (and pictures) that help the student to understand the task (Van Den Heuvel-Panhuizen, 2005). The above explanation suggests that a contextualised task has to a certain extent linguistic demands.

In a Constructivist perspective, language is a very important tool to mediate learning (Vygotsky, 1978). Although there are eleven official languages in South Africa, in almost 95% of the South African schools English is the medium of instruction. It follows that the majority of learners in South Africa learn mathematics through a second language; English. There have been attempts to study the influence of language in learning mathematics with a special reference to those learners whose first language is different from the language of learning and teaching (LoLT) (see Setati & Adler, 2001; Whang, 1996 and Howie & Pietersen, 2001). A qualitative study that was carried out in Korea (Whang, 1999) reveals that children have difficulties in solving mathematics word problems written in English. Similarly, a study on mathematics literacy of final year

WitsETD

students by Howie and Pietsern, 2001, shows that students perform particularly badly in questions requiring written answers. They write:

> Students showed lack of understanding of mathematics literacy questions and an inability to communicate their answers in instances where they did understand the question (p.19).

Murray (2003) argues that for a child to understand and respond to the problem posed, the language and grammatical constructions used when the word problem is formulated are obviously crucially important (p.39). The above arguments concur with the teachers' comments on learners' responses to the task. One typical example is the first question that was given to the learners to solve:

Six oranges cost R12, 00. How much will nine oranges cost?

It was expected that the learners would say R18. It was a great surprise to get an answer from one learner which was not expected. The learner said 18 oranges. It is evident that the learner was able to calculate 18 but did not know appropriate units. From the teachers' views, the learner understood the question and he had had mathematical content knowledge but the main problem was the language, he could not communicate his answer appropriately.

From the above discussion it is noted that the language in which a contextualised task is presented can affect learners' responses in two ways. In one way a learner may fail to model the problem because of the language used in constructing the problem, thus the learner would be unable to recognise the nature of the problem. It is obvious that once the learner has failed to recognise the nature of the problem, he can not respond appropriately. Secondly, a learner may identify the nature of the problem and solve the problem correctly (mathematically) but ultimately fail to communicate his answer due to a lower level of language competence (Howie and Pietersern, 2001). Tobias (2003) observes that to learn mathematics effectively, students need to acquire the tools to

WitsETD

communicate their ideas, so that they can express themselves and so that the teachers are privy to their understanding (p.21).

Ensor and Galant (2005) maintain that attempts to integrate the academic and the everyday potentially produce a number of serious consequences. It follows that context in Mathematical Literacy does not always produce only good results but sometimes it creates barriers to the learning of mathematics. In the next section, context as a barrier to the learners in learning mathematics is discussed.

6.6 Discussion on issue 5: context as a barrier to mathematics

Many scholars have made significant attempts at unveiling how context affects learning mathematics. There are a couple of researchers who have shown that contextualising mathematics can produce undesirable results (see, cooper & Dunne, 1999; Chacko, 2004; Naidoo & Parker, 2005; Murray, 2003; Greer, 1993 and Verschafel and De Corte, 1997).

6.6.1 Theoretical perspective

A study by Cooper and Dunne (1999) reveals how contextualising mathematics creates some difficulties for working-class students. Working-class students perform significantly poorer than their middle-class peers on contextualised tasks while performance on decontextualised task is equivalent. The study on the implications of mathematics teachers' identities and officials to mathematics discourses for democratic access to mathematics (Naidoo and Parker, 2005) involved seven grade 9 teachers. All seven teachers expressed negative orientation towards contextual mathematics. Some of the teachers maintain that:

> Teaching and assessing mathematics from situations denies pupils of adequate subject content and knowledge and that pupils were getting bits and pieces (p.63).

Chacko (2004) in her study on solution to real–world problems provides empirical evidence that the students, both at the primary and secondary school levels, are not

WitsETD

skilled at using real-world knowledge in the Mathematics classroom. It is clear that learner need to be skilled at using real–life context in solving mathematical problem in the classroom. Murray (2003) argues that inclusion of context in mathematics does not necessarily produce good results all the time. Murray asserts that learners experience real-life very differently from adults and are familiar with very different aspects of real life. She stipulates four ways in which the context can act as a barrier to understanding mathematics:

- Learners are not familiar with the context,
- The context has unpleasant connotations
- Limited context
- The problem has to be transformed or modelled by the learner before she can solve it (p.40).

Van Den Heuvel-Pan Huizen (2005) also suggests four important points about context as a barrier in teaching and learning mathematics:-

- Context can hinder finding an answer
- Students' unwillingness to take into account the context
- Context problems that do not allow one to take the context into account
- Taking the context into account is not distributed evenly among students.

The above points are supported by Mair (1991) who suggests that some of the contextualised problems have little in common with those faced in real-life; hence learners are not familiar with the context used. Learners construct knowledge based on their prior knowledge and through social interaction. It is possible that a context used in the problem might be irrelevant to a student's life or interest; this may have a negative impact on the learning of mathematics.

The above arguments provide a framework and lenses to view the possible negative impacts of contexts in mathematics. This study is about teachers' views on the role of context in mathematical literacy, thus, it is appropriate to find out whether teachers share the same views with those presented above.

