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Whither Relevance?

Mathematics teachers' espoused meaning(s) of 'relevance' to students' everyday experiences

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A research report submitted to the Faculty of Education, University of the Witwatersrand, in partial fulfilment of requirements of the degree of Master of Education by coursework and research report.

Johannesburg, February 1998

Degree awarded with distinction on 30 June 1998

Declaration

I declare that this research report is my own unaided work. It is being submitted for the degree of Master of Education by course work at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other university.

On this 25th day of February, 1998



Thabiso Nyabanyaba

To Ts'epo and 'Mats'epo,

my sources of inspiration

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ABSTRACT

This is a study of teachers' espoused meaning(s) of 'relevance' as it refers to relating school mathematics tasks and activities to students' everyday contexts. A qualitative approach was adopted, and a questionnaire and group interviews with teachers provided data on teachers' ways of talking about 'relevance'. The study focused on the inservice teachers in the Further Diploma in Education (FURTHER DIPLOMA IN EDUCATION (FDE)) programme offered by the University of the Witwatersrand (Wits).

The study analyses mathematics education literature about 'relevance', and Vygotsky's (1979) and Lave's (1991) theories as they illuminate learning as situated in socio-cultural contexts. The theories are not considered in terms of whether they provide "either-or" choices regarding relevance. Rather, they are considered in terms of some of the intricacies they reveal about relating school mathematics to students' everyday experiences.

Arising out of the teachers' ways of talking about 'relevance' were concerns for improving students' attitudes and perceptions towards mathematics. Persisting negative student attitudes are blamed on the way the teaching of mathematics has traditionally been isolated from the students' everyday experiences. Also emerging are understandings that relating the learning of mathematics to students' everyday experiences will induce positive associations for students. However, the teachers' discussions of the possible problems of relating mathematics to everyday experiences were limited to very obvious shortcomings such as this practice might be time-consuming. There were more complex understandings implicit in the teachers' talk.

This study has very important implications for those involved in curriculum development, especially the implementation of *Curriculum* 2005, as well as for teacher educators. Continuing to propagate the value of a more 'relevant' teaching approach might now be of limited value. Emerging from this study is a suggestion that beyond a discourse advocacy of the ideals of *Curriculum 2005* still lies the task of informing a more sophisticated understanding of 'relevance' in teachers, one dependent on a more practical exploration of situated tasks (relevant mathematics).

Keywords

access
espoused
everyday
meanings
relevance

List of tables

Table 1 *Emerging Categories* 96

List of abbreviations

DET - Department of Education and Training
DoE - Department of Education
ESKOM - Electricity Corporation of South Africa
Further Diploma in Education (FDE) - Further Diploma in Education
INSET - in-service education and training
LPP - Legitimate peripheral participation
PRESET - Pre-service education and training
SAARMSE - Southern African Association for Research in Mathematics and Science Education
Wits - University of the Witwatersrand

TITLE 1

DECLARATION 2

DEDICATION 3

ACKNOWLEDGEMENTS 4

ABSTRACT 5

KEYWORDS 5

LIST OF TABLES 6

LIST OF ABBREVIATION 7

CHAPTER ONE: INTRODUCTION 11

1 Background 11

2 Why teachers' "talk" 13

3 Why now 14

4 Why teachers 15

5 Underlying assumptions and theoretical framework 16

6 Conceptual Elaboration 18

7 An outline of the report 20

CHAPTER TWO: LITERATURE REVIEW AND THEORETICAL FRAMEWORK 22

1 Introduction 22

2 The relevance calls 23

3 Issues of language and culture 27

4 Vygotsky's socio-cultural theory of the mind 33

5 Lave and Wenger's Legitimate Peripheral Participation 36

6 Discussion 39

7 Conclusion 45

CHAPTER THREE: METHOD AND METHODOLOGY 47

1 Introduction 47

2 Why qualitative research 47

3 The sample 48

4 The research methods 50

5 Data Collection 51
5.1 Questionnaire 51
5.2 Group interview 53

6 Data Analysis 55

7 Issues of quality 56
7.1 Validity 56
7.2 Reliability 57
7.3 Generalisability 58
7.4 Limitations and delimitations 58

8 Conclusion 59

CHAPTER FOUR: TEACHERS' TALK ABOUT 'RELEVANCE' 61

1 Introduction 61

2 The questionnaire 61
2.1 Challenges and concerns 62
2.2 Merits of 'relevance' 68
2.3 Problems of 'relevance' 77
2.4 Developing a 'relevant' lesson 78
2.5 Some remarks 79

3 The interview 81
3.1 An overview of the group discussions 81
3.2 The evolution of categories 85
3.3 The categories 95

4 Remarks 104

CHAPTER FIVE: MEANING(S) OF TEACHERS' TALK 106

1 Introduction 106

2 Teachers' concerns 107

3 Positive association and meaning 108

4 Utilitarian perspectives 111

5 Problems of 'relevance' 112

CHAPTER SIX: CONCLUSIONS AND IMPLICATIONS 118

1 Conclusion 118

2 Implications 121

3 Further reflections 123

REFERENCES 126

APPENDICES 130

Appendix A: Questionnaire 130

Appendix B Interview Schedules 134

Appendix A1 Responses to Questionnaire 147

Appendix B1 Extracts of group interview discussions 163

Chapter One

Introduction

1 Background

"Whither relevance?" is a question on where the notion of relevance, especially mathematics tasks and activities relevant to students' everyday contexts, could be taking mathematics teaching practice: what curriculum issues it is trying to address and what meaning teachers are making of 'relevance'. The issue of what 'relevance' is trying to address will be examined through a literature review and through motivations and justifications for the research, all of which provide a necessary context for the study. The question of the "meaning(s)" themselves is the empirical focus for this study. Both the literature review and the teachers' meanings have important implications for mathematics teachers and teaching.

The background to my interest in this study includes my deep concern with the school mathematics curriculum and students' access to it. Also, in 1996, an inservice Further Diploma in Education (FDE) programme offered by the University of the Witwatersrand (Wits) for mathematics, science and English language teachers collected data on teachers' views of (a) a good mathematics teacher; (b) a successful mathematics lesson; and (c) an unsuccessful mathematics lesson as part of its base-line data. The aims for the collection of this data included to "establish and describe mathematics, science and English language **teaching/learning approaches and practices** in and across schools and teachers" and "follow-up the same sample of teachers in 1997 and again in 1998 to investigate whether and how the teaching and learning in their classrooms has changed over time and the role of the programme in this" (Adler in Adler, Lelliot, Slonimsky *et al.*, 1997, pp. 1 - 2). Therefore, part of the motivation for this research was to evaluate the impact of this FDE

programme. At the time of collecting the data the teachers had had very little exposure to the programme. Statements that recurred in the teachers' views included that the pupils must be "active" in their learning; the learning must be related to the "everyday experiences" of the learner; the teacher must "be a learner" and "prepare thoroughly"; the teacher must have "the knowledge of mathematics"; and the need for the use of "a variety of methods (Nyabanyaba & Adler, 1997 in Adler, Lelliot & Slonimsky *et al.*, 1997).

It might have been expected that teachers who had voluntarily undertaken further studies would be concerned with such ideals of a professional and committed teacher as "preparing thoroughly" and endeavouring to increase one's subject and pedagogic knowledge. But the extent to which these FDE teachers wrote about learner-centredness and 'relevance' was very interesting. In promoting *Curriculum 2005* one booklet describes as features of the new South African curriculum "active learners"; "an integration of knowledge"; "learning relevant" and connected to "real-life situations"; "learner-centred"; "teacher facilitator"; teacher constantly uses "groupwork" and "teamwork" to consolidate the new approach; "learners take responsibility for their learning (DoE, 1997, pp. 6 - 7). The occurrence of a discourse of learner-centredness is a positive indication for the acceptance of the ideals *Curriculum* 2005 among teachers. But the question remains as to what depth of understanding accompanied this articulation. Successful implementation of the curriculum requires, among other things, an interrogation of the understanding of the discourse. Because of the articulation of 'relevance', I became convinced that teachers in this programme would provide an interesting case in studying how deep mathematics teachers' understanding of the curriculum notion of 'relevance' is and what this understanding could mean for their practice.

"Depth", as regards these meaning(s) here, refers to the extent to which teachers' understanding shows critical reflection and not blind acceptance of

the discourse of time and place. As I elaborate later in my justification for this study, for South Africa, the issue of 'relevance' is closely associated with educational access. Access itself has remained central in concerns about the new curriculum which aims at redressing the inequalities of apartheid education. This study should illuminate how well 'relevance' would address the issue of educational access in South Africa in a new era of provision of equal education, given teachers' level **of understanding of its nature.**

Many teachers, not only those in the FDE programme, espouse pertinent ideals regarding their teaching, such as using everyday experiences in teaching school mathematics. Classroom observation in the 1996 FDE study indicates that there might be simplistic meaning(s) attached to this notion of relevance (Nyabanyaba & Adler in Adler, Lelliot, Slonimsky *et al.*, 1997). Such meaning(s) could have serious consequences for the teachers' practices and the implementation of the new curriculum which has 'relevance' and the integration of different learning areas as central. My study was thus set up to investigate the depth of the FDE mathematics teachers' espoused meaning(s) of the concept of relevance in mathematics education..

2 *Why teachers' "talk"*

The purpose of the study is to try to establish the depth of understanding of the espoused meaning(s) of the FDE mathematics inservice teachers regarding 'relevance'. Clearly, espoused meanings are only a partial element of the depth of understanding. A full examination would require consideration of both espoused and enacted meanings but this is beyond the scope of this study. Why I focus on espoused meaning(s), or the way teachers 'talk'[1] is elaborated in the argument for how I undertake this study in chapter 3. Teachers' talk is dialectically related to their practices. There are other factors that come into

[1] I clarify my use of 'talk' further in my conceptual elaboration. Generally "teachers' talk" refers to the ways in which the teachers in the study wrote about and discussed 'relevance' in their questionnaires and group interviews.

play in the relationship between what is espoused and what is enacted and this study does not pretend to uncover all aspects of teachers' practices. Indeed as Adler (1996 quoting Thompson, 1992) indicates looking at teachers' understanding or theory should not be underpinned by an assumption that the theory and its relationship with practice are static. Teaching, Adler (1996. p.26) continues, is "complex and deeply contextualised". Nevertheless, how teachers talk about their practice is an important element of their knowledge. In short, there is a lot that can be learned from the ways in which teachers' talk.

3 Why now

South Africa is going through a period of curricular innovation. It is important for such curricular innovations that the ways in which teachers position themselves in relation to the past and to envisaged practices are revealed and interrogated. Teachers' understanding of the theory behind the new practices is a critical element in the success of the new moves. The nature of the teachers' meaning(s) of the notion of 'relevance' will, I would argue, **indicate areas of action for preservice (PRESET) and inservice (INSET) teacher education, for successful implementation of the new curriculum** in South Africa. If teachers' meaning(s) are simplistic, their implementation might well be superficial. They may fail to see instances where a curriculum issue such as 'relevance' may create difficulties with their teaching or where it may not be desirable altogether. The level of sophistication itself does not indicate how well such teachers would be able to work with curriculum issues. However, there is an attempt in this study, to interrogate how teachers envisage working with 'relevance'. For *Curriculum 2005*, this level of reflectiveness is essential.

The discussion document on *Curriculum 2005* (DoE, 1997) includes the recommendation that the view that mathematics is a European product must be challenged. In the description for the assessment criteria for mathematical

literacy, mathematics and mathematical sciences in all the three phases of the proposed education system - Foundation, Intermediate and Senior phases - the solving of real life and simulated problems recurs. If teaches are to prepare students towards the attainment of this critical understanding and proficiency then they need to understand what relating mathematics to the experiences of students means in actual classroom practices. There are important arguments that "by locating school knowledge in the everyday activities of children, it becomes more accessible and interesting ... [and that] ... by linking classroom activities to economic, political and social issues, the practical application of school knowledge is promoted" (Taylor, 1997, p.2). But if such statements do not inform the critical understanding and the practice of teachers, then they may not amount to much.

In fact, the role of understandings of curricular concepts have a lot to do with curricular innovations in general. In this era when change and questions do not seem to besiege only developing countries, it is important that the teachers' understandings be brought aboard in building programmes for curricular change.

4 Why teachers

Teachers have been presented as key instruments of curriculum change. There may be contradictions if teachers are positioned as both the agents and the objects of change. Shalem (1997) reports that there are INSET organisers who have implemented their programmes without any regard for teachers' experiences and understanding. This practice, and the past practice of top down curriculum implementation, undermines the teachers' experiences and can lead to blind acceptance or resistance. A number of studies are beginning

to highlight the importance of teachers' experiences[2] in the move for curricular changes (Blay, 1994; Adler, 1997; Dadds, 1997).

As has already been argued, the study aims to contribute to the issue of access to mathematics knowledge in school. The level of sophistication of the teachers' meanings of 'relevance' can provide useful insights into curriculum implementation in general, and particularly important indications for the preparation of teachers for the implementation of ***Curriculum 2005***. This is crucial, not only for South Africa, but also for other developing countries which are trying to address the question of educational provision and its promise for development. It is necessary to balance the propagation of curricular ideals with a consideration for theory and practice from the perspective of teachers in order to avoid simplistic understandings.

5 *Underlying assumptions and theoretical framework*

Underpinning this study is a **social theory** of mind where learning is situated in the socio-cultural context of the students, and this includes inservice teachers learning about their practice (Vygotsky, 1978; Lave and Wenger, 1991). Learning is also through participation in a practice, one aspect of which is learning to talk in the manner of the practice (Lave & Wenger, 1991). Within a social theory of mind, what teachers' talk about, and indeed what they do, "form and are formed by their activities and practices which are social (located in institutions of society), cultural (located in language, symbols and ideas) and have a history" (Adler, 1996, p.37). Therefore, inasmuch as teachers come from different contexts, they share certain commonalities by virtue of sharing the practice of teaching at this time in history and location.

[2] There is a wide field of research and literature on teachers' thinking and knowledge. This study is not about how teachers' think. The focus here is the teachers' ways of talking about 'relevance' and what this "talk" reveals about the depth on their understanding of the concept of 'relevance'.

This theory of mind thus informed my interpretation of the teachers' talk about 'relevance', both explicit and implicit, and as formed by and informing of their practice. Although this talk is only a partial account of the teachers' understanding, it is about their practice. These theoretical underpinnings illuminate school as a specific social context with different relations to that maintained in everyday contexts. But while this difference highlights the specific features of school learning it is also used in this study to consider the relationship, though intricate, between school learning and everyday contexts[3].

These underpinnings have shaped the approaches and interpretations that have formed the centre of my study. In looking at development in children Vygotsky noted the dialectical relationship between the child, her environment and especially more knowledgeable others in mediating learning. Although Vygotsky (1979) did not completely absolve the biological processes of their responsibility in the development of children, he posited a relationship between the socio-cultural factors and the biological processes as accounting for the development of the child. Learning as a situated process implores an understanding of the contexts in which it occurs. Regarding the emerging teachers' understandings I thus also consider them in relation to the discourse of time and place. The discourse of time which culminated in the *outcomes-based-education* now on the verge of being implemented in South Africa has advocated for ideals such as "learner-centred" approaches and "learning relevant and connected to real-life situations", even as a paradigm shift. Teachers are positioned in relation to this discourse irrespective of their participation in the FDE programme at Wits. Teachers' talk could also reveal

[3] I have made a conscious choice to use a socio-cultural theory. I am aware that Dowling's sociological focus or even Enerst's epistemological focus could have been used to inform this study. However, I found that starting from the socio-cultural focus was more enabling for me. This is because at a practical and experiential level, it was Lave and Vygotsky who most informed my MEd studies. It remains a valid question whether, at an investigative level, the theoretical underpinnings chosen were the most enabling for this study. I shall return to this point in my conclusion.

their interpretation of 'relevance' in relation to their practice as Lave and Wenger so accurately note. I consider teachers as knowledgeable about their practice (Adler, 1996) and their talk as significant in their interpretation of their practice and the ideals of the time. The depth shall be in terms of what is predominant in their talk and what is even absent in their talk about the benefits and the difficulties of relating school mathematics to the everyday experiences of students.

The teachers' ways of talking is considered both in terms of what is implicit and explicit. In looking at teachers' knowledge, Adler (1996 citing Polanyi, 1967), argues that there is need to consider that which is tacit and their articulated knowledge. Thus she refers to knowledge as "both embodied and discursive"(p.37). Sometimes what we know or understand is not contained in our articulated knowledge but is embodied in our practices. It was for that reason that I included tasks in my group interview which were very illuminating in terms of their revelation of some of the more tacit knowledge of the teachers. As I consistently try to maintain throughout this study, both the teachers' talk *about* 'relevance' as they discuss its benefits and difficulties explicitly and their talk *within* as they discuss more implicitly some of the issues related to the subject and the practice are important elements of their learning to talking within the manner of the practice (Lave & Wenger, 1991). The talk, both implicit and explicit, as well as what they do not say, are important indicators of the teachers' depth of understanding. Ways of talking both shapes and is shaped by practices. Therefore, although a lot more factors come into play in the teachers' practices, the role of talk is significant.

6 Conceptual Elaboration

I use a number of concepts and terms with diverse meanings. It is therefore important that I clarify the meanings I attach to these concepts and terms.

Talk is a term that I use to describe the ways in which teachers discuss and write about 'relevance'. It is without the technical sophistication that other more elaborate discourse studies would normally embody[4]. The term has been used by Lave and Wenger (1991) to describe discursive practices with regard what the authors refer to as legitimate peripheral participation, a definition which is closer to the way I employ the term in this study. Lave and Wenger (1991) argue that talking and being silent reveals how people interpret their practice and how they are learning to act in a manner of the practice. Therefore, although 'talk' is not the only thing that can reveal how people understand their practice, it is a very important indicator of their knowledge.

Meaning(s), in this case, refer to the expressed understanding(s) of an idea. By looking at the espoused meanings I am claiming that what teachers say and describe as their understanding is very important. I am also acknowledging that there is another aspect of their meanings in what they do which might show what they fully understand the concept to mean. Espoused meanings, as I argued earlier in this section, are important as they reveal the teachers' interpretive considerations of their practice.

Relevant generally refers to what directly connects the learner and the subject. There are general concerns regarding connecting what is new to the learner with what the learner already knows in order to reduce the degree of difficulty that the learner could face in a completely unfamiliar situation. My particular concern here is with connecting the subject of mathematics with everyday experiences familiar to the learner. Where I refer to the notion of relevance as the connections between school learning and everyday contexts, I shall use quotation marks, 'relevance'. I shall also refer to the arguments of those who

[4] Although I do not enter into the full spectrum of discursive practices in this study, I do consider talk as the language "used to carry out the social and intellectual life of a community" in the same manner that Mercer (1995 in Adler, 1996, p.64) defines 'discourse'.

advocate for the bringing in of "relevant" non-school contexts into school mathematics as "the relevance calls".

Access can be defined as means or right of using, reaching, or obtaining something. In this case, language and other resources, such as the teacher, can provide means of understanding a mathematics concept. Morrow (1992) distinguishes between formal and epistemological access where the former refers to "access to the institution; the other is access within the institution to the goods that it distributes". In reference to access to higher education, Morrow argues that while reacting to the pressures for equal access, especially in the case of the previously exclusive laws of South Africa, more students can be accepted into tertiary institutions. Yet educationists in tertiary institutions should not be trapped into compromising on quality. Otherwise, the right for those students to knowledge or epistemological access would be denied. Although both issues of access arise in this study, it is epistemological access, access to mathematical knowledge, that is central to my study.

7 *An outline of the report*

Central to this study are both the literature around 'relevance' in mathematics education and the teachers' understanding of issues of 'relevance'. Chapter 2 reviews the literature that has impacted on meaningful learning and 'relevance' as a means to make mathematical learning more meaningful and more accessible. Chapter 3 describes and argues for the qualitative approach used in this study. The use of inductive research, whereby categories that emerge are grounded in the data is seen as most suited for a study of teachers' talk. Issues of validity, reliability and the limitations of the study as considering the ways FDE teachers talk are grappled with in this section. The heart of the study is chapter 4, which presents the results of both a

questionnaire and a set of interviews. In chapter 5 results are interpreted in relation to the literature review. The study concludes in chapter 6 with a discussion of the implications for further research and the practice.

Chapter Two

Literature Review and theoretical Framework

1 Introduction

This chapter considers other studies that have illuminated issues of 'relevance' and meaningful learning. It traces the concerns for the calls for relating school knowledge to students' everyday experiences and why the calls are particularly strong in school mathematics. I shall refer to these calls, as they are quite often related to attempts to remedy what are seen as unacceptably low performance in, and poor attitudes towards, mathematics by students. Calling for relating school mathematics to everyday experiences of students has opened up discussions regarding the relationship between school mathematics and issues of culture and language. These issues of culture and language shall be discussed in the context of South Africa as a multi-cultural and multi-lingual society.

I shall also review two theories that have frequently been quoted in advocating for or objecting to 'relevance' in mathematics education. These two theories, Vygotsky's (1979) socio-cultural theory and Lave and Wenger's (1991) legitimate peripheral participation, are important as they illuminate discussions about meaningful learning and learning as situated in socio-cultural contexts of students. Therefore, these theories are important in discussions about successful learning. Furthermore some interpretations have been made regarding these two theories in connection with what they imply for relating school mathematics to everyday experiences of students. Revelations that emerge from these interpretations of a distinction between everyday experiences of students and scientific concepts or school practice are

important as they problematise one's understanding of 'relevance'. But I shall go further than simply considering whether the interpretations offer an 'either-or' regard for 'relevance'. Vygotsky's theory suggests an intricate dialectical relationship between the everyday and school contexts which will form an important thrust for my discussion.

As I shall indicate in concluding this chapter, these considerations and, especially the two theories, provide a useful framework for my consideration of the teachers' talk. In general, the distinction illuminated by both Vygotsky and Lave and Wenger regarding the specificity of school has formed a very important focus for me to consider how aware teachers are of the intricate relationship between school mathematics and everyday experiences of students as an element of the depth of their understanding. This literature review, therefore, informs a theoretical framework where the depth of the teachers' understanding is considered as the sophistication of their 'talk' about 'relevance', especially the conscious sensitivity in their 'talk' about when and when not to use students' everyday experiences in mathematical meaning-making[5].

2 *The relevance calls*

Calls for relating school knowledge and the teaching practice to students' everyday contexts are strong in mathematics. One reason for this is the view that 'relevance' would render mathematics more accessible than it has hitherto been. This is very important for South Africa which is trying to make its previously discriminatory education system accessible to all the sections of its population. Failure, and even simply lack of interest in mathematics, has sparked off some exploration of the relationship between the learning of

[5] The focus of attention in this literature review is not on meanings in general but on relevance in mathematics learning. Nevertheless, as discussed in chapter 1, how we get to teachers' meanings should not be assumed and the issue is taken up in the discussion of Lave and Wenger (1991) that follows.

mathematics and the socio-cultural contexts in which it occurs. For example, Ensor (1997) reports investigative research work in which Carraher *et al* (1985) explore the relationship between school failure (particularly in mathematics) and social class structure. In fact, Volmink (1994, p.51) suggests that in order for students to discover the excitement and vigour that mathematicians find in mathematics, the teaching of mathematics should move from the ""interpretation of symbolic information" to an emphasis on situating it in the realm of everyday experiences of people". Such relevant (or familiar) contexts, it is argued, would make mathematics more meaningful and more accessible to students.

There is also a concern that, for too long mathematics has been maintained as a subject that does not necessarily have to make sense to students. Powell and Frankenstein (1997) feel that students give illogical answers to problems with irrelevant data because they believe mathematics does not make sense. The dichotomy between mathematics and common knowledge was also reported by Booth in what is referred to as an abstract-apart idea of variables. This is when students "treat variables as symbols to be manipulated rather than quantities to be related" (Booth, 1989, p.91). Booth's study argues against symbols representing manipulations apart from quantities, with no relation to any mathematical object at a lower level of abstraction that could give them meaning.

Making connections between the everyday experiences of students and their school learning is one attempt to make mathematics more meaningful to students. Bishop (1995) argues for a more meaningful mathematics in place of the exclusively rule-governed one. He maintains that any new idea is meaningful to the extent that it makes connections with the individual's present knowledge. This is the general notion of relevance that expresses the

need to move from the known to the unknown or connecting the unfamiliar to the already familiar elements of the child's knowledge. Connections with especially the future are explicitly encouraged by Stone (1993) in reference scaffolding[6] or the mediation of students' knowledge. Scaffolding occurs when we are sensitive to what the child already knows, and control those elements of the task that are initially beyond the child's capability with a view to assisting the child to carry out a task beyond the child's capability as an individual agent. However, even as they emphasise new knowledge rather than familiar experiences, such theories can be grouped together as emphasising human constructi , rather than a view to knowledge as above human experiences.

There have been other developments that have lately had some impact on the learning, especially of mathematics. For example, the end of the sole reign of Euclidean geometry as an example of absolute certainty in mathematics has led such philosophers as Lakatos (1967) and others who followed (Enerst, 1991 and Davis & Hersh, 1981) to argue that mathematics is situated less on any certain grounds, and even more on human intuitions. In curriculum discussions also there has been a growing rejection of the technocratic curriculum that emphasises an unchallengeable document in favour of curriculum as a contextualised social process (Cornbleth, 1990). Although varying in its emphasis on the individual in relation to the socially negotiated nature of knowledge, the emerging literature in learning has begun to emphasise students as active in constructing knowledge rather than as passive recipients of absolute knowledge from the teacher. I would argue that although

[6] I refer here to ***scaffolding*** in relation to Stone's (1993) discussion of the metaphor in mathematics education as well as the concept as it implies the controlling of the elements of a mathematical task that are at first beyond the students' ability. However, the concept itself can be traced back to Bruner's (1986) illumination of Vygotsky's *Zone of proximal development* (which I presently discuss) whereby the tutor or, in Vygotsky's terms, a more knowledgeable other, "performs the critical function of "scaffolding" the learning task to make it possible for the child, in Vygotsky's words, to internalize external knowledge and convert it into a tool for conscious control" (Bruner, 1986: 25).

these developments are not reflected as central to my study, they have had a very important influence on a view of knowledge as situated in the socio-cultural context of the learner rather than as absolute and unchallengeable.

The Calls for 'relevance' have at times been fuelled by the argument that mathematics denies access to students who feel that their lives are not represented because relations have centred around Eurocentric contexts and the historical development of mathematics has been provided as exclusively European (Powell & Frankenstein, 1997).

> This Eurocentric view dismisses Egyptian and Mesopotamian mathematics as merely the "application of certain rules or procedures...[not proofs] ... of results which have universal application" (p.194).

For example, the generalisation that the Egyptian approach to the area of a circle provided was not appreciated as constituting a proof in the Eurocentric view. Furthermore, in such a view there would be no mathematics seen in traditional methods and skills used in local productions of Sierra Leone's indigenous technology (Spencer, 1997). This is in spite of the fact that indigenous technology covers such mathematical concepts as measuring (weight, percentages and volume) of physical and chemical processes, as well as time and statistical data.

It is in the sense of seeing mathematics as entrenched in some cultures while the Mozambican basket weaving situation is dismissed, that Gerdes (1988) sees some bias. The class and gender prejudice in such views is also reflected in the failure to see any mathematical activity in adults handling money, students racing pigeons, and women knitting socks. In contrast, the more Eurocentric male dominated activities such as Western engineering concepts, and even some forms of sport, are celebrated as depicting a high level of scientific and mathematical thinking. Clearly, in that sense, students whose cultures and contexts are not seen as giving rise to any mathematics are bound

to feel unrepresented and this has implications for their access into the practice of mathematics.

3 *Issues of language and culture*

Following the positivist inclinations of the modern era which dominated the education theories of the thirties to the sixties, there has been a more "tentative" post-modernist paradigm shift in the theory of learning. Positivist inclinations may be evidenced by the observation made by Austin and Howson (1979) that "[both language and mathematics education], in the 1930s, '40s and '50s, attempted to adopt quantitative, scientific methods and, in particular, statistically-based research techniques" (p162). The more "tentative" shift in recent learning theories has assumed a more problematic view to education, jolting rather rudely the conviction that mathematics is an absolute, value-free and neutral body of knowledge.

While these arguments against scientifically based research in mathematics education have given rise to more acceptance of qualitative research, it does not necessarily argue against empirically based research. Rather it is an argument against the claim for objectivity on the basis of adopting quantitative, scientific methods of research. In other words, good research has become independent of method. But even more importantly, for this research, is the fact that it has now become almost established that factors such as language and culture play an important role in the learning of mathematics, as with all other subjects.

Developments in mathematics, especially the rise of non-Euclidean geometry, have led to philosophers Enerst (1991, citing Popper 1979) calling into question the view that mathematics is a neutral and value-free body of edge.

> There are no authoritative sources of knowledge, and no 'source' is particularly reliable. Everything is welcome as a source of inspiration, including 'intuition' ... But nothing is secure, we are all fallible. (p.18)

This is what I refer to as the "tentative" nature of the post-modernist paradigm that has provided even more grounds for concerns about the role of language and culture in mathematics education. Moreover, it cannot be assumed that the meaning of mathematical discourse is given and to be understood in one sense only. Specifically, Crawford (1992) maintains that:

> There is now an acceptance by many researchers that mathematical knowledge is constructed by individuals as the result of their experience. Experience is derived from acting in a cultural context. (p.1)

The calls for relating mathematics to students' experiences which are embedded in their relevant cultures is therefore not only born out of the concerns for the history of mathematics provided, which most often gives the impression that what was practised outside Europe was trivial mathematics, and certainly what is practised in African cultures is "primitive" (Powell and Frankenstein, 1997, p.197) although this is a strong enough motivation.

There is a fallacy in the taken for granted view that wisdom (as seen through the Western eyes) transcends cultures. Such "conflicts and inconsistencies are particularly evident in relation to the learning of Mathematics because the traditional curriculum has not made explicit the relationships between experiences that constitute "school math" and the position and uses of mathematical knowledge in the wider cultural context" (Crawford, 1992, p.4). Bishop (1992) makes a very interesting case of how certain cultures develop certain distinctions while others do not find the need for such distinctions based on their social and cultural back/foregrounds.

> It appears therefore that where there is less environmental need for large numbers or even for the 'infinite', there may be more use made of small finite numbers as well as of 'combinatorial' thinking about numbers. (p.25)

In fact, Breen (1986) goes as far as to say that school mathematics can be used as an instrument to promote social perspectives such as social passivity and conformity, academic snobbery and naturalness of good healthy competition which may be at odds with certain cultural norms.

It is morally and politically unfair that much of our present mathematical practices are based on Eurocentric concepts and that does disadvantage students from other cultural back/foregrounds. Presmeg (1988, p.167) argues that "discontinuity is experienced in a less form, if at all, if the schooling is seen as relevant in the pupils' future without either-or decisions having to be made". However, while there is general acceptance that learning, even in mathematics, depends on culturally embedded experiences, exactly how we may relate mathematics is not such an obvious exercise.

If only culture were a tangible concept it might have been easier to relate school mathematics to students' cultural experiences. Presmeg (1988, p.141), using van den Berg's (1987) definition, refers to culture as a "set of shared meanings which guide people's understandings of things and how they operate". She claims that because these meanings are socially constructed they are always changing. This view of culture as shared by and within a social collective, and as changing, is shared by Presmeg (1988). Presmeg (1988, p.166) states that cultural transmission includes both the transmission of tradition from one generation to the next and the transmission of new knowledge and cultural patterns from anyone who "knows to anyone who does not" (p166). Hence, Muller (1993) argues against the presentation of cultural 'heritage' as a static, atemporal, quasi-mystical reservoir of supposed psychological and material sustenance, without any regard as to how modern children with their youth-cultural preoccupations and solidarities would relate to it. If as Thornton (1992) observes, people are not endowed with some unique and fixed culture from which they draw out modes of behaviour that

makes them both recognisable and distinct as a group, then how do we then assign a certain culture to a people?

Even around the issue of language the argument remains intricate. A number of studies have been conducted on the relationship between language and thought. Bruner (1968 in Austin & Howson, 1979, p.167) argues that thought is "intimately connected with language and eventually conforms to it". Vygotsky suggests a relationship between language and thought where there is not necessarily a parallel development, but there is a dialectical influence where one benefits from the mastery of the other. It is to that extent that Vygotsky (1962) argues that a concept depends on its linguistic features, and it can be considered true of mathematics as of other subjects. The role of language, as "both tool, functioning externally, and sign, turned inwards, and a key mediator in the development of higher psychological systems" is crucial (Adler, 1995, p.266). It is an external tool for communication with others and a thinking device which children may use internally to determine their understanding of concepts.

The interdependent nature of this internal-external relationship is that we must eventually share our concepts for us to have fully understood them. Pimm (1987, p.23) reports it as "the experience of many teachers that merely as a result of asking pupils to try to articulate what the difficulty is that they are experiencing, half-way through the resulting explanation pupils say something like: 'Oh, I see now. Thank you very much for helping me'". Therefore, one of the functions of a language is becoming conscious and reflecting on one's own thinking. The much quoted Sapir-Whorf (S-W) Hypothesis (Berry, 1985; Brodie, 1989; Zepp, 1982) asserts that "the structure of a person's language has a determining influence on that person's cognitive processes" (Berry, 1985, p.19). This hypothesis is contested for its deterministic stance that we are trapped in our cultural and linguistic factors. As an explanation of the

relationship between cognitive development and linguistic factors it does not sufficiently explain how human beings are able to influence their linguistic, and indeed cultural development, if the latter has a critical and uni-directional influence on the former. Although this hypothesis, as a description of this relationship, is contested, the important role of language in cognition cannot be denied.

Pimm (1987) argues that mathematics, with its specialised discourse both in its uniquely mathematical terms and its use of everyday terms in a peculiar manner, requires attention for any learner. In South Africa, where for the majority of the people, "English is a third, or even fourth language and ... is often not encountered until children begin their schooling" (Brodie, 1989), the situation is even more complex. Some studies have been done on the relationship between mathematical concept-formation and language in multi-lingual situations where Fafunwa (1975) argues that when the language of instruction is a foreign language the African child is "being unnecessarily maimed emotionally and intellectually". Fafunwa further argues that even African languages can develop the same requirements of specificity in being precise made on the English language by mathematics.

In a study about cognitive development and main language Zepp (1982) reports that the performance of students differed on a test on logical connectives depending on the language. For example for Basotho students, in the lower grade "the 'Sesotho groups performed better than the 'English' groups, although both groups performed poorly. In Form 4 (Grade 11), the English group excelled" apparently as a result of having attained a higher proficiency in English (Zepp, 1982, p.205). The subject of logical connectives has been highlighted because it is regarded as central to complex, abstract and recursively abstract ideas, whether scientific or not. What this study implies is that it might be a pedagogically viable option to be sensitive to the main

language at the lower level of a child's education, while being sensitive to simultaneously developing the child's ability to abstract. Whether one argues as Fafunwa does that all languages are capable of developing the requirements mathematics makes on its discourse, there has to be an awareness on the part of the teacher for the development of this precision in expression. In fact, irrespective of the language of instruction, it cannot be assumed that children will develop precise mathematical discourse and conception spontaneously.

While it appears that the teaching of mathematics requires an awareness of issues of culture and language, the exact remedy is not simple. For example, Berry (1985) questions the suggestion that merely by teaching students in their main language, they would benefit. Adler (1995) particularly questions this assumption in the context of South Africa's multi-lingual classrooms. There are difficulties because the first language is not necessarily shared by all in class, nor the teacher. It is in that sense that relating school mathematics to relevant linguistic and cultural contexts of students, especially in South Africa is described as a very difficult exercise which would require "multiple strategies and knowledge and awareness of when to use" by the teacher appears to me to be the most feasible solution (Adler, 1995, p.272). It is an approach that is not impossible but one that cannot be informed by a simplistic understanding of such issues as 'relevance'. That is why the teachers' understanding of 'relevance' has so intrigued me.

Debates about 'relevance' continue to contribute to a deeper and more problematised understanding of meaningful mathematics learning[7]. Through

[7] As I prepared to finalise this report I became aware of a discussion by Boaler (1997) in which there is a report of the effectiveness of 'traditional' and 'progressive' teaching methods in preparing students for the demands of the 'real world' and the future. She draws on this study of two schools teaching differently to argue that students, who in school have been "encultured into a practice of thinking, talking, representing and interpreting" mathematics in a larger real-life context will view real-life problems in a similar way to those they attempt in school and become more successful in applying school knowledge in real-life situations than students taught mathematics in a decontextualised and fragmented manner (p.106). She

the discussion so far I made mention of theoretical perspectives that illuminate the discussion of 'relevance'. One reason for this is that these theories are concerned with meaningful learning. There have also been interpretations of the theories to advocate for or argue against relating school mathematics to the everyday experiences of students.

4 *Vygotsky's socio-cultural theory of the mind*

One such theory about learning as situated in the socio-cultural context of the learner, rather than as something simply outside or simply inside a learner, is Vygotsky's socio-cultural theory of the mind. One of the fundamental concerns of Vygotsky was with "the relationship between human beings and their environment, both physical and social" as regards the uniquely human aspects of behaviour (Vygotsky, 1979, p.19). According to Vygotsky, development in human beings is heavily mediated by others and tools, and is not divorced from context. Although Vygotsky did not intend to completely absolve biological processes of the responsibility for human development, he posited a dialectical relationship between the biological and the cultural, and so, between the individual and the social context.

The dialectical way in which Vygotsky (1979) worked with concepts can be seen first in his celebrated *zone of proximal development (ZPD)*. The ***ZPD*** is the

> distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers. (p.86)

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therefore adds to the arguments about the specificity of school learning, the angle that students who have not been specifically prepared to deal with open-ended situations will not be successful in solving open-ended problems as they occur in real-life. I came across her book too late to integrate it into my argument, but suggest that it would be an interesting argument on which to follow up.

The independent and actual level of development of the child is mediated to a higher potential level of development through social interaction. The development of the child is situated in her relationship with her socio-cultural-historical context. Through mediation, the child will eventually internalise that which she first learned from and with others. That is the manner in which development first appears at an interpersonal level (with others), and later at an intrapersonal level (within a person). Through tools and symbols such as language, the child is able to develop higher psychological functions which are more voluntary and more conscious than the elementary biological functions. It is its dialectical nature that makes Vygotsky's theory such a powerful socio-cultural theory of learning.

Vygotsky suggests the specificity of schooling as a context[8] for developing the specifically scientific and conscious concepts that are different from everyday life. This distinction should not, however, overshadow the dialectical relationship that Vygotsky advocated between the child and her context, and between what the child learns in everyday situations and in school. School aims to develop functions that are more conscious and more scientific than everyday contexts. As a context, school offers the opportunity to reorganise and see the possibility of reorganising life in ways that everyday learning contexts do not allow us. These functions of the mind that occur specifically in school, have also been referred to as higher psychological processes (Vygotsky, 1979).

[8] Vygotsky (1979) illuminates how everyday contexts tend to promote spontaneous concepts which are closely associated to experience and thus do not allow us as great an opportunity to abstract knowledge away from the immediacy of our experiences as school contexts do. If the development of higher psychological processes is a sufficient explanation of the specificity of schooling, "the value and benefits of schooling, however, provide the content of much research and debate" (Adler, 1996, p.72). Particularly, the debate here remains why schooling has been so unsuccessful for many. Therefore, Vygotsky's theory does not sufficiently problematise schooling.

While schooling for Vygotsky was a context where there is an opportunity for higher psychological processes emerge, he did not mean that scientific concepts were formed in total isolation from spontaneous concepts. By looking at the relationship, and indeed the distinction, between learning a foreign language and a native language, Vygotsky drew a very useful analogy. "Success in learning a foreign language is contingent on a certain degree of maturity in the native language" (Vygotsky, 1962, p.110). Such an interaction was also related to the interaction between scientific concepts, as those concepts most naturally learned in school, and spontaneous concepts, as those concepts that thrive in everyday situations. The interaction between scientific and spontaneous concepts gives rise to what Vygotsky (1962, p.114) refers to as **"true concepts"** which are "achieved by generalizing the generalizations of the earlier level". The nature of the interaction is most dialectical, "each system influencing the other and benefiting from the strong points of the other" (Vygotsky, 1962, p.110).

For pedagogic issues there is an important implication of this complementary nature of spontaneous and scientific concepts in school. It "challenges commonsense notions that we always learn best when we move from the familiar to the unfamiliar" (Adler, 1996, p.73). Vygotsky's theory warns us against a simplistic relation between school learning and everyday experiences. Floden *et al* (1987) then go on to make a very valid point that those who advocate relating school mathematics to everyday experiences of students have failed to also show the drawbacks of relating school mathematics to everyday experiences of students. But for me this does not imply, as Floden *et al* (1987) do, that school learning should break away from everyday experiences. Rather, I draw from Vygotsky's theory that teachers should be equipped with a deep understanding of when and how to use 'relevant' everyday contexts and when not to.

5 *Lave and Wenger's Legitimate Peripheral Participation*

Another theory about learning as a situated activity and knowledge as a human construct that has been interpreted in connection with 'relevance' is Lave and Wenger's (1991) theory of learning as Legitimate peripheral participation in communities of practice. In defining learning as a situated activity or *legitimate peripheral participation* (LPP) the authors note that

> learners inevitably participate in communities of practitioners and that the mastery of knowledge and skill requires newcomers to move to full participation in the sociocultural practices of a community. (p.29)

This thus sets up learning as located in social practices rather than in the heads of individuals. Adler (1996) argues that LPP "is in sharp contrast to dominant learning theory which is concerned with internalisation of knowledge forms and their transfer to and application in a range of contexts" (p.53). In further challenging the notion of transfer Lave and Wenger (1991) make the following note:

> schooling as an educational form is predicated on claims that knowledge can be decontextualised, and yet schools themselves as social institutions and places of learning constitute very specific contexts. (p.40)

Lave and Wenger also see Vygotsky's ZPD beyond just "scaffolding"; and beyond just the acquisition of more scientific knowledge from everyday knowledge into a form of social participation that transforms the relations between newcomers and old-timers. Learning is thus an evolving and continuous activity. Their view is that this theory highlights the

> relational interdependency of agent and world, activity, meaning, cognition, learning, and knowing. It emphasizes the inherently socially negotiated character of meaning and the interested, concerned character of the thought and action of persons-in-activity. This view also claims that learning, thinking, and knowing are relations among people in activity in,

with, and arising from the socially and culturally structured world. (p.50-51)

Therefore, although the theory focuses on a person, it encompasses the whole person: a person-in-the-world, as a member of a sociocultural community. One intricacy about learning that the authors refer to is that it is not simply about transfer and assimilation, but also about change and conflict as newcomers become old-timers.

Lave and Wenger (1991, p. 97) distinguish between a learning curriculum and a teaching curriculum. "A learning curriculum is a field of learning resources in everyday practice *viewed from the perspective of learners*. A teaching curriculum, by contrast, "is constructed for the instruction of newcomers" controlled by the instructor and not situated. Access to a wide range of activity within the community is central to moving towards centripetal participation. In the foreword Hanks (in Lave & Wenger, 1991) notes that the theory makes sense of learning as located in the processes of coparticipation, not in the heads of individuals and speech as an interaction. This adds to the growing body of research about **the situated character of human understanding and communication**. Lave and Wenger's theory shares not only the social theory that is central to Vygotsky's socio-cultural theory, but also language as a key mediational tool. In Vygotsky's (1978) terms it is a key mediator in the development of higher psychological systems.

Lave and Wenger (1991) take as their focus the relationship between learning and the social situations in which learning occurs. In other words, learning cannot be transported from context to context unchanged. Learning interacts with the context in a manner that shapes both the concept formation and the context. This serves another blow to the theory that learning is acquiring a discrete body of knowledge to be transported to different contexts. Rather learning involves engaging in the process with the full range of resources

available. We cannot therefore view learning in school in isolation from the school context and the relations in school. Vygotsky's theory, however, suggests that the development of higher psychological systems becomes internalised and thus "operate independently from future experiences and activity and evolve with development" (Adler, 1996, p.70)

About discourse and practice, the Lave and Wenger claim that "learning to become a legitimate participant in a community involves learning how to talk (and be silent) in the manner of full participants" (1991, p.105). After all, LPP treats verbal meanings as the products of speakers' interpretive activities. They distinguish between "talking *about* a practice from outside and talking *within* it" (107-108). However, such a distinction is not mutually exclusive nor does it determine being a legitimate participant. Both forms of talk can reveal the understanding and thoughts of the participants. What it actually means is that "[f]or newcomers then the purpose is not to learn *from* talk as a key to legitimate peripheral participation" (Lave & Wenger, 1991, p.109). While learning to talk about and within a practice involves learning to act in the manner of the practice, it is not the only way to learn. The full range of resources in the practice must be open for the learner to participate in order to move to full participation. Nevertheless, Lave and Wenger's distinction between talking about and talking within illumunates both the design of the study and the findings. It allowed me to consider both teachers' implicit and explicit discussions of 'relevance' as important data.

These two theories bring illuminations to my study in similar and different ways. Vygotsky's theory illuminates the characteristics of school and how everyday contexts can disadvantage the formation of higher mental functions in school. Lave and Wenger bring us to a better understanding of the school as a particular context with different social relations. Both are about the

specificity of schooling, and yet different in that Vygotsky's theory highlights the development of specifically human thinking and Lave and Wenger emphasises relations, access and sequestration within communities of practices.