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6.6.2 Teachers' perspective

Although both teachers maintain that context plays a significant role in teaching and learning mathematics, to a certain extent they also acknowledge that context can be a barrier. Teacher 1 seems to agree with seven teachers (Naidoo and Parker, 2005) who maintain that contextualised mathematics denies learners' access to mathematics content knowledge. Both Teacher 1 and Teacher 2 agree with Murray (2003) that the contextualised problem has to be transformed or modelled by the learner before he or she can solve it. This was evident when the learners were given the following task:

Three cups cost R4, 50. How many cups can be brought for R12-00?

The learner is required to transform or model the problem before getting the solution. One way to do that the learner may first calculate the value of each cup, i.e. let a cup be 'x'

Then $3x = 4.50$

$x = 4.50 \div 3$

$\mathbf{x = 1.5}$

This means that each cup costs R1.50.The next step is to calculate the number of cups that can be bought for R12.00. The final solution is calculated by dividing R12.00 by R1.50 that is = 8 cups.

Teachers agree with what was found by Chacko (2004) in her study that students are not skilled at using real-world knowledge in the classroom. Both teachers indicate that learners are not exposed to contextualised mathematics problems because teachers do not expose them to such problems. Both teachers point to two possible reasons for the learners not being skilled at using real world knowledge in solving mathematical problems.

The first reason given by both teachers is language proficiency and competence. They contend that their learners are relatively poor in English language; consequently they are likely to experience difficulties when dealing with contextualised mathematics problems.

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The Teachers however point to the mathematics teachers who teach in other languages and not in the language of instruction making learners not to develop communication skills in the language of instruction. If teachers can teach in English all the time and allow learners to communicate their answers in English, there could be a significant improvement. The second reason given by the teachers is the time available to design contextualised problems. Learners also require a lot of time to solve contextualised problems. They contend that most teachers tend to ignore contextualised problems and concentrate on content based problems to save time.

In this chapter issues raised in data analysis have been discussed. In the next chapter seven recommendations for teacher education, classroom practice and for further research are given.

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CHAPTER SEVEN: CONCLUSION

7.1 Summary of findings

The purpose of the study was to determine teachers' views on the role of context in Mathematical Literacy and what informs teachers' views on the role of context in mathematics. Semi-structured interviews were conducted to elicit teachers' views.

7.1.1 ***Critical questions***

a) What are views of grade ten teachers on the role of contexts in Mathematical Literacy?
b) What informs teachers' views about the role of context?

a) Teachers' views on the role of context

The study has shown that teachers have both positive and negative views about the role of context in Mathematical Literacy. Although teachers have both negative and positive views about the role of context, they to a larger extent maintain that context plays a significant role in mathematics more than its negative effects. The most important findings about context in Mathematical Literacy are:

- There should be a balance between mathematics content knowledge and real-life context;
- Context makes mathematics interesting, accessible and practical to the learners;
- Context makes mathematics more meaningful, easy and understandable to the learners.

The study also reveals the challenges that the teachers pointed out with regard to the negative impacts of contexts in Mathematical Literacy. The teachers maintain the following:

- To design or develop contextualised problem requires a considerable amount of time;

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- Context sometimes creates problems associated with linguistic demands to the learners whose first language is different from the language of instruction;
- Learning mathematics by incorporating real-life context might to a certain extent deny learners' access to mathematics content knowledge.

b) What informs teachers' views?

The study has revealed that the teachers' views are informed by their personal beliefs about mathematics (Ernest, 1988 and Hersh, 1986); their teaching experiences, their training (in-service) and practical experiences (see chapter 5).

7.2 Recommendations

7.2.1 Recommendation for classroom practice

Contexts are central to mathematical literacy. It is expected that the learners be exposed to both mathematical content and real-life contexts in order to achieve Learning Outcomes (DoE, 2005a). In an attempt to implement the intended curriculum (Muller & Vinjevold, 2005), teachers should take heed of the following recommendations for classroom practice with regard to the inclusion of real-life context in mathematics:

- Teachers should ensure that while contextualising mathematics to the real life, content knowledge should also be emphasised such that incorporating the everyday in mathematics does not derail mathematical goals.
- Teachers should ensure that the context used is appropriate and meaningful to the learners.

Adendorff & van Heerden (2001) suggest that teachers need to make sure that appropriate contexts are used to facilitate learning and understanding, and should change and adapt contexts found in text books or other resources to better suit their learners need (p.66).

Julie and Mbekwa (2005) add to the above suggestion, they suggest that attention should be accorded to the appropriateness of context for different cohorts of students (p.32).

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- While there are still debates on language of learning and teaching in South Africa, and code switching as a way to assist learners to talk more freely in mathematics class and so to use their main language as a learning resource (Setati & Adler, 2001), teachers should ensure that they do not disempower learners in developing communication skills in English language as it is a medium of instruction.

7.2.2 Recommendation for teacher education

There is great need for a continual teacher in-service programme. The Department of Education should have programmes in place that are designed to support and monitor the implementation of the new curriculum in schools. Each circuit or ward should have clusters (group of teachers) who will meet on regular basis to share experiences on how to approach the new curriculum, particularly mathematical literacy as a new subject. The above will ensure that all teachers carry the appropriate message to the classroom.