6 Discussion

There are concerns related to the bringing in of "relevant" contexts that are attempting to react to the view of students that mathematics is essentially a meaningless subject. Even enthusiasm about the subject is no small task of (re)building the culture of learning in South Africa and entrenching mathematics as a human activity. In fact, the value-laden nature of learning should be understood in its entirety as implying the realisation that school is not only about maintaining the values of the powerful few but can dialectically influence and change values so that it eventually empowers one to control her destiny. The treatment of mathematics which emphasises manipulative ability in isolation from any common knowledge has compromised students' ability to make sense of mathematics and thus of attaining higher conceptual understanding. As has already been indicated from Vygotsky's dialectical relationship, the development of quality understanding is a very intricate relationship of an eventual generalizing of several generalisations of lower levels of understanding to the formation of true concepts. Although school is a unique context for opportunities to systematise and generalize one's understanding, true conceptual understanding is an intricate marriage of several modes of understanding, and certainly not merely procedural understanding or the transformation of mathematics into an uncommon-sensical knowledge.

Emphasising one form of seeing mathematics at the expense of all other forms has been revealed to have serious conceptual problems for students. The investigation by Booth (1989) reveals that the view of mathematics as an

unrelational, abstract-apart discipline can be disastrous. In their investigation of inservice teachers' understanding of the number theory, Zazkis and Campbell (1996) also demonstrate that procedural dependencies without some conceptual guidance often result in tedious and time-consuming "hit and miss" strategies potentially leading towards disenchantment with the subject. The tendency of traditional teaching not to prepare students for more conceptually demanding tasks has also been confirmed in a study by Boaler (1997) referred to in an earlier footnote. The subjects in this study preferred manipulative attempts as truly mathematical activities, even when other less manipulative, and even common-sensical approaches would have yielded accurate results. It is in this sense, that treating mathematics as a practice apart from any relation to other aspects of knowledge could be criticised.

There is a strong and legitimate argument within the 'relevance' move for the provision of a more meaningful context for school mathematics than the purely manipulative practice that still persists. The presentation of mathematics as above human construction, only obtainable through memorisation of rules, has led to a great dislike of mathematics by many students. It cannot be denied either that both the historical development of mathematics as purely Eurocentric and the exclusion of other activities, especially African cultural activities, presents difficulties for the African child. There is a lot that can be done to present mathematics in a way that makes it more relevant and comprehensible for learners from other cultures. By so doing, mathematics would be seen to be "doable" and this would boost the self-image of African children. Providing everyday contexts is one method of achieving this objective.

There have also been arguments for the consideration, not only of relevant cultural contexts, but also for the use of relevant African languages at the early

stage of school learning, including mathematics learning. After all, the performance of other peoples, especially Asians, in mathematics using the mother tongue has been largely ignored as an argument for implementing a mother tongue mathematics programme, at least at an early stage.

This is not to advocate for an indiscriminate bringing in of everyday and cultural contexts into school knowledge, though. For example, the extent to which the inclusion of contexts is a political concern to give cultural activities in developing countries a pat on back, can be problematic. Culture is very complex and not everyone associates positive images with culture. Particularly striking is the argument by Vithal and Skovsmose (1997) that

> the language of 'ethnomathematics', particularly its articulation of a concern with culture in education, may appear all too familiar and conceptually rather close to apartheid education. (p.8)

The rhetoric of the apartheid marginalisation of the majority of the people in South Africa was that 'we' must all develop according to and in relation with our culture. Dowling's (1991) warning that the extent to which the bringing in of mundane context into mathematics keeps the working class out of real mathematics is also a profound one. The almost romantic reverence, which might have been influenced by Western 'liberal' scruples, can cloud the debate. The warning by Dowling (1991) about such mundane contexts needs to be heeded. We could find ourselves in a situation that further encourages the very difference we are trying to run away from where multi-cultural education is for the disadvantaged while the "normal" continue with the "real" mathematical activity. Therefore, culture as an affirmative action is not unproblematic in mathematics. Moreover, South Africa has its own complexities in terms of the use of relevant cultural contexts and even languages of instruction. Being a multi-cultural and multi-lingual country, it is not going to be easy to find teachers who are competent in the languages and cultures of the students, assuming that the students also share the same language and culture.

Even the issue of language which could be an issue of government policy, is not resolved simply. Zepp's (1982) study indicates that there would be a lot to gain for teachers to be sensitive to the learner's main language at the lower stages of learning while they [teachers] are conscious about the development of the logical expression of the student especially in the later stages. This confirms the claim by Adler (1995) and Berry (1985) that children do not gain **merely** by being taught in main language. The issue of the specialised nature of mathematics discourse (Pimm, 1987) implies that students' difficulties regarding mathematics is not resolved even by proficiency in English. Moreover, the use of main language in most societies in the East does not indicate that English is the only language capable of developing specialised mathematics discourse. But the issue of language policy is not that of educators alone. Both parents and students would have an important part to play in this matter as they can be quite resistant to the use of main language. For the time being, it appears that we are caught in the situation where teachers would have to be sensitive to main language at the early stages while not depriving students of developing logical expression and specialised mathematical discourse in English. In South Africa this a very complex requirement for teachers who may not share the same linguistic or cultural experiences of all their students.

Ensor's (1997) argument against the notion of transfer offers very useful insights. Using Lave and Wenger's argument that the school context is specific in developing identities about behaving in school, which is not transferable to non-school contexts, she argues:

> School and supermarkets are different contexts and it is theoretically questionable that school can prepare adults and children for shopping. For her [Lave], the notion of transfer of school knowledge to other sites is an assumption rather than a finding. She celebrates the competence of what she terms 'just plain folks' in their everyday haunts and suggests that what school mathematics should concern itself with is not the theoretically and empirically dubious

> enterprise of teaching pupils for non-school contexts, but with apprenticing them into mathematics, into the practice of mathematicians.
>
> (Ensor, 1997)

Lave and Wenger (1991) argue that school is a specific context. This implies that for learning about school practices students need to be exposed to the full range of the activity as it is without covering it perhaps in everyday contexts. It is in this light that they argue that while one does engage in talking about an activity in any practice, this is adequate for learning a practice. It is only by acting in, as well as talking about and within a practice, that one can learn the full range of the practice.

One other strong argument against non-school contexts in the learning of school mathematics emerges from reports that apart from an early enthusiasm at the use of everyday contexts, students rejected mathematics packs, such as those which related mathematics to factory life, on the grounds that it did not teach them 'proper' mathematics (Spadbury, 1976 in Ensor, 1997and also confirmed in Dowling, 1991). The extent to which such everyday contexts obscure the principles and practices of mathematicians, might make them more unfair than the "Eurocentric" presentation of mathematics. Research by Lave reveals that "the use of context is less useful in facilitating links than a consideration of the underlying principles and processes which form mathematics" (Boaler, 1993, p.12). The same sentiments are shared by Coombe and Davis (1995) about games in the mathematics classroom. Games can be very disenabling in mathematics classrooms because of their everyday associations (such as winning without paying any attention to the concept underlying the game). Moreover, while mathematics in the street was observed (Carraher *et al.*, 1985) as more easily computed than in the classroom, one of the questions has been whether the students regard what they are doing in the streets as a mathematics activity.

Adler, in reference to a concern about using talk in the context of multi-lingual classrooms in South Africa (a concept that is very closely associated with relevance in its question on code-switching) refers to the notion of visibility and invisibility. She argues that discussion could very easily obscure "[epistemological] access to mathematics, by becoming too visible" (Adler, 1996, p.10). Similarly, for contexts to provide access, they must be visible and invisible allowing us to see through them the underlying mathematics principles and processes, without being the object of attention by students.

Brodie has also alluded to the tension that arises as a result of giving too much freedom to the students in an attempt to be relevant. The tension or double bind (as cited by Brodie, 1995 from Mellin-Olsen, 1987) arises when "the pupils' articulation of their own ideas or activities does not meet the teacher's expectations and so she is forced to steer the discussion in a way that the crucial points are emphasised" (Brodie, 1995, p.236). Emphasising students' relevant context can compromise the teacher's awareness that there is a validated form of mathematics to which students require access if they are to succeed in school.

For me, the theoretical discussion presented here suggests a dialectical and even intricate relationship between the familiar and the unfamiliar, between the individual and the social, and problematises the relationship between everyday concepts and school concepts. As much as learning from familiar contexts can be emotionally empowering in terms of inclusion and access, sticking to the present without being generative of the future can cause some emotional rejection. Meaningful learning is a very broad concept that it does not only relate to familiar situations but to the possibilities of the future that are made available. It is in that sense that views to the 'relevance' notion have

not done it justice by defining it only in terms of the everyday contexts without revealing the intricate, dialectical and even problematic relationship with a very important aspect of mathematics as a school practice that offers new and powerful ways of looking at one's experiences

7 *Conclusion*

My main consideration in this chapter has been debates around meaningful learning of mathematics. To that effect I have presented calls for making mathematics made more meaningful by situating it in the sphere of relevant human knowledge and experience. Used to support these 'relevance calls' have been advances in and around mathematics and mathematics education. Of a more general nature have been revelations that children are active participants in the learning process. Specifically, there has been a challenge to the commonsense notions of mathematics as a certain body of knowledge. The debate however remains how we may situate and relate the learning of mathematics in culturally embedded experiences so that children benefit. Central to my conception of children benefiting has been the issue of opening up mathematics to the everyday experiences of students without losing sight of what I have called epistemological access.

I also drew on two theories as they impact on meaningful learning. I have argued that both Lave and Vygotsky inform situated learning in different ways. Vygotsky's theory further illuminates that learning in school is specifically for the development of higher psychological systems. Whether this is an exclusive nature of schooling might be contested. But that it clarifies the immediacy of everyday experiences it serves as a useful warning for teachers that they would have to mediate very closely during the use of everyday contexts in school. Lave also challenges the notion that learning can be transported from context to context unchanged. Therefore, in relating

mathematics to students' everyday experiences teachers need to be sensitive when there might be both benefits and contradictions in promoting epistemological access.

In this chapter, I have elaborated how I perceive 'relevance'. Therefore, in analysing the depth of the teachers' understanding of 'relevance' I need to look for a sophistication and sensitivity that suggests an awareness of both the benefits and the limitations of 'relevance'. In the following chapter I describe the methods and methodology used for my study.

Chapter Three

Method and methodology

1 *Introduction*

In chapter 1 I considered the theoretical underpinnings that guided my study as well as the limitations and delimitations of looking at teachers' espoused meanings in the absence of their enactments. In this chapter I explain further choices I have made in my methodology. I begin by looking at what informed my choice of qualitative research in relation to my research question. I describe my sample and how I proceeded with the study. In describing my analysis I draw on a discussion of issues of quality, especially around the validity of my recording and interpretation.

2 *Why qualitative research*

This study is shaped by a socio-cultural theory of the mind where teachers' understanding are considered as complex and deeply contextualised. In order to determine what exists as the meaning(s) teachers hold of the concept rather than how many teachers hold the 'relevance' notion I was compelled to select a qualitative rather than a quantitative approach to my research. The complexity of the issue under consideration has also been confirmed by the literature considered in the previous section which revealed that regarding 'relevance' in meaningful mathematics learning, it is not a matter of "either-or" choices. The research question, thus further elaborated, is whether and to what extent teachers are consciously aware of and sensitive to when and when not to use students' everyday experiences in the promotion of meaningful mathematics learning.

In relation to my general framework about the complex and deeply contextualised nature of the subject of teachers' meanings I decided to use "noninterfering data collection strategies to discover the natural flow of events and processes and how participants interpret them" which are central to McMillan and Schumacher's (1993, p.372) definition of qualitative research. For them qualitative data analysis is primarily an inductive processes. They describe this inductive process as four cyclical and overlapping phases. Phase one involves the **data** collection. As **topics** emerge the second phase begins. This phase ends in the third where **categories** and **patterns** can be clearly distinguished. The final phase brings with it a new **understanding** which should inform a **grounded theory** of the nature of the data. Developing categories requires going over the data again and again to look for both positive and negative associations and thus refining the categories. Grounded theory allows for a way to go beyond descriptive analysis to add a theoretical dimension. "The theory is 'grounded' in that it is developed from the data, in contrast to testing a theory from the literature" (McMillan & Shumacher, 1993, p.509). In qualitative research, unlike quantitative research, most categories and patterns emerge from the data, rather than being imposed on the data prior to data collection. Therefore, the choice of a qualitative approach was not incidental but was guided by my theoretical framework and the nature of the subject of the study.

3 The sample

Thirty-three first year inservice teachers undertaking the mathematics course in the FDE programme took part in the questionnaire run in July 1997. The programme is currently being offered to senior primary and secondary teachers (M+3) with courses covering educational studies, subject methodology and subject content (Adler in Adler, Lelliot, Slonimsky *et al.*, 1997). Although the programme is largely distance, there are residential

courses offered during school holidays. It was during the first and second of these residential courses in 1997 that I decided to gather my data. These teachers come from Venda, Phalaborwa and Gauteng, thus including rural and urban areas. The contexts in which these teachers work vary greatly in material and human resources. While it might have been interesting to contrast urban and rural teachers' views of 'relevance', this was not a focus for this study. Teachers' location was thus not considered in analyses or design. Of more interest might be the fact that all 1997 registered first year teachers present were involved. There were 18 primary school teachers and 15 secondary school teachers. The interview was set up in homogeneous groups of primary and secondary school teachers to enable focused group discussion.

The selection of the FDE mathematics teachers was more a matter of purposive (Cohen & Manion, 1994) sampling than of studying a particular case. The composition of the group in terms of primary and secondary school and in terms of the various contexts from which they come was one basic requirement that guided the selection of this group. As I mentioned in the background to this study, a previous group of FDE teachers had, on analysing their narrative, revealed an awareness of issues such as learner-centredness and 'relevance' in the drive for meaningful mathematics teaching. It was my expectation that this 1997 group also undertaking further professional development in the form of the FDE would be more conscious of their choices around 'relevance' in mathematics education than any randomly selected group would. As such, this sample would allow me access to the subject of my interest. As the teachers in their first year of study under the FDE, the influence of the programme on their talk would be limited. In fact, the literature of 'relevance' would have been more widely available in documents promoting the soon to be introduced *Curriculum* 2005 than in the FDE courses. However, I do need to acknowledge, as I did earlier, that the teachers

would still be positioned in relation to programme already in terms of what they interpreted its requirements and expectations to be.

Therefore, the selection of this sample was purposive in that it was a conscious and strategic choice of a group of teachers from a wide range of contexts committed to professional development, and who might provide interesting insights into teachers' meanings of 'relevance'.

4 The research methods

The analysis proceeded in a largely grounded manner using qualitative methods to establish categories of the ways in which the teachers talked about 'relevance' and its intricacies. McMillan and Schumacher (1993) argue that grounded theory allows for categories to emerge from the data rather than the categories being imposed on the data. Thus the complex phenomena that are teachers' understanding would then unravel with the data rather than the researcher setting up beforehand what should emerge from the data. The use of a questionnaire and a group interview was guided by a desire to increase the depth of the data and inform the interpretation in more than one way than by the typical notion of triangulation. McCormick and James, 1983 (in Cohen and Manion, 1984) express caution regarding triangulation.

> There is no absolute guarantee that a number of data sources that purport to provide evidence concerning the same construct in fact do so.... In view of the apparently subjective nature of much qualitative interpretation, validation is achieved when others, particularly the subjects of the research, recognise its authenticity. One way of doing this is for the researcher to write out his/her analysis for the subjects of the research in terms that they will understand, and then record their reactions to it. (p.241)

The use of the two methods in this study helped produce more intelligible and rigorous interpretations than would have been the case with just one method.

5 *Data Collection*

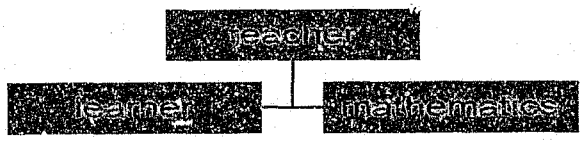
5.1 Questionnaire

The questionnaire was completed by the primary and secondary school first year FDE mathematics teachers during the second day of their five day residential course in July 1997. The FDE mathematics course coordinator was kind enough to allow me a whole hour during which all 33 teachers filled in and returned the questionnaire to me. Explanations were given both orally at the start of the session and on the questionnaire itself. These included the fact that the questionnaire was part of an MEd research project and that its results would not be used to assess the teachers' participation in the FDE programme. It was also explained that there would be a follow-up interview during the second residential course the following September.

I designed a structured questionnaire (***Appendix A***) in which the contents are organised in advance (Cohen & Manion, 1984). I structured my questionnaire in two sections. The first section was guided by a frame of mind that held that 'relevance' is contextualised within the teachers' concerns for good mathematics teaching and good mathematics learning. Therefore, the questions were designed to be general and yet provocative. The first question was about the greatest challenge faced by mathematics teachers. The second question was an inquiry that is drawn out of my understanding of the three intrinsic concerns of teaching and learning mathematics in school, as the teacher, the learner and the mathematics, which I refer to below as "the educational triangle". These concerns are *the learner as the priority*, the *knowledge of the subject matter* and the *capacity of the teacher*. This is not to ignore the role of the very important external factors in school such as the

social relations and the wider socio-cultural contexts that continually exert pressure on this more intrinsic relationship.

The educational triangle



Except in questions that were too general such as the first one and in the later section that required a description, there were ratings that accompanied questions. The ratings were included with the conviction that topical as the issues in this questionnaire were, I should not miss those questions to which teachers are resistant. However, more importance was attached to the teachers' descriptions and justifications which accompanied all the rating questions. The requirement for the teachers to justify their ratings was guided first by my view to teachers as experienced about their practice. Secondly, the questionnaire was not based on controversial issues which would necessarily raise "either-or" choices. Rather, in the true nature of the complexity of teaching, these questions arose out of pertinent questions in which teachers' sophistication and deeper reflection or understanding were more at stake. Having established these wider concerns for 'relevance' I moved to some of the more specific aspects.

The second section of the questionnaire was designed to try to raise some of the considerations made in the literature review around 'relevance'. The questions set in this section were guided by both literature review and an anticipation of what teachers might want to express their views on regarding 'relevance'. These questions were especially in relation to concerns that students were not making sense of mathematics and were not finding it easy or

even interesting and what role 'relevance' could play in remedying these situations. There were eight questions trying to probe these aspects of 'relevance' in various ways. Teachers were asked to rate the following as strengths of 'relevance' and justify their choices: making mathematics *easier*; making mathematics more *passable*; making mathematics more *meaningful*; making more student *like* mathematics; helping students move *from the known to the unknown*; making students see mathematics more *clearly as a subject*; making mathematics relevant *to other subjects*; making students see how *useful mathematics is in their lives*. All these are quite pertinent issues in mathematics and it was expected that teachers were likely to readily agree with them. However, as has been mentioned earlier, in justifying their choices they would be forced to reflect more deeply and this was viewed as being the heart of the data. The last two questions directly probed for the teachers' understanding of possible problems of 'relevance' and how the teachers might relate mathematics to students' everyday experiences in an actual lesson. These questions came at the very end because of the possibility that some teachers might find such questions so demanding of their reflection that they might stall, to the detriment of the rest of the questions.

5.2 Group interview

In the second residential course held for all the FDE teachers at Wits I was able to run the group interview. The same group of teachers who had filled in the questionnaire took part in this interview. In using the group interview, I hoped not only to generate a variety of responses, but also to deepen the quality of the responses provided in the questionnaire. Indeed as I elaborate in my discussion, the questionnaire provided me with very useful information with regard to my subject and provided important considerations for the interview. Cohen and Manion (1984, p.287) describe it as the potential of a group interview to develop discussion, "thus yielding a wide range of responses". My choice of group interviews was guided by the assumption that

groups provide an essentially social context and as such group interviewing has the advantage of revealing human behaviour through relationships. In a social setting behaviour could be much more accountable than as an individual. One must not only take account of other views, but can and often has to also clarify his own views. As a method it has the possibility of revealing reflected views and deepening views even further. As a result it has a mini-action-research element in that it can lead to change. Since I was concerned with depth as much as what exists, the method provided a possibility to come out with both the covert and the more overt meanings as the discussions deepened.

Each of the six group interviews contained two major questions (***Appendix B***), one on developing a lesson and one on discussing a 'relevant' scenario. The interviews were semi-structured in that while the lesson question was open, the scenarios included prompts. There were three lesson questions on angles, parallel lines and angle properties of a circle. The three scenarios, two of which had been raised by teachers in the questionnaire, were taking pupils to a construction site to measure and calculate trigonometric values; a shopping context for calculating profit and loss; an Independent Examinations Board (IEB) past question item in which the performances of two football teams were to be compared on the basis of two log tables taken at different times.

There were six groups of five to seven teachers in the interview, totalling 33 teachers. Withdrawals and late registrations meant that I could not determine the exact number of interviewees beforehand. A few of the teachers present were also trying to complete their registration and so were unable to attend. But these were very few. There was a video-camera covering the group discussions in order to provide back up information on the nature of the discussion. An ideal situation would have been one in which there was a video-camera covering each of the six groups, each discussion taking place in

its own room. However, there being other courses running at the time, there were two rooms available, between which I shuttled with the camera. Even if I had found the six rooms I would not have secured enough video-cameras for all. The most serious setback occurred during my transcription as the noise from other groups made it extremely difficult at times to make out what one group was discussing. But this was rare as having six tape-recorders meant one tape-recorder was provided for each group and each recorder generally captured the discussion quite clearly. Beside the tape-recorders, there was a facilitator in each group who had prompts that were meant to ensure that areas of interest of the researcher were covered during the discussion. The facilitators were made familiar with the research interest and the information sought from the interview beforehand. They were also advised to follow the discussion as they would be asked to assist in the transcription of the tapes. Facilitators were also asked to check that the teachers allocated only the 15 minutes suggested for the geometry question so that they did not erode the time (1 hour) for the rest of the discussion. The teachers were required to submit the written sections of the interview, especially on the geometry question. These were useful in tracing some of the less audible talk. The guides or *notes* provided (***Appendix A***) were meant to assist the facilitators but were not made available for the teachers.

6 *Data Analysis*

The analysis proceeded in a largely grounded manner, using qualitative methods to establish categories of the ways in which the teachers talked about relevance and its intricacies. In the questionnaire trends were recorded and the full report is provided in the next chapter on results. As mentioned, the quality of recording was reduced at times by several group interviews being held in the same room. I was, nevertheless, able to go over the recording again and again until I could make out the discussions clearly. Here also the transcripts were analysed over and over until the trends were refined. The five categories

that emerged from both the questionnaire and the interviews were *motivations, perceptions and attitudes of the learner, teacher's professionalism, mathematical knowledge and meaning, instrumental perceptions to mathematics* and *constraints*. I was able to work with these categories throughout in the analyses of all parts of the data collected.

7 *Issues of quality*

7.1 Validity

Maxwell (1992) maintains that validity in qualitative research should be understood in its own terms and not as a means to achieving the "standards" subsumed in quantitative methods. He argues that

> a method by itself is neither valid nor invalid: methods can produce valid data or accounts in some circumstances and invalid ones in others. Validity is not an inherent property of a particular method, but pertains to the data, accounts, or conclusions reached by using that method in a particular context for a particular purpose. (p.284)

Maxwell also maintains that validity is not a result of a particular method as the proponents of quantitative measures, such as the testing of hypotheses, seem to imply. However, in expanding on Brinberg and McGrath's point that "validity is like integrity, character, and quality, to be assessed relative to purposes and circumstances" (1985 in Maxwell, 1992 p.13) he takes up the alternative realist's position to the quantitative positivist's position that "sees the validity of an account as inherent, not in the procedures used to produce and validate it, but in its relationship to those things that it intended to be an account of" (Maxwell, 1992, p.281).

Maxwell outlines the first concern of qualitative researchers as providing for factual accuracy in claiming for what they saw or heard in what he refers to as "*descriptive* validity". This does not only pertain to the description of an act but also the claim for the frequency of occurrence with regard to a

phenomenon. To account for descriptive validity, I have supplied empirical evidence of what I refer to in the results section and as I move on to the next stage of interpretation. An important element of qualitative studies is "*interpretative* validity" as it refers to the meanings attached to the behaviours of people engaged in and with them. The latter is even more crucial in that unlike in descriptive validity, "for interpretive validity there is no in-principle access to data that would unequivocally address threats to validity (Maxwell, 1992, p.290). For that reason, with every interpretation and categorisation I provide a quotation from the utterances of the teachers.

Theoretical validity refers to "the degree of abstraction of the account in question from the immediate physical and mental phenomena studied" (Maxwell, 1992, p.291) such as the labelling of a certain act as malicious. I try to establish theoretical validity in my report by relating my interpretation of teachers' talk as either simplistic or sophisticated to the theoretical framework I have established. For example, I label teachers' talk that does not take into account the difficulties or possible problems of using students' everyday experiences in school mathematics learning as simplistic. As a result, higher levels of abstraction of what the teachers mean is accompanied by a close link to the theoretical framework employed.

7.2 Reliability

An important element of research is ensuring that even if one's categories are not replicable by others who would attempt to categorise my data, they are at least recognisable (Adler 1996 citing Marton, 1988). The implication of this assertion is that understanding is as central to qualitative research as authenticity, if not more. What is being argued here is that, in qualitative research, the next person may not necessarily agree with the analysis provided as **the only analysis possible** and as such 'authentic'. Rather, what is central

to the reliability of qualitative research is that the next person understands how the analysis was carried out to arrive at the conclusions made. I came up with the categories and was the only researcher involved in this study. However, I went over the data again and again, refining the categories, until they were not only recognisable to me, but were reliable descriptions of my data. I was therefore sensitive to the fact that, even if others who went through my results could not come up with the same categories as I had, they at least understood how I arrived at the categories.

7.3 Generalisability

As I have indicated, these interpretations which led to my generalisation were not necessarily the only way to see the teachers' talk. Rather, they were ways in which others would understand my categorisation. Becker (1990 in Maxwell, 1992) maintains that generalisability in qualitative studies is unique.

> Generalization in qualitative research usually takes place through the development of a theory that not only makes sense of the particular persons or situations studied, but also shows how the same process, in different situations can lead to different results (p. 293).

In other words, in generalising qualitative studies the object is not to demonstrate how the same acts would produce the same results in another situation. Rather it is a way of taking cognisance of the various factors that have come into play in the circumstances being studied as having influenced the result in a particular way. This is the extent to which I see teachers' understanding as deeply contextualised in the various factors and the socio-cultural environment within which they operate.

7.4 Limitations and delimitations

In a qualitative study one can only say so much in view of the fact that these are specific teachers who would have taken up specific positions in relation to both the topic and their context as provided by the FDE. Even as early as the

time this study was undertaken in their studies, the teachers were already positioned in relation to the programme and what they expected would be the right things to say in such a programme. Yet, if anything, this meant that these teachers were more likely to provide me with more interesting data than completely indifferent teachers. Perhaps the specific context of the teachers is not really a crucial limitation because as Maxwell (1992) notes the purpose of qualitative research is not to draw generalisations beyond the specific circumstances at hand. I do acknowledge that there must be other teachers who are worse off than these teachers, at least in terms of motivation. But a more significant feature of this sample is that these teachers came from a wide variety of contexts, some of which were are lacking in material resources.

This study focuses on the teachers' espoused meaning(s) of "relevance" and its implications for their practices. A focus in itself is not necessarily a limitation as it is meant to provide insights into issues beyond the point under consideration. However, one needs to acknowledge the fact that espoused meaning(s) provide only a partial picture. The provision of contexts in which teachers talk about "relevance" has also given the study both strengths and limitations. The contexts, on the one hand, further gave teachers' meanings some degree of reality or a relation to their enactments. On the other hand, the contexts can narrow the scope that the teachers' discussions would have otherwise generated had they been provided a wider context in talking about a curriculum document in general.

8 Conclusion

In this chapter I have considered the choices I have had to make regarding the methodology. It is important to conclude this chapter by admitting that, even in the use of grounded theory, I could not pretend to have completely absolved the approach used of my theoretical position and interpretative subjectivity. Guided as I was, by a framework that saw teachers' understanding as highly

complex and deeply contextualised, I saw the teachers as both knowledgeable about their practice and seeking through their talk to become increasingly knowledgeable about their understandings of issues relating to meaningful teaching. The issue of 'relevance' has received a lot of attention, especially regarding the students' meaningful learning of mathematics. In the face of the implementation of a curriculum that emphasises "relevant and meaningful" teaching such as ***Curriculum 2005*** it is just as important to investigate teachers' understanding of meaningful school mathematics.

As I also mentioned in the introduction, without necessarily downplaying the importance enacted meanings of teachers would play in this study, I have decided to stick with the espoused meanings. In concentrating on the espoused meanings, I missed out on an important element of how the teachers work, in reality, with their meanings, which might have provided another level of teachers' meanings. But I also gained access to their more overt and reflected meanings. Asking the teachers to relate their talks to an actual lesson and scenarios provided both a stimulus for the teachers' discussions and a useful context for my interpretation.

Chapter Four

Teachers' talk about 'relevance'

1 Introduction

In this chapter I report on the results of both the questionnaire and the group interview. I discuss categories of description as they emerged and so illuminate their development as the study progressed. More importantly I supply as closely as I can, the empirical evidence to validate both my descriptions and interpretations (Maxwell, 1992).

2 The questionnaire

The questionnaire was administered during a residential course taken by the teachers and therefore there was no question of low return. With regard to the construction, the contents of the questionnaire were organised in such a way that it began from very general issues of teaching and learning, proceeded to the subject of my research and ended with questions that required teachers to reflect on their understanding of 'relevance' and how it related to their practice. As has been argued in the methodology section, the organisation of the questionnaire in such a way that it began with a very general question was premised on the assumption that teachers' understanding of 'relevance' would be contextualised in real concerns about successful teaching and learning. In starting on what were the greatest challenges faced by mathematics teachers in South Africa, I wanted to determine where in the larger context of teaching and learning the concept of relevance was placed by teachers. The question provided very interesting results regarding the teachers' major concerns about the learning and teaching of mathematics. I am going to present the results in this chapter in such a way that I let the categories develop themselves in line with my assumption that the best approach to qualitative research is through a grounded approach. Where quotation marks are used, the teachers' original

words have been used directly from the questionnaires. This is in order to address the issues of validity, specially as they relate to my description and interpretation of the results. A detailed summary of the results is presented in the appendices (*Appendix 1A1* to *2C*) from which I draw my description of the results in this chapter.

2.1 Challenges and concerns

The greatest challenge for mathematics teachers

In general, teachers were concerned about changing the students' perceptions and promoting positive attitudes towards learning mathematics. The greatest challenges described as faced by teachers included finding ways of teaching mathematics in a manner that would "instill the love of maths in pupils". The most basic challenge for teachers in this group was to overcome the indifference, fear, hatred and even abhorrence of mathematics persisting in students. It was, therefore, important that teachers should be looking to "motivating students and making them at ease in mathematics" as a great challenge. The aim was not only to increase the love for mathematics, but also to "encourage pupils" and "increase their participation" in the mathematics classroom. The latter concern appeared to be connected as much to changing students' indifferent attitudes towards mathematics as it was related to what was the theoretically and pedagogically proper thing to do when teaching mathematics. Students should be more active and resources should be found for "small group activities" in mathematics. The eventual aim of the teachers' concern with this change of perceptions and practices of students was very closely related to "making the subject [of mathematics] friendly" and "easier" for students to "grasp". Mathematics must ultimately be "enjoyable and easy". These concerns led me to what I refer to as the ***motivational (mot)*** category (*Appendix 1A1*). In short, the greatest challenge for mathematics teachers was motivational.

Also highly rated and very much connected in general to the motivational category was meaning making in ***mathematics (math)*** as challenging. Relating students' school learning to their everyday experiences was not only important in changing the attitudes of students towards mathematics, but also in helping students make sense or meaning of the subject. Talk about mathematics meaning ranged from developing "fundamental skills"; the "manipulation of symbolic form" to encouraging "creative thinking" in students. As will be discussed later, a change in perceptions appeared to be the central concern of these teachers towards students making more sense of mathematics as a subject, in the same way that I have alluded to Morrow's (1992) call for institutional access not to compromise epistemological access.

A very basic challenge related to meaning-making, that teachers also identified was changing the way in which mathematics has hitherto been presented. Mathematics should be presented in a "less abstract, more concrete" manner. Particularly, it was argued as a necessary element of teachers' concerns to "change the past maths theory emphasis" in mathematics and present it in a more practical manner. In this sense teachers were being blamed for their past practices. A further argument that the teachers made was that there was a tradition of making mathematics a monster by divorcing it from the common sense experiences of students. Mathematics needed to be made more meaningful, to "bring the awareness of maths in everyday". Beyond that it should be applicable to the students' "daily lives". Such daily activities that were quoted included interpreting "everyday life information" and "real contexts such as buying and selling". The teachers argued that mathematics should be instrumental in preparing students for the "fast transforming technological" era we are living in and become "a tool for science and technology". Eventually mathematics must prepare students fopr their careers. This was related the concerns for the lack of "engineers, doctors, and scientists for the country". This is what I came to term a ***relevance and concreteness***

(rel & con) category. It was about changing past practices that presented mathematics as an abstract, subject-apart subject that did not have to have anything to do with the everyday lives of human beings. The shift exhibited in these concerns is towards mathematics as instrumental or of a utilitarian view to mathematics[9].

Much of the blame on the persisting attitudes and practices in mathematics teaching were placed mainly on poor teacher practices. It was important to "redress, develop teachers" in order for students to love and apply mathematics appropriately. Similar concerns were expressed regarding "updating" of teachers, the development of "love" and the teachers' desire to "upgrade" themselves in their subject knowledge and "many methods". This was not only related to the predominance of "underqualified" teachers in the profession, which might lead to the inability to "impart" as well as "insufficiently" or "ill prepared students", but also to the lack of teachers' commitment such as in preparing for lessons. Teachers , in their views, needed to take the initiative to improve their knowledge bases and their presentation skills and be prepared to "consult books and others" in the endeavour to increase what I came to call ***professionalism (profs)***. In general, past and present teaching approaches were blamed for the fact that many students have come to find mathematics a difficult and dull subject. As a result, teachers regarded their knowledge as central to changing the poor state of affairs to meaningful mathematics learning.

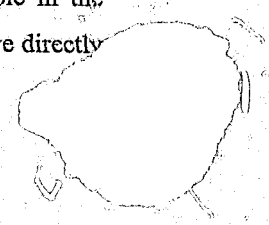
The teachers described some of the conditions that existed in the teaching profession which presented serious challenges and made it very difficult for

[9] Ernest (1991) in a philosophical description of views towards mathematics (ideologies) alludes to the ideology of mathematics as instrumental in preparing pupils for their roles in the world as utilitarian. I use both terms, especially instrumental, as describing the teachers' view to mathematics as preparing pupils for their daily and future roles. Therefore, although I have to acknowledge from where these terms originate, they were not used by the teachers, nor have they been adopted as categories here, within the same philosophical interpretation to which Ernest was referring.

successful teaching and learning to take place. I have already alluded to some of these challenges, including relating to human resources difficulties emerging from "underqualified teachers" and "poorly prepared students". These two, which overlap with the previous category at times, went together in the teachers' description. Sometimes teachers who were underqualified and even had no real love for mathematics except that they had landed the job of teaching mathematics because it was the only one available, often did not prepare students well. This resulted in serious problems later. Even with "competent" teachers, there was still the problem of material resources which led to "full classrooms" where teachers would then have to deal with "overpopulated" classrooms with learners of different ability or preparation. These are the challenging conditions faced by teachers which I refer to as ***constraints (con)***. The results of this question are summarised in the appendices (***Appendix 1A1***). Thus these challenges presented by teachers have been organised into five broad categories: *motivational*, *mathematics meaning-making*, *instrumental*, *teacher professionalism* and *constraints*. These five categories arose quite consistently, even if with varying emphasis from one category to another depending on the question.

Three concerns of mathematics teachers

In what I perceived as another exercise to continue to contextualise teachers' concerns for mathematics, the questionnaire then proceeded to ask teachers to rate and justify their ratings for three concerns in mathematics teaching. These three concerns were the students, the mathematics and the teachers. This is based on a triangle that I referred to earlier in the methodology section as "the educational triangle". It is my acknowledgment then, and it remains my argument now, that other larger socio-cultural factors, as well as issues of power relations, both in and outside school, play an important role in the equation. In retrospect, it might also have benefited my study to have directly



sought out the teachers rating of students' everyday experiences as a school context for learning. But I had been conscious at the time of presenting a more general context and not immediately channelling the teachers' thoughts.

Generally teachers saw all the elements in this triangle as important. Therefore, they rated all three highly and indeed it was not the intention to determine which of the three was held highest by teachers. However, it was interesting to note the importance with which teachers regarded the promotion of positive and meaningful learning in this question. In their justifications around the learner they showed great concern for the motivation of the learner and a great distaste for teacher practices that "intimidated" pupils. Rather mathematics should be made "attractive and simple", so said one teacher. Also held quite highly once again was ensuring that mathematics made sense to students rather than making students follow in a "parrot-like" fashion. A common recommendation towards making mathematics more meaningful was 'relevant' teaching. Students should "see the importance" of mathematics in life and thus be motivated into learning. The reference to teachers was not very complimentary and there were very strong calls for teachers "to boost and not to boast". Only one teacher maintained that the students were central to the improvement of mathematics performance in the country and unless they "cooperate and think positively", nothing would change (***Appendix 1A21***).

In the discussion of concerns about mathematics as a subject, teachers expressed their open disagreement with the development of mathematics as a formal discipline. The importance attached to mathematics meaning making took a different element in this question. Mathematics must be informal so that it broadened students "perspectives", did not "narrow their scopes" and did "away with maths phobia". Students must see the role of mathematics "outside school". A few teachers argued that there was no salvation as long as they still

had "to cover the syllabus" and until there were enough "qualified mathematics teachers" and enough teaching "facilities" (*Appendix 1A22*).

Once the question turned to teachers, then the need for the development of teachers' professional skills became more pronounced. Teachers should be trained to impart their knowledge with "confidence". The aim was for the teachers' knowledge to benefit students and "motivate" for "good students come from good teacher". This was to ultimately "facilitate learning" and prepare students for "the new South Africa's economy" (*Appendix 1A23*).

What is lacking in the three concerns?

Views were developed where the teachers were asked to further describe which of the concerns discussed in the previous section was most lacking in mathematics. The extent to which teachers were blamed for what was clearly a question of the prevailing situation in teaching made for very interesting results. As reflected in *Appendix 1A3*, twenty-one of the thirty-three teachers felt that teachers and poor teaching are quite important factors in what is lacking in the teaching of mathematics. From unqualified to unmotivated teachers, the problem is quite clear to these teachers: teachers' incompetencies and lack of skills are leading to poor students' attitudes and performance. Teachers should be exposed to "new, effective techniques" and learn to "relate maths to life" and not teach it "in isolation". Within the concern for increased teacher efficiency, there was a strong association between the fact that "students hate mathematics" and "teachers lack skills" to "impart" or lacking "the zeal". Only occasionally was the blame placed on issues beyond teachers, such as students who are "promoted" and lack "positive attitudes and resources". Therefore, both poor attitudes and non-performance in mathematics are blamed on teachers. In short, while the professional development of teachers was a predominant category in responses to this question, the other four main concerns - attitudes of learners, mathematics

meaning-making, relevance and concreteness of mathematics and constraints were also present.

In conclusion, it is apparent that the questions in part A were regarded as contexts in which to continue to express the concerns which led to the five categories above. However, the shift in focus is an interesting element of this section. In general, the most important concern appeared to be motivating students and helping them make sense of mathematics. But once the attention was turned onto teachers, then the issue of knowledge and how they present mathematics became central. Teachers still regard their role as central to the extent that they blame themselves for what was lacking in mathematics education.

2.2 Merits of 'relevance'

In the second section I turned my attention more specifically to 'relevance'. The questions were set up in such a way that teachers would have to rate a statement made about 'relevance' and mathematics education on a scale from 'disagree', 'unsure' to 'agree'. More importantly, teachers would have to justify their rating. Therefore, my attention was not only on where the teachers located themselves but more on how they justified their choices. The questions set in the section were largely influenced by the literature review, especially the calls for 'relevance'. These were: making mathematics easier or more accessible to students; improving examinations' results; making mathematics more meaningful; developing students' interest towards mathematics; helping students into new areas of mathematics knowledge; clarifying the mathematics subject or what I have referred to as the epistemological concern for mathematics (Morrow, 1992); integrating mathematics with other subject areas; and promoting the useful or utilitarian nature of mathematics. There was general agreement with these areas as positive aspects of relevance. However, there was a noticeable decline in the agreement with regard to whether it was a

positive aspect of 'relevance' to promote the mathematics discipline or subject, to make mathematics easier and more passable. I will first describe the teachers' explanations as they emerged from the eight questions set in this section.

Making mathematics easier?

The majority of the teachers felt that making mathematics easier should be and was an appropriate ideal of the 'relevance move'. In this, many teachers talked about the development of "the love for" and "appreciation" of mathematics, as well as "motivation of students". An interesting divide among these teachers was which came first: making mathematics easy so that it was interesting, or making it interesting so that it was easy. Seven of the teachers argued strongly that only if mathematics was made easier would it become more interesting and accessible. Nine teachers felt that the love for mathematics was a necessary and even sufficient condition for mathematics to become easy. However, the presence of motivational and attitudinal concerns remained quite strong in these responses.

The view that relating mathematics to students' everyday experiences makes the subject more meaningful was popular here again. Utilitarian views to mathematics were also strong here. It was recommended that teachers should make students aware that mathematics is "part of their [students'] lives"; that it is instrumental to "technological advances" and is also "relevant to the job search". However, five of the teachers argued that there are conditions which make it impossible for 'relevance' to promote successful teaching and learning of mathematics. These conditions included an insufficient number of "trained teachers", "not enough teaching approaches knowledge" and the shortage of material resources which made "use of teaching aids" difficult.

Although this was still, in general, a very popular statement, there were quite a number of teachers who showed reservations about making mathematics easier as central to the 'relevance drive' (***Appendix 1B1***). Two teachers were unsure of their commitment to this as an ideal of 'relevance', and perhaps so were the other three teachers who did not respond. One of the two teachers responded that 'relevance' would fail to make mathematics easier "if the teacher is incompetent". This teacher's argument appeared to imply that we are possibly awarding too much importance to 'relevance' in the very intricate teaching and learning situation. The other teacher felt more specifically that there were "not sufficient trained personnel for the teaching" of mathematics for 'relevance' to perhaps make the desired impact. Five teachers expressed an outright rejection of this ideal. Two of the teachers felt that the standard of the subject of mathematics should not be "lowered" and they agreed with 'relevance' if it would mean the epistemological access would have to be compromised. The other three teachers argued that it was not in the nature of mathematics to be "easy".

Making mathematics passable?

'Relevance' as an attempt to make mathematics more passable was the least popular notion (***Appendix 1B2***). Besides the three teachers who did not respond, nine rejected the idea altogether. Teachers were clearly convinced that making mathematics more passable meant that the standards should be lowered, an element of the 'relevance calls' with which they would totally disagree. Mathematics was expressed by one of the teachers as "challenging" and another argued that it was not "the culture" of mathematics to be passable. Other teachers suggested that attention should be turned away from passing to such issues as making mathematics more "applicable", more "familiar", more relevant to "daily occurrences" and the "passing" would come naturally. Otherwise, warned another teacher, we would end up "with half-cooked individuals for life". A further four teachers expressed their uncertainty

regarding whether passing is or should be central to the 'relevance calls'. One teacher argued that even with 'relevance' students would "still not" pass and another claimed that it would depend "on the types of students one is teaching". One more teacher stated that she was uncertain that that would mean "less challenging exercises". Perhaps if it meant less challenging exercises, she was not for 'relevance' at all.

Motivating students as an ideal of 'relevance' still dominated this question (eighteen of the teachers). This was expressed in such statements as the need for "students support and motivation"; the elimination of "the views that mathematics is difficult and for the elite"; the promotion of the subject through "more" pupils passing. Also quite popular (with eight of the teachers) was a more utilitarian view once again. The whole notion of 'relevance' was, in these teachers' arguments, premised on the preparation of students "to pursue mathematics in tertiary education" and "life" and, more generally, to make the subject more applicable. Once again another category that emerged and was expressed by six of the teachers, especially from the uncertain responses, was that there are "other aspects" which could contribute to making mathematics a passing subject.

Making mathematics meaningful?

The next question was whether 'relevance' makes mathematics more meaningful and how. This was one of the most popular statements (***Appendix 16.1***). Apart from the one teacher who did not respond, only one disagreed with this statement and it was on the basis that to date mathematics "was taught fragmented and there was no scaffolding". One other teacher was cautious (uncertain) in view of the fact that "sections like geometry are not meaningful at all" and perhaps cannot be made more meaningful. The most popular expression (twenty-two teachers) in this category was that 'relevance' would make mathematics more meaningful because students would see how

useful it was in life. In fact, two teachers maintained that it was only meaningful if it is "related" or "used in daily life". Many of these expressions were utilitarian in that 'relevant' mathematics, to be meaningful, had to be seen to be useful in the students' lives. Mathematics should be useful from students' daily "counting" exercises to their choices of "careers". In fact students need to learn that "their lives revolve around maths" and that mathematics was meant "to build the economy". Following closely were statements expressing that once mathematics was meaningful it would attract or be liked by students, thus changing the students' perceptions towards mathematics. Such mathematics would "be closer to the world of pupils" and would not be "foreign". There were no constraints expressed in relation to this category. In short, for most teachers 'relevance' was strongly argued to promote meaningful learning because it is tied to students' experiences.