Institutions of higher education should design accredited programmes for teachers which will be offered part-time to practicing educators. Such programmes should address challenges of the new curriculum.

7.2.3 Recommendation for further research

The present study focused on Teachers' views on the role of context in Mathematical Literacy. There is a need for further research on learners' views on the role of contexts in mathematical literacy, and a need for further research on relationship between learners' views and teachers' views on the role of context in Mathematical Literacy.

There is a need for a further research on how teachers and learners use contexts in teaching and learning of Mathematical Literacy. Such research should involve the observation of classroom practice.

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There is a need for further research on the same topic but involving a large sample of teachers.

7.3 Limitation

This was a case study that involved only two teachers (Opie, 2004) hence the results obtained in this study can not be generalised to the large population of teachers. While an extensive planning was undertaken for this study, one of the weaknesses of this study was that data collected did not provide enough information about what informs teacher's views. There are two possible reasons for the data that was collected to have little on what informs teachers' views. The first reason was that the interview question did not adequately lead to more information on what informs the teachers' views. The Second possible reason was the context in which teachers were interviewed. Only Mathematical Literacy task and learners' responses were used to contextualise interviews. If classroom observations and teachers' work schedules/book were also used to contextualise interviews, teachers would have responded in such a way that a broad picture of that which informs their views on the role of context in Mathematical Literacy would have been identified.

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9. APPENDICES

APPENDIX 1: INTERVIEW PROTOCOL

Name of Interviewee: _____ Interview duration: 40 min

Interview method: Semi-structured interview

Focus question: What are teachers' views on the role of contexts in mathematical literacy?

Question format: Open-ended questions

Response mode: Recorded by interviewer (Audio-tape)

Introduction: The purpose of this short interaction is to collect information on teachers' views of the role of contexts in mathematical literacy. Information gathered will be used by curriculum developers and mathematical Literacy teachers. This interview will last 30 minutes. You may ask questions of clarity or raise concerns during the course of this interaction, you are most welcome to do so, feel relaxed. The aim of this interaction is to understand your views on the subject under discussion.

Questions

1. a) What is your understanding of Mathematical Literacy?

Probe: *How do you view the nature and scope of Mathematical Literacy?*

(b)What are your experiences in Mathematical Literacy?

2. Mathematical Literacy seems to contextual mathematics. What contexts are commonly presented or used in Grade 10 mathematical Literacy textbooks that you are using?

Probe: *Can you name them?*

3. What do you think could be the possible reason for inclusion of contexts in mathematical literacy?

Probe: *From your experience how do contexts help you as a teacher as well as learners?*

4. How would mathematical literacy look like if contexts were not included or emphasized?

Probe*: Do you view Mathematical Literacy would be more meaningful or less, explain?*

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5. Do you prefer to use contexts in teaching and learning Mathematical Literacy?
Probe: *If so why, if not why?*

6. If you were involved in curriculum design for Mathematical literacy, what will be your suggestions about structure or nature of Mathematical literacy for grade 10?
Probe: *Why you make such suggestions*?
7. According to Department of Education the purpose of Mathematical Literacy as a fundamental subject is to ensure that South African citizens become highly numerate consumers of mathematics. From your point of view do you see Mathematical Literacy going to fulfill this purpose?
Probe: How and/or why?

Thank you for participating in the interview. Your responses were very informative. I will let you have some information about the outcomes of the project.

Note that these questions were further developed after the scripts were analyzed.

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APPENDIX 2: INTERVIEW TRANSCRIPTS

1. PHASE 1: DATA COLLECTION

TRANSLATED version

Teacher 1: Interview duration: ±30 min

Interview method: Semi-structured interview

Focus question: What are teachers' views on the role of contexts in mathematical literacy?

Question format: Open-ended questions

Response mode: Recorded by interviewer (Audio-tape)

Introduction: The purpose of this short interaction is to collect information on teachers' views of the role of contexts in mathematical literacy. Information gathered will be used by curriculum developers and mathematical Literacy teachers. This interview will last 40 minutes. You may ask questions of clarity or raise concerns during the course of this interaction, you are most welcome to do so, feel relaxed. The aim of this interaction is to understand your views on the subject under discussion.

Questions

Researher: What is your understanding of Mathematical Literacy?

Teacher 1: Ya! My understanding of Mathematical Literacy is that it was designed to help the South African citizens, because before (in the past) Mathematics was done by a certain people and others could not. And then…. there are problems or there are real life situations whereby people should know to solve those problems or to read certain statements like bank statements, telephone bills or water-bills ….. all those things. So, they are unable to read those things, because they are mathematical illiterate. So, that is why mathematical Literacy is introduced so that all people can be in the position to read all those statements …….

Researcher: What are your experiences in Mathematical Literacy?

Teacher 1: I have attended some workshops on Math Lit. Like, last year (2005) I attended one which was in Durban, so where Math Lit was first introduced to teachers, like how to teach it, which modules should be covered so a year especially

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in Grade 10. So that is what we did last year. And then early this year (2006) we have also attended another workshop which was organized by the Department of Education, and the…., that one was.., the focus was on teaching, how to teach, especially the approach, to approach certain chapters and how we assess, like how many class work exercises, homework exercises that need to be included/done., projects and so on…! And I was also accepted by The University of KwaZulu-Natal to do ACE in Mathematical Lit. I was accepted this year (2006) but I am going to start next year January (2007).