Making mathematics likable?

Once again, in the question on whether and how 'relevance' would help make more students like mathematics, motivational attitudinal explanations were quite prominent (nineteen of the thirty-three teachers) (***Appendix 1B4***). Twice the word "monster" was used to describe the way in which mathematics had been presented in the past. Mostly to blame for this perception of mathematics were teachers, some of whom even used "vulgar" words to drive away struggling students. Teachers advocated for the change towards "motivating" even the slower students, "raising the interest of pupils and assisting them" and "encouraging pupils to take more responsibility for their learning" rather than promoting the "superiority complex from math pupils" against those who were struggling. Again, liking mathematics was closely associated with some utilitarian views (nine teachers). Mathematics would be liked if 'relevance' was meant to show how useful mathematics is in everyday life and in future careers. "Students must like mathematics because it is a daily function" and they will like it "only if they understand what they are doing it for".

"Mathematics is important in [and should promote] the future world of science and technology". This was an especially important issue for the black population which, to date, lacks mathematics. The last statement sets the scene for some of the more tentative explanations.

Some of the teachers, although agreeing with the fact that students should be made to like mathematics through relating it to the everyday experiences of students, expressed other factors as also being important. Such factors included that even if "the teacher can help" by relating the subject, "but the love" for the subject and the change of attitudes must be from the students. The government "should [also] contribute by rewarding passing students". One teacher felt uncertain that students should be made to like mathematics. Rather "pupils should be free to choose" which subject they like although the same teacher argued that mathematics was useful in all fields. The one teacher who disagreed maintained that "pupils' preconceived ideas [about mathematics being a horrible subject] cannot be changed by even the 'relevance' move. Such were the constraints that the 'relevance' move would have to face. This item confirmed the fact that teachers blamed themselves for the negative attitudes because of the way mathematics has been presented as a difficult and meaningless subject. 'Relevance' was therefore seen as an approach that would not only promote positive attitudes towards the subject, but would also help students see the value of mathematics in their lives.

Helping students move to unknown?

The next question was whether and how 'relevance' would help students move from the known to the unknown in the mathematics classroom. Answers to this question made it quite clear that the teachers felt I was being ridiculous (***Appendix 1B5***). They maintained that "that was the aim of teaching" anyway and that "teachers must always start from known to new matter" as a matter of principle. Four teachers explained it as the aim of teaching to always move

from known to unknown while a further three argued that that was how mathematics should be taught anyway. Mathematics was described as a "link" subject that emphasised "continuity" and "build [new] concepts on [already existing] other".

There were still issues about "encouraging" students and intensifying strategies that would "increase the love for math" and make students "eager to learn", and "not to attract the hatred" for the subject. There also remained some utilitarian views revealed in teachers advocating for making students "realise that mathematics can be implemented"; that it was essential to understand mathematics in order to "go further in life"; and that school mathematics was important because they would be "applying (mathematics) knowledge into (future) tertiary institutions". Only one teacher felt uncertain enough about 'relevance' assisting the move from the known to the unknown to explain that "it depends on students' comprehension and creativity". However, the motivational and the relevance categories were overshadowed by the expressions by the teachers that it was an obvious requirement of teaching and the nature of mathematics. In fact, what attracted the most explanations in this question was mathematical knowledge as a category.

Clarifying the subject of mathematics?

Still many teachers agreed that 'relevance' makes students see mathematics more clearly as a subject (***Appendix 1B6***). It was argued that it was important to find mathematics as a subject interesting and "challenging" enough to warrant studying. There would be "no interest if mathematics is not seen clearly as a subject". However, it should still be simplified and not to be treated as an "isolated subject". In fact, the promotion of mathematics as a subject should not be at the expense of the students and other educational issues. Many teachers argued that enough had already been done to promote the view of mathematics as a subject apart from all other subjects and issues.

Such statements as "teachers are already good at teaching mathematics as an isolated subject" and "most students [already] see it as a subject, and one they hate" or "for the chosen few" illustrated the existing perceptions which the teachers felt were important to eliminate. Students must not be made to see mathematics as a "monster" or as a subject "for a selected few". "Students must be free [of prejudice] so as to find mathematics simple and interesting" and the "atmosphere [in mathematics classrooms] must be simple and real". Therefore, motivational and 'relevance' arguments were still strong here too.

It was the one question in which the teachers expressed their most reservations (four teachers uncertain) and disagreement (four teachers disagreed) with the given statement. One teacher argued that mathematics should be "as challenging as life" itself, not a subject removed from life. Mathematics teaching "should encourage even slow student" rather than emphasis being placed on covering the content. One of the four teachers who disagreed with 'relevance' promoting mathematics as a subject rather than concentrating on the institutional access, argued that it was more important to realise that students had already "developed negative attitudes" towards mathematics and work to do away with these attitudes. The other three felt that concentrating on developing mathematics as "part of their [students'] lives", using it for "conquering life's obstacle" and developing skills for "science and technology" was a more important function of relevance than promoting the subject apart nature.

Integrating mathematics with other subjects ?

Another question in which teachers generally felt that it should be the function of 'relevance' was whether and how it should make mathematics relevant to other subjects. Hence once again, mathematical knowledge as a category was the most prominent in this question (***Appendix 1B7***). The noticeable difference in this question's responses was that it was argued that it should be but was not

necessarily already the nature of mathematics and its teaching and learning to integrate it with other school subjects. It should be the aim of mathematics teaching to work "towards a more collaborative culture of learning" and "math should be integrated" were some of the explanations given. Students should be aware that mathematics "overlaps", is "interrelated" and "links" with other subjects. Two teachers reiterated the statement made in the previous question that mathematics should not be "isolated" from other subjects.

For some teachers utilitarian views and motivational goals still dominated their explanations to their ratings in this question. In many instances (thirteen teachers) it was argued that students should be made aware that mathematics is not only "everywhere" and important for job "opportunities", but also featured in other subjects from "physical sciences" to "social sciences" and "geography". Numerals, argued two teachers, were found in the English language, and all other languages. Twelve teachers argued that the nature of 'relevance' to integrate mathematics was important in changing the perceptions of many students and developing "the love and relevance".

Illuminating the usefulness of mathematics?

The last question in this question was for teachers to state whether 'relevance' would make students see how useful mathematics is in their lives" (***Appendix IB8***). Once again this stirred up arguments for the utilitarian nature of mathematics (in twenty-eight of the teachers). It was argued that seeing the usefulness of mathematics in "everyday" or "daily" activities, in such contexts as "shopping" and "meter-reading" would make students value mathematics more. It should be emphasised that mathematics would help any student "follow a career of her liking", was useful for those who wanted to be "builders, land surveyors, computer operators and doctors" and generally that students with a strong mathematics background were "marketable" and stood a "better change of getting jobs". Students should realise that "there is no

progress in life" without mathematics and being made to see the "shortcomings" faced by those without mathematics, would "motivate" students to learn. It should be becoming clear that these utilitarian views overlapped a lot with the motivational arguments. It was important for students' perceptions towards mathematics to change. Thirteen of the twenty-eight teachers who expressed utilitarian views argued that even making mathematics appear useful in life was in order to make students keen to learn the subject.

The results of this section confirm the five concerns of teachers. But an even more interesting predicament - or is it? - revealed by these results is what making mathematics accessible for students could mean for the "standards" associated with mathematics. On one hand, this could be a dilemma teachers are facing about the discourse of change conflicting with their entrenched beliefs that mathematics must not be in their views a 'common' subject that everyone then comes to take for granted. On the other hand, it is possible that for some teachers mathematics can be made more accessible to students without compromising what they refer to as its "challenging" nature or in Morrow's (1992) terms epistemological access. However, the degree to which this apparently textured understanding is real can only be demonstrated by the teachers' ability to carry it through to their practice. This is beginning to raise what I later discuss about the need to turn to informing teachers' practices rather than promoting the discourse of change. If the teachers' understanding is as sophisticated as it sometimes appears to be about the need for change, then the point is no longer their consent to change, but their capacity to carry it through.

2.3 Problems of 'relevance'

The last part of the questionnaire asked teachers to explain what they felt were the problems of trying to relate mathematics to everyday experiences of

students (***Appendix 1B22***). Many teachers (twenty) argued that the problem was that mathematics has been presented as a monstrous and an irrelevant subject. Fourteen teachers argued that "motivating" students and making them see that mathematics was not "difficult" poses a serious problem for teachers who wanted to make mathematics 'relevant'. Six of the fourteen teachers who argued for the change of students' perceptions and attitudes such as "fear" also argued that students were not or had not been made "aware of mathematics in life", showing a strong correlation between issues of 'relevance' and those of motivation. It did not come as any surprise at this stage that once again the blame being placed on teachers would arise in this question. Nine teachers argued that it was the fault of the teachers who did not "relate" that students find mathematics difficult and meaningless.

Five teachers blamed other factors such the lack of "teaching aids", "rural areas which did not promote the use of English language", students who "lack basics" and generally "lazy students" (two teachers in the last one). Only four teachers argued that it was in the nature of mathematics, especially "geometry" to be "difficult", "irrelevant" and not to be "concrete". Therefore, while students, especially their attitudes towards mathematics, were sometimes indicated as the problem, in the majority of responses, teachers tended to blame themselves for the poor performance of students.

2.4 Developing a 'relevant' lesson

In the questionnaire, teachers were to illustrate by the use of a lesson in mathematics how they would work with relating mathematics to students' everyday experiences. Teachers (twenty teachers) generally described very simplistic contexts relating school mathematics to "oranges" for fractions (two teachers), "business" and "daily activities" such "shopping" (three teachers) and "building" and "constructions" such as dams (three teachers), and the practical calculations of surface area and perimeter such as erecting a

"fence"(two teachers). However, it was apparent once again that this was related to making mathematics more meaningful, as was explicitly expressed by nine teachers and motivating the students into developing positive attitudes and interest as well as engaging more enthusiastically in the learning of mathematics (five teachers). The question was, however, not as useful in bringing out reflections from the teachers as I thought it would be. It could have been the issue of time running out or teachers becoming a bit tired. It was for this reason that in the group interview I made sure that two groups shared the same scenario and the same lesson to develop but at the same time, while one group began with the scenario, the other would start with developing a lesson. The data are presented in ***Appendix 1B23***.

2.5 Some remarks

The results of this questionnaire will be discussed together with those of the interview. However, at this point I need to mention how useful this questionnaire was in influencing the shape of interview. It is without doubt a significant limitation of the questionnaire that it was unable to discriminate in terms of the relative popularity of the various questions on relevance. This is especially so in section A , number 2 of the questionnaire about the three concerns and the reports are tabled in ***Appendix 1A21*** and ***1A22*** to ***1A23***. The redeeming feature of the questionnaire was the very informative manner in which the teachers were able to justify their choices. As discussed later, their justifications opened up issues of the motivational function of 'relevance', their views to the relationship between the motivations of students and the actual meaning making process, the instrumental view to school mathematics in preparing students for daily activities and future careers. The questionnaire already provided insights into the depth of teachers understanding of 'relevance'. Quite predominant here were positive associations between 'relevant' everyday experiences and school mathematics and quite absent were the possibility of negative associations arising in this relation. Yet it was also

apparent that teachers did reflect on the relationship between 'relevance' and access, suggesting dilemmas in practice. The positive associations were not only about attitudes but about mathematics meaning for now and for the future.

Another interesting issue is the manner in which teachers blame the failure in mathematics education on themselves. Although this could be the start of a reflective attitude on the part of the teachers it is limited in that it does not consider other factors that play a role in student failure. The limitation in the teachers to raise such problems of 'relevance' as negative associations was already evident in the questionnaire. Thus I sought to put specific probes in the interview for teachers to discuss the limitations of 'relevance' in relation to specific contexts and activities.

While the limitation of the teachers' understanding was confirmed in the interview, the quality of the discussion was improved considerably allowing me to pick up on the more implicit discussions of the problems in the talks within activities and contexts. When teachers were talking in the group interview, or in Lave and Wenger's (1991) terms, partly within their practice as teachers, whether of developing a lesson or what the scenario was all about, very interesting issues arose. As will be discussed later, almost unaware, they brought up issues of possible conflicts between everyday mathematics and the school mathematics. Despite the limitations of the questionnaire that I have already mentioned, it did suggest for me very interesting contexts and activities for the interview. The lesson topics of angles, angle properties of the circle and parallel lines were suggested by the teachers' observation that geometry was a generally irrelevant topic. I felt that this needed a measure of follow-up. Teachers also mentioned such contexts as shopping and construction in the questionnaire which were later used in the interview for the

discussions. This gave me a very important element of continuity and the teachers a sense of worth in what they said.

3 *The interview*

The teachers were divided into six groups as described in more detail in the methodology section. However, a brief overview of each group discussion follows. Six topics were identified for discussion. Three descriptions of lessons on the introduction of angles, parallel lines and angle properties of a circle were to be developed by the teachers, first individually and then discussed in the group. Three contexts/activities on shopping, a football log table examination item and a visit to a construction site were also to be discussed in the groups. Although this was not entirely successful as described in the methodology, an attempt was made to divide the groups into homogeneous groups of primary and secondary school teachers beforehand. Each group discussed one context and a lesson topic.

3.1 An overview of the group discussions

Very significant results emerged in the discussions that occurred in the group interviews and it is useful here to provide an overview and a summary of what transpired in each of these group interviews. In all groups, the teachers were to spend the first 30 minutes on the first question and the last 30 minutes of the allocated hour discussing the second question. For example, in group *A*, the teachers were supposed to spend 30 minutes on developing and discussing a lesson on "the sum of the angles of a triangle" and how this might be made more relevant to students' everyday experiences. They were then to spend the next 30 minutes discussing the advantages and disadvantages of taking students to a construction site as part of their mathematics learning. In an attempt to find relevant everyday situations on angles, the discussion got stuck on right angle situations such as "door frames". Then debates as to whether

such situations as "door frames", "floor tiles" and "tables" demonstrated right angles accurately, which followed, were made all the more difficult by attempting to persuade each other in everyday language. The construction site was generally argued to be useful in developing geometric concepts as well as preparing students for future careers. The limitations discussed were obvious ones, such as that this activity would consume time needed to cover the syllabus and would require too much preparation and organisation.

Group ***B*** was to develop a lesson on parallel lines and discuss the advantages and difficulties in using a shopping context for the teaching of mathematics. The first teacher suggested "ESKOM" power lines as a good place to start to relate parallel lines to students' everyday experiences and another suggested the opposite walls of a house. The controversy came when another teacher suggested she would just ask students to draw lines which are straight and do not meet in order to introduce the definition of parallel lines. Would she accept curves and how would she know that the lines drawn by students would never meet were questions with which she was showered. The discussion was forced onto concentric circles and whether these would constitute parallel lines, especially if a circle is considered as being made up of a line. Regarding the shopping context it was unanimously agreed that the shopping context would help students develop the four basic operations. The teachers discussed the complexity that while some students do well in street mathematics such as selling oranges after school, they lag behind in school mathematics. This is an interesting comment and confirms a similar finding by Carraher *et al.*, (1985). Otherwise, the rest of the limitations observed were obvious ones picked up by other groups that such contextualisation are time-consuming and require too much organisation on the part of the teacher.

Group ***C*** was supposed to discuss developing a lesson on angle properties of a circle and the use of a football context in assessing school mathematics. One

result of my inability to determine the exact composition of this group beforehand was that this group ended up with a mixture of primary and secondary school teachers. This obviously limited the discussion and it is not surprising that the discussion of a lesson on angle properties of a circle never went beyond the use of a "face clock" to develop the concept of direction. The clockwise and anti-clockwise directions on the clock were regarded as the angle properties of a circle (clock) to be discussed. However, the second question was more generative of some interesting data. It was interesting to note the degree to which the football context distracted the teachers as they became absorbed in discussing what different symbols stood for and in justifying why in their view "Amazulu" was doing better because it was "climbing fast". The task at hand was hardly attended to. Beyond the usefulness of such a context in developing students' ability to analyse data, draw graphs and functions, the limitations were not discussed at all.

In group ***D***, the discussion was supposed to start with a discussion of a visit to a construction site and proceed to a discussion of a lesson on "the sum of the angles of a triangle". It was also agreed in this group that the main benefit of this activity would be in the teaching of geometry although algebra and even numerical calculations were mentioned. Beyond the school the activity would prepare students for the requirements of technikons and the future in general. However, questions were raised as to whether school mathematics really prepares students for real life, given that some people are able to erect sophisticated constructions without having gone to school. As in the group which observed the difference between school and street mathematics, the issue was not really discussed much further. It was also noted that although we are living in a world of science, students were not very keen to engage in school mathematics and teachers who presented the subject as "tough" were once again blamed. The limitations raised about such an activity included that it was not suited for students in rural-based schools. One teacher tried to

encourage the other group members to ignore the obvious limitation of not gaining access to the site and concentrate on the limitations of the site itself. In response, yet more obvious limitations such as the difficulty of organising a field trip were raised. The angle lesson once again did not go beyond the use of a clock to promote right angles and perpendicular lines indicating that the difficulty in group *C* was more the difficulty of teachers' inability to move into any depth of mathematics once they tried to relate school mathematics to students' everyday experiences.

Group *E* was to discuss the use of a shopping context in school and the development of a 'relevant' lesson on parallel lines. Once again the shopping context was noted for its possibility to develop the four basic operations. Additional to that, it was suggested that it could be used to develop maximising and minimising profit in linear programming. The difficulty that was noted with such contexts was that the language that was used to describe the context tended to impede rather than assist mathematics learning. Regarding the development of a lesson on parallel lines, the railway lines were proposed as one 'relevant' context that could be used to start off pupils. It was also suggested that the use of the letters FUN could promote positive associations to corresponding, interior and alternate angles. Once, the discussion was almost derailed by arguments as to whether students should be told what parallel lines are or not. Difficulties regarding unqualified teachers who are forced to teach mathematics because that is the only job available were also discussed.

In group *F* the teachers were to discuss the football context and the development of a lesson on the angle properties of a circle. The football context was once again related to interpreting information and making predictions as in school probability. Once again the football context threatened to distract the group as they sought to discuss what it was really about and

some showed of their knowledge of football. The first difficulty noted was that the context could be biased against girls who would need an explanation of the symbols used. As the discussion of whether football, being of such interest to some students could lead to biased answers, some interesting remarks were made. One such remark was that teams from abroad could be used to reduce the amount of bias in the context. However, one teacher questioned whether it would still be a 'relevant' context if teams from abroad were used. To this another teacher suggested that football as a context would still be 'relevant' with or without the use of local teams.

The discussion on the area properties of a circle was once again not very close to the mathematics required. It started off with a discussion of whether circular houses which are only found in rural areas or exclusive locations are really 'relevant' contexts. Then the teachers became excited about their discoveries of 'relevant' contexts such as pie-charts of expenditures, pizzas and pots. Finally one teacher suggested that the construction of a kite adhered to the property that the angle at the centre is twice the angle at the circumference to which others expressed surprise and even disagreement. One teacher suggested calling in "professionals" in order to promote students' awareness of the place of mathematics in everyday contexts but others noted that many so-called "professionals" are not themselves aware of the mathematics contained in their professions.

3.2 The evolution of categories

I had initially conceived of six descriptions through which I would analyse the teachers' ways of talking about 'relevance':

1 **Affective**: seeing the function of 'relevance' as developing positive attitudes towards mathematics, students enjoying the learning of mathematics;

2 **Usefulness:** considering the function of 'relevance' beyond attitudes: participation and commitment and meaning;

3 **Utilitarian**: seeing 'relevance' as a "tool" for teaching students to employ mathematics pragmatically for their everyday activities and to use it as an instrument for preparing students for their future careers;

4 **Relational:** seeing 'relevance' as working with the familiar experiences to provide **access** to new (mathematical) experiences and empowering the students for their future (careers);

5 **Reflexive**: being critically aware of the problems/conflicts that 'relevant' contexts might create with school mathematics;

6 **Complementary**: considering how to work with familiar 'relevant' contexts to overcome conflicts and constraints in order to provide access to new (mathematical) experiences and empower students for their future (careers).

Guiding this framework was a general perception that the teachers' talk would distinguish itself at different levels of understanding. I perceived a simplistic understanding, as one that only involved attitudes (**affective**) and making links to school meaning (**usefulness**). Then a more involved level would be about broader access to everyday activities and future careers (**utilitarian**) that would at one level become dialectically practical at opening up access to new school experiences both now and in future (**relational**). Finally, a more sophisticated discussion would involve the potential problems of relating school mathematics to everyday contexts (**reflexive**) and their possible resolutions (**complementary**). Underlying this approach was a broad framework in which I viewed the dialectical relationship between school mathematics and 'relevance' as requiring an analysis of interrelationship in terms of how each complemented and hindered the other. However, the ultimate refining of the categories was influenced by an interactive analysis of

the data whereby I listened very closely to what the participating teachers said. Thus, I proceeded by reading through the data picking up on only the talk about relevance. Teachers often viewed the function of 'relevance' as establishing positive links or associations that would make mathematics easier and more enjoyable. The following are extracts from the discussions.

Throughout the extracts in this chapter the emphasis (in **bold**) is mine in order to make my point. The dotted lines were used in the transcription where there were pauses or where others interrupted the speaker. The words in brackets such as [live] or just empty brackets [] indicated words which were so inaudible that I was never able to completely make them out. In some instances as in [live], I was able to guess what the word might be by using the rest of the context.

T3: And then some people say that this activity would make mathematics easier and more meaningful as it is concrete. Would you agree with this? Give your reasons. I say, yes.

T1: Why?

T3: Because, the lesson will be informal and it will be easy for the learners to **associate** what they are learning with the real life situation.

T1: And they can in turn do it, may ... Like you saw what the construction site. And **in future** he can be able to do what he saw. He'll understand it better because he saw it done [**practically**].

T2: And pupil will, maybe ... the [live], they **won't hate** maths any longer, because they see what happens outside concerning the geometry.

(Group A)

T1: Here we have a question: Would you use this kind of [*shopping*] context for your mathematics teaching? I think, yes! And the reason is children will learn more **easier** and [writing] about something that they are ... clearly understand. So, from my experience I found that children even end up **enjoy**ing the lessons and they can have an input on the lessons. Shopping, for an example, is what **they do almost daily**. So, very convenient for ... for a lesson. Thank you, that's all.

T2: It's more .... What I've written is more or less what he's written. I said, yes. Students can do some calculation. Let's say in ... if OK is selling some oranges. She will know **the cost price** and then **the selling price** and then the profit. In doing that he will ... using four basic [operation] signs adding, subtractions ... subtracting.

T3: In mine I said, yes. Because in real life situations we're used to the oranges, apples and peanuts. Then children **if selling** those oranges, he or she should be able **to use the** four basic operations: multiplication, addition, subtraction and division.

T4: What I've written it is the same thing that they said. Pupils should not be **spoon-fed** anything from the textbook. They are... do, I mean, any ... any content which should be taught pupils should be well prepared and pupils **like** to hear something of their background.

(*group B*)

T2: Yoho. What I think you have to look at that object at ... if I'm looking **at bicycle wheel** moving around the axis, they've got some sort of angles. I think in that case we need to ...

T1: But in this case we can also add on that, if we **link** it to everyday life we can ..

T: I don't know what do they expect us to maybe ... [re khotse haholo] but what I'm thinking, although I said my primary level. But just looking at the **face clock**, how do I **link** it to the face clock? There're childs with the face clocks everyday. So how do I **link** it to face clocks ... the angles to face clocks?

(group C)

T: We can continue with this one. Give reasons. I've just quoted some, I don't know if ... So, ke li-reasons tsaka tse ... this activity will make mathematics **easier** and more meaningful.

(group D)

T7: ...what is this x? Always x. Can't you have a, or b, or c?

T6: It makes them lack some sort of an interest. But if they can **associate** that, they will have an **interest** that, but we're using this. So we must do it.

F: And then they understand.

T6: And they understand.

T1: Actually, the right answer is that they must able **to use** ...Unfortunately our maths is not like that. It seems to be sort of lost somewhere.

T7: The way we were taught maths ... when you use *Curriculum 2005* it's going to be...

T1: Yahoo, I think there it's going to be ... because things that have been introduced are **practical**. They don't want to divorce mathematics.

(group E)

T3: Yahoo, what we're saying is that if I want to talk about angle properties of a circle, starting from **buildings**, they going to

be asked how many buildings around you are circular? To even begin to understand angles within a circle...

(*group F*)

In all the six groups, as indicated by the extract, teachers talked about positive associations or links, enjoyment and especially the value of concrete and practical situations which I have come to call attitudinal or motivational concerns. I have highlighted their more explicit words which I later grouped together to form a category of talk. (*Table 1*, p.96)

The teachers also talked of how 'relevance' can offer students an awareness of mathematics in a broader sphere than just the school domain as well as help them understand concepts so that school mathematics makes more sense than it would otherwise do in isolation. The following extracts illustrate talks that came to influence this second group of teacher talk:

T: I'll make them to be **aware** of that angle and I will ask them which type of an angle by estimation. Do you think its a third? Then they'll tell is ever it's an acute angle or a right angle.

T3: And then what about the door, it's not a right angle?

(*group A*)

T1: I'd ask pupils questions like this .... Before I introduce the concept - parallel lines, I'll ask pupils question like this: What kind of a material does ESKOM need to bring electricity in home town? How are those electricit ... electrical wires being connected? Most pupils would respond because they see them when they come to school. I would then go outside with them to see it. Later I would tell them that we say those wires are parallel. They ... I can let them draw something on their own

which is parallel to each other. I think that would be my exercise.

(*group B*)

T1: OK, I've said that so that students be made **aware** that mathematics is not only in classrooms. It can be found in the **outside** situation. Another thing which I said we learn by **concrete.**

(*group D*)

T6: It's because pupils, if they **associate** them. They might find **sense** in what they are doing. Because some of the things, like she has said x, why do we **need** x? Why? What for?

(*group E*)

A lot of the words that I grouped together in this category which I called "*aware*" also appear in the first set of extracts. In those abstracts words like "understand" (group A, B, E and F) and "see" (group A) feature quite a lot. I refer to the fact that it did not only become difficult, but also quite impractical, to distinguish between these two categories later when I describe how this emerging talk influenced my categorisation. This overlap should already be clear at this point in the report.

There was also, specific to the football context, talk that 'relevance' is about increasing students' ability to analyse information.

T3: Would you ? Yes. Yahoo, we agree on that. Why would you use this as an assessment activity? Then give reasons. You assess students' **analytic** skills of reading data. What else.

T1: Write it.

T2: Because students would be demonstrating the analytic skills ..

T: Are we not developing ..

T3: No, but, but ...

T: We just say students will be able to analyse.

T3: Analyse and interpret

(group C)

T1: You want to start with geometry? Because I think this has got to do with, first of all, with the handling of or being able to **interpret** whatever information you get. I mean, if students see that they've got two logs: What is happening with these two logs? Can I read the **difference**? What has happened from this point - from this log, up until that other log? What really happened in between? One must be able **to read in between the lines** as to what really happened in between. And if you were to look at this, you can clearly see that, now, there were some increase in the points. If we say the club is performing, then the points must be higher. But now as you look here you find that Moroka Swallows, from the 10 games played, it gets 14 points, now after 12, it means it played only extra two games, then it had 14 ...eh, 16 points. It means it had only two points in between. Now, it means of the two games played, it had only two points. Now, how did it ... how did they get those two points? Then you read back into the information. The information tells you here the number of games they played, the wins, the losses, the draws. If you look at the first one, and look at the second one, you see that, now, there's a **difference** in the ... if you look at the wins, the draws and the losses, somewhere there is a **difference**. The child must be able to **identify that difference** and that difference is the one which will tell him what is happening.

(*group F*)

Specific to this context were words like "interpret", "analyse" and "identify" mentioned explicitly and an implication of thinking critically in such open mathematics contexts. This **process** of critical thinking was often talked of as part of the requirements of *Curriculum 2005*. Throughout the foregoing extracts as well as the following, there was also talk about 'relevance' assisting students in their **everyday activities** as well as **in future**, in their careers which was about the **usefulness** of mathematics.

T1: Exactly! But you know why I say may be it is? I don't know whether I can say it's rel...And .... Like maybe you can get, the child becomes something like maybe an **artichect**.. Or what? He can be able to use the knowledge he got when he was at school, measuring angles doing certain ....So I think it will help them **ultimately**. So, not knowing that it must be ... they must use while they are at school or should it help them when they are ... they finish with their courses or what?

(*group A*)

T2: It's more .... What I've written is more or less what he's written. I said, yes. Students can do some calculation. Let's say in ... if OK is selling some oranges. She will know the cost price and then the selling price and then the **profit**. In doing that he will ... using four basic [operation] signs adding, subtractions ... subtracting.

(*group B*)

T2: Yahoo, it's practical. Apart from that you go to **technikons** or these technical schools, you find that the requirements there is

mathematics. Why? Because doing the practical things. That's why you find that a particular child, even if he fails the mathematics. As long as he was doing mathematics, they take him. Because they know that he has done ....

(group D)

T1: In the programme , whereby the theme ... that is learner has to link the linear programming with the outside world, whereby, for instance, for the ... like food value, when he goes out to **market** to buy some stocks, he has to know exactly which type of a fruit must he buy most. That is moving faster than the other, so that he can gain maximum profit. Of which, right, he can do that easily without some calculations because he don't know if any ... whatever .... He's not aware that generally what he is doing, unaware. It is like linear programming. Because that's what ... in linear programming which is to know how

(group E)

T: But then you may then go **tertiary** level and then take one fragment and then develop it to applied levels. Let's say the issue around mensuration, it is quite easy to make the students see the need for surface areas, volume or perimeter ... all those things. Then **boiler-makers** and people that have to be dealing primarily with round structures, definitely need that information about areas of a circle and surface area, the whole concept of volume. As against profit making and loss. Are gonna make a geyser which is this long ... or that long.

(group F)

Table 1 below summarises how I began to see the categories emerging.

Table 1: Emerging categories

associations	awareness	process	usefulness
concrete	see	compare	instrumental
practical	know	difference	for future
enjoy	sense	openness	everyday
easier	realise	critical	
like	understand	interpret	

3.3 The categories

In general, the data that came through did not disappoint me in terms of distinguishing between these various ways of talking about and levels of understanding of 'relevance'. However, the specifics of the ways the teachers talked guided me to a new conception of the ways in which teachers understood 'relevance'. McMillan and Schumacher (1993) advise that developing categories and patterns requires going over the data again and again looking for positive and negative associations and thus refining the categories.

The original categories were thus first refined into four categories reported on the table above (*Table 1*). What I had envisaged would be talk of the ***Affective*** function of 'relevance' or development of positive attitudes arose in the teachers' actual talk as **association** category. What I had originally conceived as talk of the ***usefulness*** of 'relevance' in promoting meaning-making, arose as **awareness**. There was also talk of the **process** of interpreting which arose in relation to the football context. As I continued to revisit my categories it

became apparent that the boundaries between these categories, which were originally four and then three were quite blurred. Eventually, **ass. iations, awareness,** and **process** became one category of **meaning-making.** ***Utilitarian*** views which are reported as **usefulness** in *table 1* remained a very distinct category in the teachers' talk.

In seeking a more practical categorisation, it soon became clear that teachers talked about links and meanings in the same way. It was implicit in the way teachers talked about concrete or practical situations that they saw their fundamental role as helping students make sense of mathematics. Group C's assertion that they should try "to avoid the abstract and the stress on "must" in group A.

T1: ...and you must also encourage them to measure. If I say it's 30, they must measure this 30 degrees.

T: Yahoo, they **must give you the practical** ...

(group A)

T: I think you **don't just have to concentrate on abstract** things or knowledge at school. Even at home there are some things that you can relate to using those things, the angles I think.

(group C)

I still maintain later in the discussion that teachers talked about everyday contexts as mainly functioning to enhance motivations and attitudes and this an issue worth giving attention to as I do later. However, the blurring of the boundary between talks of positive "associations" and "understanding" led to collapsing these two categories.

T1: Here we have a question: Would you use this kind of [*shopping*] context for your mathematics teaching? I think, yes! And the reason is **children will learn more easier and writing about**

something that they are ... clearly understand. So, from my experience I found that children even end up enjoying the lessons and they can have an input on the lessons. Shopping, for an example, is what they do almost daily. So, very convenient for ... for a lesson.

(*group B*)

T1: OK, I've said that so that students be made aware that mathematics is not only in classrooms. It can be found in the [outside] situation. Another thing which I said we learn by concrete.

T2: They learn more better than ... **they learn more better by concrete.**

(*group D*)

T6: It's because pupils, **if they associate them, they might find sense in what they are doing.** Because some of the things, lik.: she has said x, why do we [need] x? Why? What for?

(*group E*)

T3: Yahoo, what we're saying is that if I want to talk about angle properties of a circle, starting from buildings, they going to be **asked how many building around you are circular? To even begin to understand angles within a circle...**

(*group F*)

Therefore, even the categories which I had come to distinguish as **associations, awareness** and **process** in table 1 were eventually categorised as **meaning.** The other category about **everyday** or **instrumental** remained **usefulness.** Talk of this **usefulness** category has already been reported during

discussions of shopping contexts in "OK" (group B), buying some "stocks" (group E) as well as such "future" activities as "artichect" (group A), mathematics as a requirement for "technikons" (group D) and "tertiary" in general (group F).

There was one very important aspect of the teachers' talk that my categorisation did not yet capture. As the teachers talked about the activities almost unaware that they were alluding to my interest, very interesting issues began to arise.

T3: And then what about the door, it's not a right angle?

T1: ...right angle...

T2: Yes, it depends ... you know when even if

T4: ...the open door...?

T3: Mm!

T2: The door frame or the door?

Ts: Both.

T: Mamela, like this .. It is open like this. Can you say it is a ninety degrees?

T1: It's not really ninety degrees.

T3: Why?

T1: I mean ... you can. No, it's not like this - straight. They're like this at the moment. If ene touchitse lebota I could say it is a right angle but now I don't think it is a right angle because I think it must be vertically ...

(group A)

This shortened extract of an even more prolonged discussion illustrates some of the problems of relating mathematics to the everyday experiences of students that teachers were only discussing implicitly as they discussed the activities. There are many everyday experiences that can be related to school

mathematics. But many examples, like the open door and the door frame, do not contain the precision of the school concept. Even more interesting is the language in the last utterances in relation to mathematical terms. A word like "straight" and "vertically" is probably used informally to refer to "perpendicular". Everyday contexts can promote such loose application of mathematics terminology. As I discuss this issue later, this is a very serious problem to the extent that the teacher is sensitive to it and is aware of enabling students to cross bridges from everyday contexts to school mathematics (Mercer, 1995).

The difficulty arises again in group E in relation to the precise definition of parallel lines:

T1?: There's something that I want to know. When you give pupils instructions, do you tell them that these lines must not meet at any point?

T4: Yes.

T1?: What about the distance? What if the distance is a long distance but the distance between these curves is not the same throughout but they don't meet? What about that? ... Maybe something like this: you have two lines - this is the first line and then ...

The discussion degenerates into a prolonged discussion of the distinction between a line and a circle. The teachers conclude by making the subtle observation that the teacher must know what the precise definition of mathematics terms and concepts is before indulging in activities and contexts that are informal in school contexts. These situations reflect what is quite likely to happen when students undertake discussion of such 'relevant' contexts and how they could just as easily lose sight of the mathematics concepts in prolonged discussions of what should and what should not be. The

boundaries in everyday contexts between concepts and terms is often not well-defined and a lot of confusion is likely to arise when the mediation between everyday contexts and school mathematics is not taken seriously. Discussion of issues that are not quite mathematical also arose in the soccer log context.

T1: And Amazulu it's having two games at hand. It's important to play.

T2: It has a chance. That our reason. I want to write it down. How do you write it?

T1: We would start that we said, y... The first thing we're going to say ... I'm just talking before you write it, so that we can ...

T2: OK, OK! Were you saying that

T1: Two games [] the advantage. And the difference ..

T: Are we sure that Amazulu this remaining its going to win?

T2: No...

T3: That's an assumption ...

T1: It does not. At least it stands a good chance.

T3: For the moment.

F: And I think there are some other reasons here where your argument is going to be ...

T1: It's moving ...

T: Yahoo, it goes up ..

T1: And now when it comes here []. You realize that indeed still the difference is two. And still the goal attempt it is one point each for the draw. So now, this, the difference its []

T: Let's look at the draw of Amazulu. What are the ...

T3: Are you answering the question? Which one? You should give reasons can you use this as an assessment activity. Can you use this kind of context as an assessment activity?

(group C)

In fact, until T3 notes that they may not be answering the question at hand, the group was quite happily discussing details unrelated to the question such as Amazulu's chances and advantage. That is an implied danger of everyday contexts to attract non-relevant discussions.

Therefore, a third category was added in which the limitations (and resolutions) of relevance were discussed. This third category, of **problems**, emerged out of both explicit and implicit talk of problems, difficulties or conflicts around 'relevance'. There was a specific prompt in my activities for teachers to talk of limitations of relating school mathematics to everyday contexts. Both from this prompts and quite spontaneously, teachers brought up some very interesting limitations as well as possible resolutions.

T2: I don't know but ... things in my classroom. You may find a student selling sweets at school, that knows how to add to find best profit, but could not add.

T: So they can't subtract when coming to the right things at all?

F: You mean, he can add the money, give you correct change, ...

T2: ...correct change. Maybe after school he's selling oranges on the school. But when coming to ... when coming to a classroom situation, he's the one who is lacking behind in mathematics.

T: The problem is that maybe the child is not aware of that he is busy doing subtraction, addition and multiplication when he is busy selling and giving change.

(group B)

T4: But there is something interesting. There are some people, they didn't even go to school, but they can construct the exact measurements on the ... like ... I don't know ...

T7: I think ... sorry, just for clarity. I think you're right in saying that ... you're right to say that because people just ... there are

people who can just construct. and the question is: "Do you think that school mathematics is ...

T: ... is sufficient? OK: is it enough; is it necessary?

(*group D*)

What is the aim here? The aim is to relate mathematics to what the pupils know. Now, if you put foreign clubs, the pupils don't know about foreign clubs ... so I still ...

T3: They know soccer ... they know soccer.

(*group F*)

Especially at prompts about the problems of 'relevance', some difficulties of relating school mathematics to the everyday experiences of students, many of which were fairly obvious, were also quite easily picked up by the groups.

T2: But we think the limitations...

T3: But it won't be hundred percent marked ...I mean, participation ... like you said, the pupils... others will be playful, not concentrating on what is happening. They see as, you know, just an outing.

(*group A*)

T: Even if it can have all operations to one question. But what I'm trying to say it mustn't be too long, mustn't be or even two paragraphs. ..confuse the students what are actually asking.

F: The number of words themselves.

T2: And another thing is some of the authority are confusing ... want to see homework, classwork and tests. And you have cover the syllabus in time. So ..

(*group B*)

T2: Er, sometimes, this is school. You'll have to hire. You'll have to look for a t ... transport. Let's say the children are coming from [*unclear*], they would need transport to undertake such a journey to go the construction place. So, you can even put that as a ... one disadvantage.

T4: And then, the other one, I can say the disadvantage of it, maybe, others ... to some constructions which are maybe high ... some are afraid to. And then this will ...

(*group D*)

T1: And then it ... this things, you know, textbook...

T6: And teachers! There are not enough trained teachers..

(*group E*)

T: First of all, it's going to depend on whether ... from what locality are you from. If you're from the rural area, you've got so many circular houses around; if you're here, the circulars are, maybe, in those other fancy buildings. Usually you find them in the fancy buildings where you find ...

(*group F*)

It was the discussion of discourse patterns within communities of practice by Lave and Wenger (1991) that guided me to seeing this more implicit talk for what it was. I began to see this implicit talk as similar to what Lave and Wenger (1991, pp.107-108) describe as "talking *within*" in contrast to "talking *about*" a practice. The distinction is not necessarily mutually exclusive as both forms of talk reveal the understanding and thoughts of participants. Teachers spent a lot of time discussing relating school mathematics to everyday contexts and revealing the difficulties although they did not explicitly refer to

them as such. This very important talk was categorised as discussions of **problems** as part of talk within.

4 Remarks

Therefore, I ended up with three categorises: **meaning**, **usefulness** and **problems**. A lot of the teachers' talk fell within the first category. In other words, 'relevance' is seen predominantly functioning in order to assist students make positive connections and in helping students make sense of school mathematics. Using the construction of "rail-lines" to demonstrate parallel lines and the arms of "face clocks" to illustrate angles were all about helping students make sense of these concepts by linking them to what they meet in their daily lives. Some of the 'relevant' contexts were seen as serving the purpose of preparing students for such activities as shopping at the "OK" and in future careers in "technikons" and "architecture".

There were also a lot of limitations and problems of 'relevance' although much of it was as yet implicit and teachers have yet to articulate them explicitly and deepen their understanding of its full implications. Questions were raised as to whether an open door, as an illustration of a right angle, was "really ninety degrees". Even more interesting was the discussion of what it would take for parallel lines, in practice, to be parallel and a lot of mathematical discussion about conditions for lines to be parallel and the definition of a "line" as opposed to a "curve" ensued. More explicit questions such as whether "school mathematics is ... sufficient" or necessary for non-school activities, were raised quite spontaneously during the discussions.

In response to the question on what limitations such activities and contexts had, teachers raised the more obvious difficulties such as that some of these

contexts are not available in "rural" areas and that such activities are "time-consuming" , difficult to "organise" and can serve to distract rather than attract the students' "participation". Teachers did pick up intrinsic difficulties such as that non-school contexts can be biased, and even discussed such possible solutions as reducing the bias of such contexts as soccer logs by introducing "teams from abroad". There were some silences regarding, how everyday contexts can be incompatible with school contexts and even make the latter more difficult although these could be picked up in the more implicit talk *within*. 'Relevance' was mainly seen as deriving positive associations and meaning. The fact that some of the associations could be negative and the meanings inaccurate was not directly picked up. The results of the teachers' talk about relevance have been summarised in the tables provided in the ***appendices 2A, 2B*** and ***2C.***

Chapter Five

Meaning(s) of Teachers' Talk

1 Introduction

Teachers' talk about 'relevance' illuminates some very important aspects of their understanding. On the surface, there are clear concerns that these teachers show throughout the study, and it is important to discuss these and what they might signal about the teachers' context as well as their understanding. It remains my contention that context and understanding are very much related. There are also conspicuous presences that are exhibited by these teachers. These presences are important indicators of the teachers' understanding of 'relevance'. In the teachers' talk, there were also significant signals in the ways in which the focus shifted depending on what the teachers were talking about. These presences and shifts have crucial implications for teacher education and further research.

With reference to Lave and Wenger (1991), I have indicated that talking is an important aspect of the teachers' understanding of their practice. However, when one considers these teachers as learning about their practice in the face of curriculum reforms, talking about a practice is certainly not enough. An important distinction that Lave and Wenger make is that for newcomers, "the purpose is not to learn *from* talk as a substitute for legitimate peripheral participation; it is to learn *to* talk as a key to legitimate peripheral participation" (p.109). Talking *about* from outside a practice can lead to sequestration or alienation and not necessarily access. The significance of this is that there is no pretension in this study that these teachers' ability to talk about their practice represents their practice.

2 *Teachers' concerns*

The teachers maintain the same concerns with varying degrees of emphasis throughout their talk. They are concerned about motivating students and changing the students' negative attitudes towards mathematics. It is clear that teachers are talking from experience regarding the unsatisfactory attitudes of students towards, and even performance in mathematics. This concern is related to concerns to assist students to make more sense of mathematics and the "calls for 'relevance'" (chapter 2, p. 12) indicate that these are not isolated voices of concern. Developments in mathematics education research, ranging from how children learn to work, on the nature of mathematics indicate that mathematics learning is, and should be, treated as a meaningful process if it is to benefit students. The need for the change of attitudes is very much related to the drive for meaningful mathematics learning.

Yet the very extent to which this concern is grounded in the literature of change could raise various dilemmas for teachers. Quite clearly the teachers in this study saw mathematics as a very important subject without which students might not progress in life. Their understanding of 'relevance' was guided by a consideration for mathematics as instrumental almost in a central manner. The messages this conviction of teachers could send to students who succeed in mathematics, and even more importantly to those who fail, is cause for some concern for me. How devastating it is to assume that on the basis of one school subject one is doomed to fail in life! In addition, there was a clear regard by these teachers for the standards of mathematics to be maintained, or in Morrow's terms not for the access to knowledge to be compromised (Morrow, 1992). There was an interesting element in the teachers' reaction to simplifying mathematics that it could never be made simpler and it was in the nature of mathematics to be challenging. As I have indicated, this is where teachers could be more practically informed.

Teachers are also concerned with their development as professionals. On the one hand, it would be fair to expect that these teachers who have come for further training would be concerned about their professional development. On the other hand, the importance they attach to professional development could indicate that teachers still view their knowledge as central to the learning process. Hopefully, this concern for professional development is not to the traditional extent that teachers view themselves as carriers of the knowledge that is absolute and certain. Yet the extent to which teachers are blamed for the failures in mathematics education is worrying. Consideration for other factors that might play a role in successful mathematics learning was absent. The 'blame the teacher' tendency could very easily obscure some other important issues that teachers have to deal with. One possible outcome of this tendency is that, for these teachers, when after gathering knowledge they see very little results, they might not be able to grapple with other factors that might be influencing their success or lack of thereof. This has important implications for teacher education. Teachers need to be aware that they are central but not decisive in the learning process and certainly that their knowledge is not the panacea to educational problems.