Researcher: So looking at Mathematical Literacy, it seems to contextual mathematics. What contexts are commonly presented or used in Grade 10 mathematical Literacy textbooks that you are using?

Researcher: If you can just name them?

Teacher 1 : Most of the things that are emphasized there, as I have mentioned earlier on that, there are things like, bills, cell phones, like- eeh how cell phone calls charge during pick hour or the off pick hour, all those things, eeh, investments, actually, I mean if the interest is 13% and you are investing money, how much are you going to get, and if you make borrow money, things like loans, that actually loans, how you repay them. So you are able to see the interest rates, the money you are going to pay at the end, so that you will be in the position to choose amongst those loaning companies. You choose the best that will suit you. There are things like that…. Also, when it comes to things…., like to buy carpets for the rooms students must be able to calculate the area of the room, so that when they go to the factory, they simple give the area of the room, and then those in the factory (sellers) they will only give the size, and they will give them exact carpets because the size is there…. And there are other things related to that!!

Researcher: What do you think could be the possible reason for inclusion of contexts in mathematical literacy?

Teacher 1: So, the context will be in the position to help, because those problems are in real life situations that are happening so that's why more contexts are included so that learners will be interested in doing it.

Probe: *From your experience how do contexts help you as a teacher as well as learners?*

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***Teacher** 1:* It helps me a lot, like because now I am able to understand, like for an example the way they charge to post a letter at the post office, I am able to know that if I am having such an envelop, this is what they are going to charge me. Like if I am investing money at a certain interest rate then I know that after a period of let say 10 years this is how…., the amount I am going to get. We are able to plan or to predict what will happen in future, if at the present moment we have this situation. So it is helping a lot and to learners as well.

Probe: What about in teaching and learning?

Teacher 1: It make it easy because, actually I would like to go back again, the problems that are dealt with are the problems related to the real life situations. So, that is why it is easy, although sometimes there are some problems there and there, like lesson planning and time. Most of the exercises are time consuming.

Researcher: How would mathematical literacy look like if contexts were not included or emphasized?

Probe*: Do you view Mathematical Literacy would be more meaningful or less, explain?*

Teacher 1: If we take out the context from Mathematical Literacy, so Math Lit will be less meaningful because really Math Lit will not create or develop that interest to the learners to do Math Lit. Like in the case of mathematics most of the things are not contextualized, it is just pure Mathematics. I can say mathematics is too abstract and learners fail to understand or to make sense out of it. I-Math Lit to me or the way I look so it. So the inclusion of context in Mathematical Lit is so important because it makes it more meaningful.

Researcher: If you were involved in curriculum design for Mathematical literacy, what will be your suggestions about structure or nature of Mathematical literacy for grade 10?

Probe: Why you make such suggestions?

Teacher 1: The percentage of context and content, the way I look at it, it is not balanced. Right now the context is about 70% and the content is about 30%, so it makes it difficult, actually currently learners can not do some or certain calculations–because others they do understand what is said, what is required, but they lack basic fundamentals that will enable them to treat the problem. So my suggestion is of 50%

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content and 50% context, which can make learners to be able to acquire basic fundamentals that will make them to treat problems. In most cases learners, they do understand that it is that and that and, but then you find that they lack those basic fundamentals that can be used to treat the problems.

Researcher: According to Department of Education the purpose of Mathematical Literacy as a fundamental subject is to ensure that South African citizens become highly numerate consumers of mathematics. From your point of view do you see Mathematical Literacy going to fulfill this purpose?

Probe: How and/or why?

Teacher 1: Yah, the way I look at it, it is going to fulfill it- the purpose although ummh!! There are areas need to be reviewed. To be re-addressed again in a new way. But it is going to fulfill the purpose ye DoE, but there are some areas like to put it clear to learners especially to those who are doing Math Lit- to know what is the aim of Math Lit, and what is Math Lit., why is it included in the curriculum? What is the purpose? So that they will exactly know that they are doing Math Lit because of 1, 2, 3 and 4, so that they will know the purpose of what they are doing and why they are doing it

Researcher: (*additional question*) you have mentioned important thing in the beginning about training. Were the teachers exposed to the purpose of Math Lit and aims of Math Lit during the training sessions?

Teacher 1: Yah! At first, this was not highlighted the aim of Math Lit, like when we attended the first workshop last year, it was not clearly highlighted or explained to teachers, even to learners and to parents through media. It was not clearly done. But this year in the workshops, the time we started the workshops-the focus was on the purpose and aims of Math Lit., then we continue to deal with the content and context. But the main focus was on why Math Lit was introduced in the curriculum and the other things, so that the teachers will be in a position to influence learners or motivate learners to do Math Lit. Because in most cases you find that the learners do Math Lit because they are afraid to do Maths. So they are trying to plant that seed to the learners that they are doing Math Lit not because they are afraid to do Maths, but they do it because the reasons behind are 1,2,3 and 4.

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Thank you for participating in the interview. Your responses were very informative. I will let you have some information about the outcomes of the project.

2. PHASE 1: DATA COLLECTION

Teacher 2 : Interview duration: ±30 min

Interview method: Semi-structured interview

Focus question: What are teachers' views on the role of contexts in mathematical literacy?

Question format: Open-ended questions

Response mode: Recorded by interviewer (Audio-tape)

Introduction: The purpose of this short interaction is to collect information on teachers' views of the role of contexts in mathematical literacy. Information gathered will be used by curriculum developers and mathematical Literacy teachers. This interview will last 40 minutes. You may ask questions of clarity or raise concerns during the course of this interaction, you are most welcome to do so, feel relaxed. The aim of this interaction is to understand your views on the subject under discussion.

Questions

Researcher: What is your understanding of Mathematical Literacy?

Teacher 2: Eeh!!.., Math Lit actually with the understanding that I have, it is a bit Mathematics but actually meant for people who are not Mathematical Literate, it deals with numbers. It is trying to take out that perception that mathematics is done by those who are intelligent.

Probe: How do you view the nature and scope of Mathematical Literacy?

Yah it is bit interesting but the fact of the matter is that, it is not well arranged, as a new subject they are trying to look at the way to make it easily understandable even to learners.

Probe: What are your experiences in Mathematical Literacy?

Teacher 2: Although there are hick up because initially learners had perception that Math Lit is going to be an easy subject- but now they are enjoying it. It is not just easy but

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challenging. I have a bit of experience on Math Lit because I was once appointed by DoE to be a Tutor for quiet of some times, so I really have some experiences on that.

Researcher: Mathematical Literacy seems to contextual mathematics. What contexts are commonly presented or used in Grade 10 mathematical Literacy textbooks that you are using**?**

Probe: *Can you name them?*

Teacher 2: well eeh- normally I do refer the learners to something that they can see, and giving them some projects as to how actually they are going to work on calculations, eg some data sheets, asking them to go even to local clinics to do some statistics-to check how many people who are HIV+, how many who are obese and so many things, they then come back and make some graphs, mostly the context is on health issues.

Researcher: What do you think could be the possible reasons for inclusion of contexts in mathematical literacy?

Probe: *From your experience how do contexts help you as a teacher as well as learners?*

Teacher 2: Well, I think that could be a difficult issue for learners, so there should be both context and content. Normally in the past what made mathematics to be difficult was that it was based on content only. So the inclusion of context now, the learners can see what they are doing. It helps a lot because we teach learners what they can see, actual practical thing- it is easy for them to understand if you teach them what they can see.

Researcher: How would mathematical literacy look like if contexts were not included or emphasized?

Probe*: Do you view Mathematical Literacy would be more meaningful or less, explain?*

Teacher 2: It was not going to be more meaningful-if the context was not included because content goes hands in hands with context. So context makes it more interesting. At the present moment the content is about 60% and context 40%. I feel it would be better if the context was 60% and content 40%.

Researcher: If you were involved in curriculum design for Mathematical literacy, what will be your suggestions about structure or nature of Mathematical literacy for grade 10?

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Probe: *Why you make such suggestions*?

Teacher 2: What is in my mind is- we can try to make Math Lit more easy. We need to start basically on the context, from context then to we go to the content, that is going to be easy to the learners, because, if you are talking about what the learners can see- you are moving from context to content thus you are relating Mathematics to something that students they know to that they do not know.

Researcher: According to Department of Education the purpose of Mathematical Literacy as a fundamental subject is to ensure that South African citizens become highly numerate consumers of mathematics. From your point of view do you see Mathematical Literacy going to fulfill this purpose?

Probe: How and/or why?

Teacher: Yaa! Exactly, the way, even how learners are coping, a lot of people are going to benefit. The way Math Lit has been structured, it has moved away from away from theory to practical. So students can solve thing that they see than solving x and y. so context first then content…

Thank you for participating in the interview. Your responses were very informative. I will let you have some information about the outcomes of the project.

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3. SECOND PHASE: FOLLOW-UP INTERVIEW

Name of interviewee: **Teacher 1** interview duration: 40 min.

Focus question: What informs teachers' views of the role of contexts in mathematical literacy?

Question format: open ended questions

Response mode: Recorded by interviewer (Audio-tape)

Introduction: The purpose of this short interaction is to collect information on teachers' views of the role of contexts in mathematical literacy. Information gathered will be used by curriculum developers and mathematical Literacy teachers. This interview will last 40 minutes. You may ask questions of clarity or raise concerns during the course of this interaction, you are most welcome to do so, feel relaxed. The aim of this interaction is to understand your views on the subject under discussion.

Last time we had a very interesting and informative conversation on the role of context in Mathematical Literacy.

1. Consider the following questions that were given to grade ten learners.

a) Six oranges cost R12, 00. How much will nine oranges cost?
b) If two learners go out from the class after every four minutes. After 10 minutes how many learners will have gone out of the class?
c) Three cups cost R4.50. How many cups can be bought for R12.00?
d) Solve for X: $4x = 12$
e) If $3y = 6$ then $5y =$ ……..

Researcher: How much is the context and content in these questions?