3 *Positive association and meaning*

In the questionnaire and the interview the teachers talked about the need for a change of attitudes. Both in section A of the questionnaire and throughout section B of the interview teachers talk about relating school mathematics to students' everyday experiences in order to rebuild the lacking motivation and interest in the subject. Laridon (1993) reports on a very disturbing state of affairs in the former black (DET) 1989 examinations' results, whereby of the 15% of students who had taken mathematics as an option in secondary school only 16% passed.

> This supports the claim that of every 10 000 black school entrants eventually only 1 will emerge with an exemption in mathematics and

> science under the present dispensation. The proportion of students who opt for mathematics in the senior secondary phase is cause for concern. (p.4)

It is not surprising that teachers have come to feel a serious need to build more positive perceptions towards mathematics as a subject in the drive to help more students make sense of the subject.

The alienation that many students feel towards mathematics is indirectly being blamed on the fact that mathematics has hitherto been presented as a subject that is above human experiences. Broadly the view to mathematics as neutral and objective has been challenged (Lakatos 1967; Enerst, 1991 and Davis & Hersh, 1981) and the teachers are apparently not lagging behind in this post-modernist perspective. The need for change is as much a feature of making mathematics more meaningful as it is an attempt to be more inclusive. An interesting feature of this need for change is the fact that in this study teachers were blamed for the persisting negative attitudes towards mathematics (***Appendix 1A3***). Teachers were said to present mathematics "in isolation", use "vulgar" words to discourage students and it was said that they lacked the "subject competency" and presentation "skills" to make the subject both interesting and meaningful. The teachers in this study argued that teachers are passing onto students their limited view of mathematics as an abstract subject that is meant for a "selected few".

The teachers do acknowledge that at times teachers are helpless because, arising out of the shortage of qualified teachers and "overcrowded" classrooms, students are not well-prepared and nevertheless indiscriminately "promoted". The majority of students then go on to hate and fear mathematics while the few who succeed become prejudiced. However, there was also a strong message that teachers needed to develop their own professionalism. An "enthusiastic" teacher would then rub off her love of mathematics onto

students as positive attitudes and commitment. The need for teachers to prepare themselves on a daily basis and improve their subject and pedagogic knowledge recurs throughout the teachers' justifications in section A, question 3, of the questionnaire.

Across the FDE teachers there was a very heavy presence of an understanding of 'relevance' as working to make mathematics more meaningful and more humane. This was to be expected and falls within current trends to make mathematics more of a human construct and less of an immutable body of knowledge. As discussed in chapter 2, calls for relating school knowledge and the teaching practice to students' everyday contexts are very strong in mathematics. Mathematics has hitherto been presented as an abstract subject which does not have to make sense. This is in line with the observation by Powell and Frankenstein (1997) that students give irrelevant answers in mathematics because they believe that mathematics does not have to make sense. Therefore, these perceptions and motivations are about sense and meaning. Teachers appear to understand 'relevance' as helping make sense of the subject as it moves from the interpretation of symbols and rules (Bishop, 1983) to being situated in the students' everyday experiences (Volmink, 1994).

The teachers were, however, very clear that it should not be a choice between passing students and the quality of mathematics learning. This dilemma has been drawn into these discussion as the teachers grapple with the balance between making mathematics easier and more passable and maintaining the quality of the mathematics learnt. They argued that making mathematics meaningful and enjoyable could be done without "lowering the subject". Like Morrow's (1992) suggestion that educators should not have to choose between epistemological and formal access, the teachers in this study argued that mathematics did not have to be passable in the sense that it was less "challenging" (***Appendices 1B1 and 1B2***).

Vygotsky's socio-cultural theory provides a way of seeing the development of a child as determined, at least in part, by the learning situation provided. To this extent Mercer (1995, p.72) challenges the assumption that "children learn best if they are given tasks which suit their level of development so they can manage them without a teacher having to intervene". In the describing *scaffolding* in the process of meaningful learning, Mercer refers to the child concentrating on the difficult task she is about to acquire with the assistance of the teacher. Therefore, in this we find a theory of learning which would very much enable the teacher to see her part as eventually withdrawing her supportive role as the learner becomes able to carry out the 'difficult' or "challenging" tasks.

4 Utilitarian perspectives

'Relevance' was seen as not only helping students make sense of their school mathematics but also as instrumental in daily activities and future careers. First of all students would learn much better if they see the function of mathematics in their everyday lives and futures. Therefore, there was both talk of 'relevance' assisting students make sense of their mathematics now and in the future. However, there were strong perceptions among these teachers that mathematics is not only instrumental but indispensable in life. By showing the students the "setbacks" of not having a strong mathematics background, students would be motivated to learn school mathematics. The arguments for showing how useful mathematics was in life were related to motivating students and helping them see the sense in studying the subject.

In fact, their view to the usefulness of mathematics was toned down by those who also challenged the notion that school mathematics could prepare students for everyday activities. As I reported under talk of problems among group D, almost as an afterthought, one teacher reflected that there is something

interesting in that some people who had never gone to school do well in everyday activities and then questioned whether mathematics was sufficient or even necessary for preparing students for everyday contexts. The issue of transferring school mathematics skills to everyday life situations was raised again on other occasions to illustrate that what is being done in everyday contexts is not a conscious school mathematics application but was rather a specifically everyday activity. This was raised on a number of occasions in discussion reported under problems (***Appendix 2C***) about students who can calculate profit correctly outside school, but "when coming into the classroom situation, he is the one most lacking behind" and regarding some people who, although having not gone to school, are able to construct "exact measurement". The distinct practices related to everyday activities and school activities confirms Lave and Wenger's (1991) argument that everyday knowledge is not directly transferable to school context and *vice versa*. This was also argued in studies by Dowling(1991) and Ensor (1997) where such everyday contexts were not conscious mathematics activities.

5 *Problems of 'relevance'*

Talk around the problems of relating mathematics to the students' everyday experiences revealed both what I expected from the teachers and some rather subtle understanding. Much of what was to be expected has already been discussed in terms of positive association. This presence of talk of positive association between school mathematics and the students' everyday experiences was to be expected in view of the popular literature on learner-centredness and 'relevance' as well as in the propagation of *Curriculum 2005*. Although some of the intricacies were revealed in implicit talk of the teachers, they are silences in terms of the teachers being aware of them and referring to them explicitly. Vygotsky's (1979) distinction between everyday experiences and higher mental functions that normally occur in school suggests that

teachers have to be conscious of scaffolding or more precisely crossing the bridges between everyday contexts and school mathematics (Mercer, 1995).

In general, the teachers' talk of problems revealed an awareness of some of the more obvious issues. They said that 'relevant' activities are "time-consuming" and demanding on the organising teacher to take students on field trips which would relate school mathematics to everyday contexts. Related to this was an observation that was also quite commonly made that the syllabus does not allow for this kind of indulgence. Some of the limitations noted included that some of these contexts are not readily available in, especially, rural areas. Another observation was that students would also be "playful" or would be distracted once outside because they associate outside activities with more fun than learning. Although potent in the teachers' talk about the contexts themselves, it was not always explicit that everyday contexts can distract students to the extent of compromising school mathematics. For example, in the soccer context and relating parallel lines, prolonged discussions and even arguments about definitions were not always relevant to the task at hand. The teachers' inability to avoid or overcome this potential deficit of open-ended activities and everyday contexts can perhaps be explained by the fact that they were directly involved and were not aware of their behaviour as the facilitator should have been. However, this does indicate the reality of such a threat of the immediacy of 'relevant' context which can derail discussions. For me the lack of awareness of this potential problem is related to the fact that even as the teachers blame teachers for negative perceptions in students, the larger socio-cultural factors are ignored. The role of parents and the government, especially the legacy of apartheid, in the equitable provision of both human and material resources is not really considered.

There was a conspicuous absence of the limitations of 'relevant' everyday contexts in the construction of meaning. Relating school mathematics to

everyday contexts appeared to mean to teachers that there could only be positive associations. It never featured in the teachers' talk that some associations might be negative on their own or create negative associations. As becomes explicit in one teacher's language (group A, section 4.6.2), the negative associations can also arise as a result of the lack of specialised terminology in everyday expressions that describe the mathematics concepts in the precision required in school. Hence, the teacher struggles to describe perpendicular lines as she uses words like "straight", "touchitse [has touched]" and "vertically". At a very basic level, the teachers' use of such everyday contexts as a "corner" for a right angle, opposite walls of a room for parallel lines can create problems of the precise definitions of these concepts in mathematics. I need to add that I see the degree to which this is a potential problem as the extent to which the teacher is unaware of, and mediates in, the possibility of such loose terminology to unintentionally mislead and misinform the formation of concepts.

It would be problematic for teachers to enter into relating school mathematics to everyday contexts with the conviction that it will always make school mathematics easier. Talking about learner-centredness (Brodie, 1995) and language issues (Adler, 1996), other educationists have indicated that teaching is a very complex undertaking requiring an awareness of when and when not to use such approaches as relating school mathematics to students' everyday experiences. In fact, the position that Ensor (1997) takes is that one has to consider the context of school as specific in developing identities about behaving in school which are not transferable to non-school contexts. Some teachers did indicate that they are aware that the two contexts are not always complementary. Yet, the discussion of this state of affairs was only casually referred to and was not discussed explicitly. Discussion of what contributes to this discontinuity between everyday activities and related school activities was absent.

Less frequently teachers referred to the fact that school mathematics did not appear to prepare students for their daily activities or future careers. The question that some raised was whether school mathematics was "necessary" or "sufficient" for daily activities or future careers. In one group it was noted that in some careers, especially in construction and some basic technical occupations, where school teachers would like to note some mathematical activity, the people involved appear not to regard their actions as mathematical at all. Such questions were rare and were not discussed at any length. Another argument that can be related to this rather subtle awareness is one observation that I have already mentioned that the teachers made that making mathematics easier or more passable should not compromise the quality of the subject. In fact, one teacher indicated that students' deeply ingrained attitudes would still make them find mathematics difficult and fail it whether they find it relevant or not. There is a danger in awarding too much to 'relevance' in reversing deeply-seated and complex issues about mathematics perceptions and performance. If *Curriculum 2005* fails, people could revert to indiscriminate 'traditional' teaching because they associate the failure with the new curriculum without seeing that there were other problems that aggravated the situation which had been inherited.

The most sophisticated observation made with regard the limitations was with the soccer log context. When it was observed that such soccer contexts induced biased answers as students referred more to their support for team than the figures in front of them when deciding which team was doing well, it was suggested that "teams from abroad" might provide a better context than local teams. It was then debated whether this would still be a relevant context or whether soccer on its own was sufficiently relevant. It was a very rare observation and was informed more by the discussion within the soccer

context and what it meant than by a conscious talk about the limitations of 'relevant' contexts to mathematics learning.

Indeed when teachers were talking within the subject, a lot of intricate issues emerged. In discussing definitions such as of parallel lines, it became clear that 'relevance' could provoke some further limitations. The teachers, however, did not bring this discussion to bear on the limitations of daily illustrations, such as railway lines and power lines, to demonstrate fully the concept of parallel lines as should be understood theoretically. The issue of whether walls of a house and the door were really parallel or could be used to illustrate right angles were also discussed but no explicit reference was made to this being a limitation of some 'relevant' to accurately and fully describe theoretical issues of mathematics.

The fact that the most sophisticated awareness of problems of relevance occurred during discussions of specific tasks has very important indications. As teachers talked *within* such tasks, exchanging information necessary to the progress of ongoing activities such as a lesson on parallel lines, some of the most intricate problems arose, even if they were mainly implicit. The talk *within* the football log further demonstrated that the task provided clear opportunities for teachers to engage with 'relevance' at a more sophisticated level than when they are merely talking *about* as was the case mainly in the questionnaire. As Lave and Wenger (1991) indicated, 'talking about' is a form of learning, but does not imply that one learns the actual practice and can thus lead to sequestration rather than access. Mercer (1995) also confirms this in his distinction between *educational discourse* as "the conventional exchanges" and *educated discourse* as developing new ways of using language to become active members of a community.

> [T]he important goal of education is not to get students to take part in the conventional exchanges of educational discourse, even if this is required of

them on the way. It is to get students to develop new ways of using language to think and communicate, 'ways with words' which will enable them to become active members of wider communities of *educated discourse*. (p.80).

The talk of teachers assisted me to draw some significant conclusions and reflect upon the implications of the talk on further research and aspects of curriculum implementation in the face of Curriculum 2005.

Chapter six

Conclusions and implications

1 Conclusion

This research report reviewed teachers' talk to explore the depth of the teachers' understanding of 'relevance'. Through analysis and interpretation of a questionnaire and an interview, arguments have been drawn that relate to theories and debates in mathematics education about and around 'relevance'. Besides the teachers' experiences in their practice it can be deduced that the discourse of the time is quite clear about its support for 'relevance'. Hence that the teachers' talk about relevance as a very important concept, and a useful practice if the performance in and attitude towards mathematics are to improve, can be contextualised as an issue that is not only pertinent to South Africa, but of international concern. This context for the teachers' views of 'relevance' is not the only explanation about the teachers' understanding. Within a situated theory which I espouse, there is no attempt to find a direct correlation between an understanding and the context. However, it is to recognise that the teachers' understanding does not occur on its own but rather is mediated by other socio-cultural factors such as events and discussions at the time. And in true loyalty to Vygotsky's intricate socio-cultural theory, I do not see this as a one-way direction. Teachers' understandings are produced in a context which mediates them, and their understanding also influences their positions in relation to the context. A further complication is that I am aware of the possibility that the teachers espoused these views as a result of what they anticipated I expected of them as teachers in a course about theory and practice of mathematics teaching.

What I can actually claim from this study is that at least it is a favourable start that teachers are positive towards the ideal of promoting mathematics as a human practice, and one that has to be both liked and instrumental in promoting access to the present and the future practices of students in school and outside school. A very important revelation is also the degree to which teachers blame themselves for the failures in mathematics education. I have indicated that this could be a very confining attitude if teachers view their increase in knowledge as directly proportional to students' performances. Teacher educators need to broaden teachers' understanding of other more socio-cultural factors in the balance in teaching even if they cannot deal with all of these factors within their educational programmes. It should be helpful to indicate that teachers are not going to be successful merely by attending further courses in mathematics and mathematics education.

There are other problematic presences in this study which have to be confronted. I have already alluded to the fact that in the implementation of *Curriculum 2005* there needs to be a shift from simply advocating issues of more meaningful and productive learning. How teachers actually deal with these in their teaching is the most important challenge facing teacher educators and INSET providers. For example, it has to be established that 'relevance' in its entirety is not only about making students happily involved in activities that may not be mathematical. Teachers are aware of the dilemma. But the degree to which this textured understanding comes through in the teachers' practices will depend on the extent to which those involved in teachers' education and facilitation enable teachers' practices. There is already an emergence of reports to the effect that teachers may be undermining the mathematical activity in their emphasis on such values as groupwork and relevance[10]. This might be due to a simplistic understanding of the emphases

[10] The reports quoted here are from the proceedings of the sixth annual meeting of the *Southern African Association for Research in Mathematics and Science Education*

on integrated knowledge and learning in OBE that mathematics is no longer important. When this simplistic understanding comes through and becomes noticeable after implementation it could have very serious consequences on "the new thing" that has taken away the future generation's mathematical proficiency. This could give grounds to a shift back to old methods that have been proven disastrous.

Teachers in this study do raise some very intricate issues relating to 'relevance' and school mathematics. It is clear that they can sense some limitations and difficulties in relating school mathematics to everyday experiences. However, their awareness according to this study is yet implicit. Their talk about limitations is about obvious, though pertinent, issues such as that these activities are time-consuming and difficult to organise within the constraints of the present syllabus. It is, therefore, fair to say that teachers' understanding of 'relevance' is not altogether simplistic. The question then is what this implies for relevance: "Whither Relevance"? As was indicated by the literature review, it means that the question is not whether 'relevance' is good or bad. Relevance has positive functions, especially in the meaning-making process. However, there are dangers in that teachers tend to associate only the positive aspect of relating mathematics to everyday experiences of students without turning their attention to some of the intricacies. That has serious consequences for making mathematics more accessible to students and especially for the implementation of the ideals of *Curriculum 2005*.

Negotiation of mathematics meaning in the traditional classroom setting is notoriously difficult. Yet in the use of everyday contexts, as Christiansen (1997) so aptly notes, students can encounter even more serious problems of conflict where they are not sure whether what is at stake is the meaning as

(SAARMSE), held at the University of South Africa in Pretoria in January 1998. The publication of the proceedings is expected to be available before the end of this year.

related to the use of the everyday context within mathematical school practice (i.e. *virtual reality*) or the use of the everyday context within the conventions of everyday practices (i.e. *real reality*). Since "meaning is always meaning in a particular context" it is important that the understanding of such situations as everyday contexts brought into classroom is not "taken-to-be shared" (p.1). There must be conscious attempts to enable students to cross the bridges between everyday contexts and school contexts if students are to resolve their difficulties with 'relating' school mathematics to everyday experiences.

2 *Implications*

The implications are significant for South Africa and all concerned with making mathematics more accessible. For me it means that teachers are aware of the usefulness of relating mathematics to everyday experiences of students in promoting positive attitudes and even making more sense to the students. This is very important in an era when mathematics is being promoted as a human discipline and not absolute and above [the comprehension of] students and teachers. Therefore, it might not be very useful for written materials promoting *Curriculum 2005* to continue to swarm teachers with the importance of relating mathematics to everyday contexts of students. In fact, such a trend could very well serve to blind teachers to the intricacy of the subject. This study already reveals that in the absence of activities related to the intricacies of relating school mathematics to everyday experiences, discourse advocacy would not serve the purpose of enabling teachers. The tasks in the group interview, being so closely tied to contexts that are practical, managed to raise very important issues about teachers' understanding of 'relevance'. In a workshopping situation related to practical tasks, there would be ample opportunities for engaging teachers with their understanding, which was beyond the scope of this study but is suggestive of what would be useful to do for the implementation of the new curriculum. In

fact, such tasks would allow for teachers to engage with how they might handle the intricacies that are bound to occur as they deal with aspects of their teaching that are contained in the new curriculum.

Teaching is not about choosing between the new and the old or the good and the bad, There is a very limited degree to which making the literature that promotes new curricular ideals available can work to truly inform the teachers' understandings and practices. Teachers being the instruments of change, this study confirms the issue that implementing a new curriculum document or new curricular ideals like "relevant teaching" should go beyond making the curricular discourse available. It should seek out how the literature is being understood by teachers and how the teachers may be effectively equipped for their practices. Although this study has not been able to firmly point out the way to equipping teachers for their practices, it does indicate that not enough has been done in that area and that remains the daunting task in the implementation of *Curriculum 2005*.

This study's main contribution (as I see it) is the revelation that there are still tensions that have to be confronted if we are to enable teachers in their practices. These tensions are related to the complex nature of education not being a matter of either-or choices. There are also tensions that are about this time of change and what it is doing to teachers' understanding, both in theory and in practice, about mathematics as a school subject. The place of 'relevance' in the struggle to make mathematics make more sense and prepare students for more conceptually demanding mathematics is an important one (Boaler, 1997). The distinction that Vygotsky's (1978) and Lave and Wenger (1991) reveals between school mathematics and everyday contexts is significant in the contribution to depth of an understanding of 'relevance'. However, as Mercer (1995) and, more recently, Christiansen (1997) note, it is

about being aware of bridges to cross between the everyday and the school contexts and not taking the understanding of such situations as shared.

3 *Further reflections*

I made some crucial remarks at beginning of the study that require me to reflect upon the aspects of this study that are central to my claims about its significance. These have to do with my theoretical framework and how it guided me through the study so that in future researchers may perhaps explore other theories or a broader framework that might be more enabling, or differently illuminating. Also important is a consideration of the methods in this study and what was enabling and limiting about them. In the process of these considerations I will also make significant remarks about the role of talk as central to my study.

Learning as a situated process allowed me to see the complexities of the teachers' talk as deeply contextualised and intricate. It allowed me to interpret the teachers' talk not as merely simplistic but very highly sophisticated, if only at an implicit level. Particularly, Vygotsky's and Lave & Wenger's distinctions assisted me in realising the difficulty involved in 'relating' school mathematics to everyday experiences of students. At that point I was unable to counter the recommendation by Ensor's (1997) and Floden *et al.*,(1987) that we break from everyday contexts in school mathematics. However, if the distinction by Vygotsky clarified the characteristics of school learning it did not account for the obvious failure in school mathematics with which we are faced. I continued to have a very serious discomfort that there was a lot to the calls for mathematics to be made more meaningful as there was a very apparent problem with our school mathematics. Even if we consider that Vygotsky's theory was not about learning and could not provide answers to this failure, it still does not describe sufficiently what school mathematics was.

Lave and Wenger's (1991) apprenticeship metaphor also falls short of explaining the exact relationship between the teacher and the student. The student is not being apprenticed to become what the teacher is, nor is the mathematics teacher's practice strictly that of a mathematician. While some students are expected to study mathematics further, or even go on to become mathematicians, and others might have to immediately join the job market, the exact hybrid that is school mathematics is neither strictly about preparing students to be mathematicians nor to start work immediately after leaving school.

At this stage a more enabling theory for me was Mercer's (1995) and Christiansen's (1997) description of the need to be conscious of crossing the bridges and that the understanding of situations, especially those that use everyday contexts in school mathematics learning, should not be taken-as-shared. Therefore, the socio-cultural theory that I started with underwent very significant changes in the process of the study. Whether or not one starts off with a socio-cultural, sociological or ideological theory, no theory is totally enabling and, in any study, it is more important to be open, to listen to the study as it provides one with new insights.

The method that I used in this study was both very enabling and quite constraining at times. The tasks provided very useful insights into very tacit understandings of teachers. But beyond the obvious limitation of espoused meanings to provide only a partial picture, as does enactment, there were some serious shortcoming in the design that I have to take cognisance of. First of all, as Mercer notes "[p]eople will try to say things that they think are relevant and appropriate to that situation" (1995, p.67). To that extent the manner in which my questionnaire was designed was such that teachers would primarily say things that are positive about 'relevance'. To this extent the ratings of teachers failed almost completely to tell me much for my study. This clear weakness

was, however, made up for in the teachers' justification. This was not an easy problem to resolve because while the teachers' opposition to 'relevance' would have been an important revelation, it was more the awareness of the intricacies of crossing the bridges that I wanted to inquire into. Still, I would not have been able to refer to any intricacies, even if implicit, that were raised by the teachers, without the group interview. Future researchers wishing to undertake a similar study would need to consider the possibility of actual tasks, and beyond, to engage in very subtle understandings. My reference to beyond is an expression of regret at having missed an important opportunity to engage the teachers' understanding even further, into more explicit understanding which might have been brought up if, for example, the task of criticising each other's 'relevant' lessons was carried out.

References

Adler, J. (1992) Small Scale Action Research: Possibilities and Constraints for Mathematics Teachers in Post-Graduate Study. In Proceedings: *PME 16*, University of New Hampshire, Durham, USA.