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Teacher 1: The way I look at it the context is not too much because mostly it involves division and multiplication. The questions are interesting because they are talking about money, about the things that learners like, like oranges.

Probe: So if you were to rate the content and context in these questions in terms of percentage, what will be the percentage?

Teacher 1: I can say the content and context are balanced, that is 50% and 50% (respectively)

Probe: How do you determine the percentages of context and content?

Teacher 1: I look at the question itself. Like the first question, the statement is simple and the question is simple, and there few calculations that are to be made. There are no complications in as far as content and context.

Researcher: Why is necessary that there should be a balance between content and context?

Teacher 1: At the early stages like this in grade 10, I think content and context should be balanced so that learners will be interested as they read the questions, so they find that the content and context are balanced, they become interested in such things. If the content is more than the context or the context is more than the content there will be some problems.

Probe: The need for the balance is for the learners?

Teacher 1: Yes, especially for grades 10, there should be a balance. But, in grades 11 and 12 things can be changed.

Researcher: What do you think could be an appropriate approach to solve these problems?

Teacher 1: The approach can be, taking this, and giving this to the learners and say, look my friend, if you are buying oranges, like the first question: Six oranges cost R12, 00; how much will nine oranges cost? The approach can be, just give the learners to calculate how much each orange can cost so that they can be able to calculate how much nine oranges can cost.

Probe: the approach can be to ask the learners to calculate how much each orange can cost?

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Teacher: Yes, if they know how much each orange costs, then they will know how much 9 oranges can cost. So, it involves division and multiplication.

Researcher: What about this one: if two learners go out from the class after every four minutes. After 10 minutes how many learners will have gone out of the class?

Teacher: There are two options here to approach this problem. The first one, the one that I like, "the ratios" they can use the ratios to calculate the number of learners who would have gone after 10 minutes. The ratios are in the form of fractions. Even in the first question we were using the fractions because we were dividing.

Probe: What about this one, (pointing to number 3) it has some commas?

Teacher: Yah, this one, it also tests the knowledge of decimals, because when we count money there are some cents and rand. So it is testing that portion of mathematics. So, even here it is multiplication and division and commas.

Researcher: Do you think these were easy or difficult questions?

Teacher 1: Yah, if it is balanced, the content and context, then it becomes easier for the learners to solve the questions

Probe: Do you think the inclusion of contexts makes these questions easy?

Teacher 1: Yah, as compared to (d) and (e), because here in number (d), the learners just look 4x = 12, they just look, what is 4x, there is nothing that come s to their mind before solving the problem or finding the value of x.

Probe: Do you think there is something interesting for the learners in these questions?

Teacher 1: Especially with the first three questions, such questions enable learners to think constructively and logically, taking it from the real situations and then using the content to solve the problem. When the problem is in the real world situation, it is much easier for the learners to solve than when it is not contextualised.

Researcher: Let's look at some of the learners' responses. In the first question (a) the expected answer is R18. What would you say if the learner says 18 oranges instead of R18?

Teacher1: Yah, that one can be taken as an answer but not given full credits, because the learner might have forgotten that what he/she is calculating is the money not oranges. The method is correct but the answer is not correct.

Probe: Don't you think the context was the cause or had an influence in this answer?

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Teacher: Yes, the context might have had the influence, because some of our learners have some problems, let me say the language barrier, so which is giving us a lot of problems.

Researcher: One learner wrote a very interesting answer. The question was: if 3y = 6 then 5y = ? He said 2/5. What is the origin of this answer?

Teacher 1: I think here this learner did understand that y = 2, then here instead of multiplying 2 by 5 he/she divided 2 by 5. So the problem is operation.

Researcher: In the second question (b), one leaner said: "I think 40 learners are gone". Why this learner responded like this?

Teacher 1: Eh, I think the learner understood the question or maybe he/she used 4 **X** 10 to get 40. But I don't know why, what was the reason.

Probe: Can you comment on the effect of the context in this question and answer?

Teacher 1: yah, the problem is the context.

Probe: The very same learner was able to solve 4x =12. so what does this suggest about the role of the role of the context in mathematical literacy?

Teacher 1: From what I have seen, I feel maybe more context should be included maybe 55-60%, because we have this problem of language barriers, so in most of the problems here not that learners can not solve these problems but it is just that they are not used to such questions.

Probe: What is your suggestion?

Teacher 1: More contexts should be included so that the learners will be acquainted with the uses of the contexts.

Probe: in other words, you mean the context helps the learners but the problem they are not exposed to it? So the best thing is to expose the learners to the use of context. At the end of the day if learners are exposed to the contextualised mathematics, in future what will be the benefit for the learners.

Teacher1: I think they will benefit a lot because in most cases we find the people having some problems in real life and they fail to solve those problems. I think if the learners can be able to master this they can be good Citizens.

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Probe : You mean the problems outside the world in real world situation they are context based, though they are sometimes mathematical. So what if the learner has done just mathematics not mathematical literacy, will he/she solve problems in real world situations?

Teacher 1: Yah, the student can do that to the certain extent, like us, we did not do Math Lit but we are able to solve the problems, especial, as I indicated earlier on that if one can understand what is given, what is needed/required and relate that to the content of mathematics, then, one can be able to solve the problem.

Probe: Is there any way to solve the language problem.

Teacher 1: Right now I can not come out with the answer, but what I can suggest, the learners must be exposed to the questions which have lot of contexts.

Probe: When should they be exposed?

Teacher: Every time

Researcher: What implication does it have on time?

Teacher: Yah, it does create some problems, especially time, to design tasks with contexts is time consuming but on the other hand it really helps the learners.

Researcher: What could be your comments on the following statements?

a) If a learner does not perceive mathematics to be necessary for the career path or study direction chosen, the learner will be required to take Mathematical literacy (p.11).

b) Mathematical Literacy should not be taken by those learners who intend to study disciplines which are mathematically based, such as the natural sciences or engineering

Teacher 1: I disagree with the 1st statement because even if maybe, the learner will not do any thing in his career that will require Maths but that leaner must be allowed to do mathematics.

Probe: How do learners find themselves doing mathematical literacy or mathematics?

Teacher 1: Some they choose, some are forced to do Math Lit while they are not interested, and this is done on the bases of the school curriculum on the way the curriculum has been structured.

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4. INTERVIEW PROTOCOL

SECOND PHASE: FOLLOW-UP INTERVIEW

Name of interviewee: **Teacher 2** interview duration: 40 min.

Focus question: What informs teachers' views of the role of contexts in mathematical literacy?

Question format: open ended questions

Response mode: Recorded by interviewer (Audio-tape)

Introduction: The purpose of this short interaction is to collect information on teachers' views of the role of contexts in mathematical literacy. Information gathered will be used by curriculum developers and mathematical Literacy teachers. This interview will last 40 minutes. You may ask questions of clarity or raise concerns during the course of this interaction, you are most welcome to do so, feel relaxed. The aim of this interaction is to understand your views on the subject under discussion.

Last time we had a very interesting and informative conversation on the role of context in Mathematical Literacy.

2. Consider the following questions that were given to grade ten learners.

a) Six oranges cost R12, 00. How much will nine oranges cost?
b) If two learners go out from the class after every four minutes. After 10 minutes how many learners will have gone out of the class?
c) Three cups cost R4.50. How many cups can be bought for R12.00?
d) Solve for X: $4x = 12$
e) If $3y = 6$ then $5y =$ ……..

Researcher: How much is the context and content in these questions?

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Teacher 2: The context is almost **60 %** and the content is **40 %.**

Probe: How do you determine the percentages of context and content?

Teacher 2: I look at the question as a whole, the way they have been structured. The first three questions are context based and the rest are content based, so it is **3/5 = 60%** most of the things they are context based, so these ones are also context based.

Researcher: Do you think there is a balance between content and context in these questions?

Teacher 2: Yah, basically there is a balance because in the Math Lit most

Researcher: Why do you think there should be a balance between content and context?

Teacher 2: I think the reason is being that some of the learners are actually…. since this is the new subject they should get used to it. There is a need for a balance because some are used to the old style. So if the context and content is balanced, the learners will be covered, get context and a bit of content.

Probe: What is that you consider as balanced content and context?

Teacher 2: I think there is a need of having both content and context but dominated by the Context.

Researcher: If I remember well, in the last interview you indicated that the current curriculum context is not balanced, you suggested that the contexts should be 60 %. Do these questions meet your recommendations?

Teacher 2: Yes, these questions do.

Researcher: What do you think could be an appropriate approach to solve these problems?

Teacher: I think the first thing that one can do; I think you should bring along oranges in the class. You write, if you have so much number of oranges and they cost so much, then so much number of oranges will cost so much. From there a sort of formula of some kind will come out through those steps.

Probe: Look at this one, question (b), What do you think could be an appropriate approach to solve these problems?

Teacher: I think for this one, they can do this, in terms of using the old system where they use x and y and solve the problem.

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Probe: Don't you think by doing in that way we are trying to take out the context, if we use x and y?

Teacher: not exactly, but as the one way of introducing it, alternatively is to use the ratios. The learners can use the ratios to solve this problem.

Researcher: Do you think these were easy or difficult questions?

Teacher 2: I can't say they were easy or difficult but I can say they were up to the standard, especial learners who listen when the teacher is…….!

Probe: Do you think the inclusion of contexts makes these questions interesting?

Teacher 2: Yes, like question (c), this has to do with budget, like if you buy cups at Three cups cost R4.50, then for R12.00 you get …

Researcher: If I remember well, last time you talked about context and mentioned that contexts make Mathematics something that you can see. Do you think that these questions are about that which you can see?

Teacher 2: Exactly, like the first question (a) , when you talk about 6 oranges, they can see and touch, the second question is about something that happen in real situation, even question(c) students are used to such a question because it talks about money.

Researcher: what do you think will happen to the learners when answering these questions? Do you think they will prefer a, b and c or they will prefer d and e; or both?

Teacher 2: I think they will go for both depending on the learner what question she prefers.

Probe: Do you think learners would prefer questions with contexts?

Teacher 2: Yes, because it is something that they can discuss, and set examples, but in terms of these ones like 4x =12 they are solving for x which they do not know what x is all about- this question with a context is more practical. So they will find these very interesting.

Researcher: Let's look at some of the learners' responses. In the first question (a) the expected answer is R18. What would you say if the learner says 18 oranges instead of R18?

Teacher 2 I think that can happen, it is the matter of understanding, whether he/she did or did not understand what the question requires. Because some of the learners they

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take this for granted. 6 oranges R12 than 9 will be 18, without understanding. I think we need to teach our learners to understand the question before they attempt answering any question.

Probe: Don't you think the context was the cause or had an influence in this answer?

Teacher 2: Yes it is a barrier because they need to understand.

Probe : So should we move away from context because it is a barrier for the students to access mathematics?

Teacher: No, we should not run away from the context but we need to explain to the learners thoroughly that this is what they need to understand-when they attempt any question.

Probe: What if they are writing a test or examination where they have to write on their own.

Teacher: I think another thing that we need to know is that: time frame is the problem, because the students they do not read the questions with understanding because of the time factor. We need to give learners enough time rather than running away from context.

Researcher: The question was: - If two learners go out from the class after every four minutes. After 10 minutes how many learners will have gone out of the class? The leaner responded " I think 40 learners have gone". What do you think is the source of that 40?

Teacher 2: I think there was a misunderstanding here, he thought, he should multiply 10 by 4. So that's why I say understanding is a barrier which make them to take things very lightly.

Probe: can we still stick on the context here?

Teacher 2: Yah- I think there was misunderstanding of the question.

Researcher: Can you make a comment on this response, 3y = 6, then 5y = …? The response from the learner is **2/5.**

Teacher 2: I think this one (learner) was guessing. He did not even have the content.

Researcher: What would be your general comment on the role of context in mathematics?

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Teacher 2: It is very important when you are teaching the learners something that they can see. It is easier for them to understand or compare to something that they do not know, as I highlighted before that even…. It will be good for the DoE to put more contexts so that learners will be able to do the tasks even at home on daily basis.

Probe: When you look at the context you are saying the learners will be able to do maths at school and out of the school?

Teacher 2: Yah!

Researcher: What could be your comments on the following statements?

c) If a learner does not perceive mathematics to be necessary for the career path or study direction chosen, the learner will be required to take Mathematical literacy (p.11).

d) Mathematical Literacy should not be taken by those learners who intend to study disciplines which are mathematically based, such as the natural sciences or engineering

Teacher: I think the two statements are almost the same, but I am against the first one which says "If a learner does not perceive mathematics to be necessary for the career path or study direction chosen, the learner will be required to take Mathematical literacy". I think learners should take both Maths and Math Lit; and maybe the learner will have to choose which one is additional subject and a major.

Researcher: How do the students find them selves doing Mathematical Literacy or Mathematics?

Teacher 2: With the understanding that I have, there was this saying that math Lit is easier than Maths that I find it more contradicting, you see when you sit down with the learners and do equations, you find that it is not easy. This one (Math Lit) requires a lot of understanding when you deal with, you should have a good understanding of English, and if you do not understand English, than you will have a problem.

Probe: You are raising the issue of the Language as a barrier in learning Math Lit?

Teacher 2: Yes, language is a barrier, a big problem especially to our learners.

Researcher: What is your suggestion on this problem?

Teacher 2: I think the problem that we are having is us teachers, we intend to teach in the home language and we expect the learners to answer questions in English. No one

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will interpret for them in the exams. If we can teach it (Math Lit) in English, then the learners will be able to answer questions

Researcher: So how the learners choose between Math and Math Lit?

Teacher: What I have observed, many learners are running away from Maths and they are doing Math Lit. Even those who are doing a science you find that they are doing Math Lit. I think the reason is that they are having information that Math Lit is much easier compared to Maths! Which is not the truth?

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APPENDIX 2: LETTER OF CONSENT: TEACHERS

Dear Grade 10 Mathematical Literacy Teacher

I am seeking consent for your participation in research project that is part of my M Sc (math Ed) program at the University of the Witwatersrand. The ***aim*** of the research is to determine the ***views*** of teachers on the role of contexts in mathematical Literacy. You are requested to participate in the interview which will be conducted in August/September 2006.

The interview will be reflective and will be based on individual views. With your permission, I would like to tape record our conversation so that I will not forget important information you will provide. The interview will take no more than one hour. I will not use your names when making my report on this research.

It is envisaged that your participation in this research will make you more aware about the nature and scope of mathematical literacy as well as it relevancy to every day life.

If you are agree to participate, please complete the slip below and return it to me. Please contact me (Mr. Themba Mthethwa, at 0847600960/0828333437 or by email mthethwat@science.pg.wits.ac.za/ tmmthethwa2002@yahoo.com.

Thank you for your cooperation.

Yours Faithfully

Mr Themba M Mthethwa

I _____, hereby agree to be a participant of the research to be undertaken by Mr Themba M Mthethwa. I understand

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that the purpose of the research is to determine the views of the teachers on the role of contexts in mathematical literacy.

I therefore acknowledge that:

- the aims, methods, anticipated benefits and consequences of research, have been explained to me.
-I voluntarily and freely give my consent to my participation in such a study.
- I understand that results will be used for research purposes and may be reported in academic journals
- I am free to withdraw my consent at any time during the study.

Signature _____ Date ____/_____/_____

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