Adler, J. (1996) The dilemma of code-switching. In *Secondary Teachers' Knowledge of the Dynamics of Teaching and Learning Mathematics in Multilingual Mathematics Classrooms*. Unpublished Doctoral Thesis. Johannesburg: University of the Witwatersrand. Ch 6.

Adler, J. (1997) The base-line study: assumptions, context, methodology and major findings. In Adler, J, Lelliot, A, Slonimsky, L *et al.*, (1997) *A Base-line Study: Teaching/learning practices of primary and secondary mathematics, science and English language enrolled in the Wits Further Diploma in Education programme.* Wits.

Austin, J. L. & Howson, A. G. (1979) Language and mathematics education. *Educational Studies In Mathematics* 10, pp.161-197.

Becker, H. S. (1990) Generalizing from case studies. In E. W. Eisner & A. Peshkin (Eds.), *Qualitative research in education: The continuing debate* (pp. 233 - 242). New York: teachers College Press.

Berry, J W (1985) Learning mathematics in a second language: some cross-cultural issues. *For the Learning of Mathematics* 5 (2) 18-23.

Bishop, A. J. (1992). Cultural issues in the intended, implemented and attained mathematics curriculum in G. Leder (Ed.), *Assessment and Learning of Mathematics*. Victoria: ACER

Bishop, A. J. (1995) The social construction of meaning, a significant development in mathematics education? *For the Learning of Mathematics*, 5, 1, pp. 24 - 28 [Extracts].

Blay, J (1994) Action-Research: Teachers as reflective practitioners. In: *Proceedings of the First Annual Meeting of the Southern African Association for Research in Mathematics and Science Education*. Rhodes University. Jan. 1993. CASME, University of Natal, pp 1 - 92.

Boaler, J. (1993) 'The role of contexts in the mathematics classroom: do they make mathematics more "real"?' in *For the Learning of Mathematics*, 13 (2), 12-17.

Boaler, J. (1997) *Experiencing School Mathematics: Teaching styles, sex and setting*. Open University Press.Buckingham.

Booth, L. R. (1989). "A question of structure" in S. Wagner & C. Kieran (eds) *Research issues in the learning and teaching of algebra*, (57 - 59) Reston, VA: National Council of Teachers of Mathematics.

Breen, C J (1986) Alternative Mathematics Programmes in Oberholzer (eds) *Proceedings of the Eighth National Association of Mathematics Educators of South Africa (AMESA)*; Stellenbosch. pp. 178 - 188.

Bringberg, D. & McGrath, J. E. (1985). *Validity and the research process*. Newbury Park, CA: Sage.

Brodie, K. (1995) Classroom talk, interaction and control: an analysis of teaching strategies in a mathematics lesson. *Perspectives in Education*, 16, 2, 227 - 249.

Brodie, K (1989) Learning mathematics in a second language. *Education Review* 41 (1) 39-54.

Bruner, J (1986) Vygotsky: a historical and conceptual perspective. In Wertsch, J . V. (1986) (Ed) *Culture, Communication and Cognition: Vygotskian Perspectives*. Cambridge University Press: Cambridge.

Carraher, N.T., Carraher, D.W., Schliemann, A.D. (1985) Mathematics in the streets and in schools. *British Journal of Developmental Psychology*, 3, pp.21-9.

Cohen, L. & Manion, L. (1984) *Research Methods in Education*, London: Routledge.

Coombe, J. & Davis, Z. (1995) 'Games in the mathematics classrooms' in *Pythagoras*, 36, p. 19 - 28.

Cornbleth, C. (1990) *Curriculum in Context*. London. Falmer Press.

Christiansen, B. & Walther, G. (1986) Task and Activity. In Christiansen *et al* (1986) (Ed) *Perspectives on Mathematics Education* Reidel: Holland.

Christiansen, I. (1997) When negotiation of meaning is also negotiation of task: Analysis of the Communication in an Applied Mathematics High School Course. *Educational Studies in Mathematics*, 34: Klower, Belgium. pp. 1 - 25.

Crawford, K. (1992) Cultural Processes and Learning: Expectations, Actions and Outcomes. A Paper presented at ICME-7 Quebec

Dadds, M. (1997) Continuing professional development; nurturing the expert. *British Journal of In-service Education*, 23, 1.

Davis, P. J. & Hersh, R. (1981) *The Mathematical Experience*, Penguin Books.

Department of Education (DoE) (1997) *Curriculum 2005*, April 1997

Dowling, P. (1991) 'A touch of class: ability, social class and intertext in SMP 11-16' in Pimm, D. & Love, E. (Eds) *Teaching and Learning School Mathematics*. London: Hodder and Stoughton. pp. 137-152.

Ernest, P. (1991) *The philosophy of mathematics education*: Chapter 1 "A critique of absolutist philosophies of mathematics" and Chapter 2: "The philosophy of mathematics reconceptualised" (pp1 - 34) The Falmer Press, London

Ensor, P. (1997) *School mathematics, everyday life and the NQF; A case of non-equivalence?* Unpublished. Presented at SAARMSE, 1997

Fafunwa, A. B. (1975) Education in the mother-tongue: A Nigerian Experiment - the six-year (Yoruba-medium) Primary Education Project. *West African Journal of Education* 11 (2)

Flodén, R. E., Buchman, M. & Schwille, J. R. (1987). Breaking with Everyday Experience. *Teachers College Record*, Vol. 88, Number 4, pp. 485-506

Gerdes, P. (1985) 'On culture, geometrical thinking and mathematics education' in *Educational Studies in Mathematics*. 19. 137-162.

Hanks, W. F. (1990) *Referential practice, language, and lived space among the Maya.* Chicago: University of Chicago Press.

Lakatos, I. (1967) *A renaissance of empiricism in the recent philosophy of Mathematics, Science and Epistemology.* Cambridge University Press

Laridon, P. (1993) Towards transforming mathematics education in South Africa in *Pythagoras*, 31, April 1993, pp. 40 - 45.

Lave, J. & Wenger, E. (1991) *Situated learning: Legitimate peripheral participation.* Cambridge University Press: Cambridge.

Marton, F. (1988) Phenomenography: A Research Approach to Investigating Different Understandings of Reality. In Sherman, R. R. & Webb, R. B. (eds) *Qualitative Research in Education: Focus on Methods.* Falmer Press. London. pp. 141 - 161.

Maxwell, J. A. (1992) Understanding and Validity in Qualitative Research. *Harvard Educational Review.* 62 (3).

McCormick, R. and James, M. (1983) *Curriculum Evaluation in Schools.* Croom Helm: Beckenham.

McMillan, J. H. & Schumacher, S. (1993) *Research in Education: A Conceptual Introduction.* HarperCollins College Publishers: New York.

Mellin-Olsen, S. (1987) *The politics of mathematics education.* Dordrecht: Kluwer.

Mercer, N. (1995) *The guided construction of knowledge: talk among pupils and learners.* Multilingual Matters.

Morrow, W. (1992) A picture holds us captive. In Pendlebury, S., Hudson, L., Shalem, Y., Bensusan, D. *Kenton at Broederstroem. Conference proceedings*

Muller J. (1993) Difference, Identity, Community: Some lessons for curriculum reconstruction from the United States in Taylor, N (ed) *Inventing Knowledge: Contests in Curriculum Construction.* Cape Town: Maskew Miller Longman. pp. 39 - 57

Nyabanyaba, T & Adler, J (1997) Further Diploma in Education (FDE) base-line study: Report on the teacher narratives. In Adler, J, Lelliot, A, Slonimsky, L *et al.*, (1997) *A Base-line Study: Teaching/learning practices of primary and secondary mathematics, science and English language enrolled in the Wits Further Diploma in Education programme.* Wits

Pimm, D. (1987) *Speaking Mathematically: Communication in Mathematics Classrooms.* Routledge & Kegan, London.

Polanyi, M. (1967) *The Tacit Dimension.* New York: Doubleday

Powell, A. & Frankenstein, M. (1997) *Ethnomathematics: Challenging Eurocentricism in mathematics education.* Albany: SUNY Press. Introduction to section IV: reconsidering what counts as mathematical knowledge.

Presmeg N. (1988) Cultural Mathematics for Mutual Understanding; In Malone, J., Burkhardt, H. & Keitel, C.; *The Mathematics Curriculum: Towards the year 2000*; CURTIN Perth, Australia.

Shalem, Y. (1997) Teacher Supply, Utilisation and Development in Gauteng; Overview of Research in Progress. A working paper for the Gauteng Teacher Supply, Utilisation and Development Project.

Spencer, (1997) *Indigenous Technology* Paper presented to the fifth annual meeting of SAARMSE, University of the Witwatersrand.

Stone, C. A. (1993) What is missing in the metaphor of scaffolding. Extracts from chapter 6 Forman, E. A, Minkk, N & Stone, C. A *Contexts for learning*. Oxford University Press

Taylor, N (1997) *Curriculum 2005*: Some issues in ***JET Bulletin***, October 1997: No. 7.

Thompson, A (1992) Teachers' beliefs and conceptions: a synthesis of the research. In Grouws, A. D (ed) *Handbook of Research on Mathematics Teaching and Learning*. National Council of Teachers of Mathematics. New York: Macmillan. pp. 127 - 146.

Thornton, R (1992) Culture: A contemporary definition; In E. Boonzaier & J. Sharp; *South African Keywords: The uses & abuses of political concepts* Cape Town: David Philip.

Vithal, R. & Skovsmose, O (1997) *The end of innocence: A critique of 'ethnomathematics.*

Volmink, J. (1994) Mathematics by all. In Lerman, S (Ed) *Cultural Perspectives on the Mathematics Classroom*. Kluwer. Dordrecht. pp. 51 - 67.

Vygotsky, L. S. (1962) "The development of scientific concepts in childhood. Extracts from *Thought and Language*. Cambridge, MIT Press, Chapter 6.

Vygotsky, L. S. (1978) *Mind in Society*. Cambridge, Massachusetts: Havard University Press. Chapter 6.

Zazkis, R and Campbell, S "Divisibility and Multiplicative Structure of Natural Numbers: Preservice Teachers' Understanding" in the *Journal for Research in Mathematics Education*, 1996, Vol. 27, No. 5, 540-563.

Zepp, R (1982) Bilingual understanding of logical connectives in English and Sesotho in *Educational Studies in Mathematics* 13 205-221.

Appendices

Appendix A: Questionnaire

As part of my M Ed studies at Wits University, I am undertaking a project on the issue of 'relevance' in mathematics. I have now joined the FDE programme as part of my post-graduate duties and was also inspired onto the subject by your responses to the question on what makes a good mathematics teacher/lesson.

I hope that the questionnaire will help you reflect further on your teaching and contribute towards your studies. The information gathered here will be treated with the utmost confidence. The nature of the responses given here will ***not*** be used for assessing your participation in the FDE studies. However, the contents of your responses may be used to conduct a follow-up interview on the matter.

Write your name on the top part of the first page (only for the purpose of identification if a follow-up interview is found necessary).

Section A

1 What do you feel is the greatest challenge for the teaching of mathematics?

_____

_____

_____

2 On a scale, with **1 = very unimportant; 2 = unimportant; 3 = unsure; 4 = important and 5 = very important**, indicate (by ticking the box of your choice) how you would rate each of the following concerns for you as a mathematics teacher. On the line below each concern explain how you feel each concern would assist or not assist in the teaching and learning of mathematics:

A Presenting mathematics in such a way that students feel closer to the subject

1 2 3 4 5

Explain: _____

_____

_____

B The development of formal mathematics knowledge in school mathematics

1 2 3 4 5

Explain: _____

_____

_____

C The development of teacher's competencies and skills

1 2 3 4 5

Explain: _____

_____

_____

3 Which of the concerns in 2 above do you feel is lacking the most in mathematics teaching: _____

Comment: _____

Section B

1 These are some of the justifications that have been given for the calls to make mathematics more relevant to the students' everyday experiences. Indicate, by ticking your choice, how far you rate the following as **strengths/merits** of relevance:

A Making mathematics easier for students:

__Disagree __Unsure __Agree

Explain:_____

B Making mathematics more passable

__Disagree __Unsure __Agree

Explain:_____

C Making mathematics more meaningful

__Disagree __Unsure __Agree

Explain:_____

D Making more students like mathematics

__Disagree __Unsure __Agree

Explain:_____

E Helping students to move from the known to the unknown

__Disagree __Unsure __Agree

Explain:_____

_____

_____

F Making students see mathematics more clearly as a subject

__Disagree __Unsure __Agree

Explain:_____

_____

_____

G Making mathematics relevant to other subjects

__Disagree __Unsure __Agree

Explain:_____

_____

_____

H Making students see how useful mathematics is in their lives.

__Disagree __Unsure __Agree

Explain:_____

_____

_____

2 Briefly explain what you feel are the **problems** of relevance to students everyday experiences in mathematics teaching.

_____

_____

_____

_____

_____

3 Using a lesson to illustrate your point, briefly describe how you think teachers should work with the issue of relating mathematics to students' everyday experiences.

_____

_____

_____

_____

_____

_____

Appendix B Interview Schedules

Group A

1 In the questionnaire you filled in in July, you did not have enough time to develop a lesson that is relevant to students' everyday experiences. Spend about 10 minutes developing a lesson on the sum of the angles of a triangle. The lesson must be in such a way that it is relevant to students' everyday experiences. Thereafter, spend 20 minutes discussing your lessons in your groups.

(Note to the facilitators: The group should develop its own meaning as far as possible. Therefore, unless the discussion is dull or you detect a serious misunderstanding you do not have to probe. An example of a possible probe, if necessary, would be whether the teachers would expect any problems with the lesson and how they would minimise such problems. But you must be careful not to be suggestive of the answers expected of the teachers.)

2 In the questionnaire you filled in July, some teachers felt that it was important in the teaching of mathematics to highlight future careers by, for example, taking students to a construction site. The students would then be made to see and work on the kinds of calculations that construction workers use. In that way the students would realise that they need mathematics for their future.

(a) Would you use this kind of activity for your mathematics teaching? Give reasons why you would or would not use such an activity

(*Note*: The same caution about not being too explicit about what is expected of the teachers made above applies here. But you might have to probe deeper if the group is not generating good data. A possible probe could be: "Should students be made to believe that mathematics is necessary for their future and why or why not?")

(b) What mathematics (content) would the activity help with?

(*Note*: If necessary you may have to explain that this question is asking which topics teachers would use this activity to teach.)

(c) Some people say that this activity would make Mathematics easier and more meaningful as it is concrete.

Would you agree with this? Give your reasons.

(*Note*: This question is meant to lead to a discussion on whether such an activity would necessarily make mathematics easier and more meaningful. Therefore, you might have to probe along the lines that: " Would actual constructions necessarily be easier for school children and why or why not?")

(d) What might be some of the limitations of such an activity in teaching mathematics?

(*Note*: If the discussion is not making progress, you might have to probe as to how the teachers might try to overcome the limitations).

After writing down your views about the activity in 2 above, discuss those views in your groups.

(*Note*: Please, look after the time carefully so that you allocate 10 minutes for the writing, and 20 minutes for the discussion, for each of the activity.)

Group B

1 In the questionnaire you filled in in July, you did not have enough time to develop a lesson that is relevant to students' everyday experiences. Spend about 10 minutes developing a lesson on introducing parallel lines or alternate angles of parallel lines. The lesson must be in such a way that it is relevant to students' everyday experiences. Thereafter, spend 20 minutes discussing your lessons in your groups.

(Note to the facilitators: The group should develop its own meaning as far as possible. Therefore, unless the discussion is dull or you detect a serious misunderstanding you do not have to probe. An example of a possible probe, if necessary, would be whether the teachers would expect any problems with the lesson and how they would minimise such problems. But you must be careful not to be suggestive of the answers expected of the teachers.)

2 In the questionnaire you filled in July, some teachers gave the case of shopping as a relevant everyday context for mathematics teaching. For

example, if a student is selling oranges, apples and peanuts, he or she should be able to use the information on her sale to say which fruit makes the most profit.

(a) Would you use this kind of context for your mathematics teaching? _____ give reasons

(*Note*: While the same caution about not being too explicit about what is expected of the teachers made above applies here, you might have to probe deeper if the group is not generating good data. A possible probe could be: "Should students be made to believe that mathematics is necessary for the students in their everyday lives and why?")

(b) What mathematics (content) would the activity help with?

(*Note:* If necessary you may have to explain that this is asking which topics teachers would use this activity to teach.)

(c) Some people say that students enjoy this kind of context but that it is difficult to get them to write the mathematics involved. Do you agree with this? Give your reasons.

(*Note*: This question is meant to lead to a discussion on whether such a context would necessarily make mathematics easier and more meaningful. Therefore, you might have to probe along the lines that: "If students enjoy a context does it necessarily makes it easier to understand?").

(d) What might be some of the limitations of such a context to teach mathematics?

Give your reasons.

(*Note*: If the discussion is not making progress, you might have to probe as to how the teachers might try to overcome the limitations).

After writing down your views about the context above, discuss those views in your groups.

(*Note*: Please, look after the time carefully so that you allocate 10 minutes for the writing, and 20 minutes for the discussion, for each of the activity.)

Group C

1. In the questionnaire you filled in July, you did not have enough time to develop a lesson that is relevant to students' everyday experiences. Spend about 10 minutes developing a lesson on angle properties of a circle. The lesson must be in such a way that it is relevant to students' everyday experiences. Thereafter, spend 20 minutes discussing your lessons in your groups.

(Note to the facilitators: The group should develop its own meaning as far as possible. Therefore, unless the discussion is dull or you detect a serious misunderstanding you do not have to probe. An example of a possible probe, if necessary, would be whether the teachers would expect any problems with the lesson and how they would minimise such problems. But you must be careful not to be suggestive of the answers expected of the teachers.)

2 The following was an exam item for grade 9.

Based on the log tables below, students are asked to say whether Spar Amazulu is doing better than Moroka Swallows on the 5th of May explaining their answers

Castle League Log 26-04-93

Name of club	P	W	D	L	F	A	Pt
Moroka Swallows	10	6	2	2	11	9	14
Santos	9	3	5	1	10	6	11
Amazulu	8	4	3	1	10	7	11
Umtata Bucks	10	3	5	2	8	8	11
Albany City	9	3	2	2	10	8	10
Pirates	7	4	1	2	10	6	9
C. T. Spurs	7	4	1	2	7	3	9
Celtic	7	3	3	1	7	5	9
Ratanang	8	3	3	2	11	8	9
Sundowns	5	4	0	1	10	2	8
Dynamos	7	3	2	2	8	5	8
Chiefs	6	3	1	2	9	8	7
Hellenic	6	3	1	2	9	8	7
Jomo Cosmos	9	2	3	4	5	8	7
Wits	9	2	2	5	8	7	6
Callies	8	2	2	4	8	13	6

Castle League Log 25-05-93

Name of club	P	W	D	L	F	A	Pt
Moroka Swallows	12	6	4	2	13	11	16
Amazulu	10	4	5	1	13	10	13
C. T. Spurs	9	5	2	2	11	3	12
Ratanang	10	4	4	2	13	8	12
Santos	11	3	6	2	11	9	12
Albany City	11	4	4	3	13	12	12
Umtata Bucks	11	3	6	2	10	10	12
Celtic	9	4	3	2	11	9	11
Sundowns	5	5	0	1	14	4	10
Pirates	7	4	1	2	10	5	9
Wits	7	4	1	2	10	5	9
Dynamos	7	3	2	2	8	5	8
Chiefs	8	4	0	4	10	10	8
Callies	9	3	2	4	10	13	8
Vaal Pros	11	2	3	6	9	12	7
Jomo Cosmos	10	2	3	5	5	10	7

(a) Would you use this kind of context for your assessing students' mathematics knowledge? _____ give reasons

(*Note*: The same caution about not being too explicit about what is expected of the teachers made above applies here. But you might have to probe deeper if the group is not generating good data. A possible probe could be: "Would this kind of examination item be easier for all students and why or why not?")

(b) What mathematics (content) would the activity be assessing?

(*Note:* If necessary you may have to explain that this question is asking which topics teachers would be assessing the students in with this item.)

(c) Some students answered that Moroka Swallows would still be on top of the log table, it is a good team, they had seen it play. How would you have assessed such answers?

(*Note*: This question is meant to lead to a discussion on whether such an examination item would not be difficult to assess as students might bring in their feelings. Therefore, you might have to probe along the 'ines that: "If students believe that they know about a context, would it make school mathematics easier for them and why or why not?").

(d) What are some of the limitations of such an examination item? Give your reasons.

(*Note*: If the teachers' discussion is not making progress, you might have to probe beyond the limitations to ask how the teachers might try to work with these limitations).

After writing down your views about the item in 2 above, discuss those views in your groups.

(*Note*: Please, look after the time carefully so that you allocate 10 minutes for the writing, and 20 minutes for the discussion, for each of the activity.)

Group D

1 In the questionnaire you filled in July, some teachers felt that it was important in the teaching of mathematics to highlight future careers by, for example, taking students to a construction site. The students would then be made to see and work on the kinds of calculations that construction workers use. In that way the students would realise that they need mathematics for their future.

(a) Would you use this kind of activity for your mathematics teaching? Give reasons why you would or would not use such an activity

(*Note*: The facilitators must be careful not to be too explicit about what is expected of the teachers in their discussions. But you might have to probe deeper if the group is not generating good data. A possible probe could be: "Should students be made to believe that mathematics is necessary for their future and why or why not?")

(b) What mathematics (content) would the activity help with?

(*Note:* If necessary you may have to explain that this question is asking which topics teachers would use this activity to teach.)

(c) Some people say that this activity would make Mathematics easier and more meaningful as it is concrete.

Would you agree with this? Give your reasons.

(*Note*: This question is meant to lead to a discussion on whether such an activity would necessarily make mathematics easier and more meaningful. Therefore, you might have to probe along the lines that: " Would actual constructions necessarily be easier for school children and why or why not?")

(d) What might be some of the limitations of such an activity in teaching mathematics?

(*Note*: If the discussion is not making progress, you might have to probe as to how the teachers might try to overcome the limitations).

After writing down your views about the activity in 2 above, discuss those views in your groups.

(*Note*: Please, look after the time carefully so that you allocate 10 minutes for the writing, and 20 minutes for the discussion, for each of the activity.)

2 In the questionnaire you filled in in July, you did not have enough time to develop a lesson that is relevant to students' everyday experiences. Spend about 10 minutes developing a lesson on the sum of the angles of a triangle. The lesson must be in such a way that it is relevant to students' everyday experiences. Thereafter, spend 20 minutes discussing your lessons in your groups.

(Note to the facilitators: The group should develop its own meaning as far as possible. Therefore, unless the discussion is dull or you detect a serious misunderstanding you do not have to probe. An example of a possible probe, if necessary, would be whether the teachers would expect any problems with the lesson and how they would minimise such problems. But you must be careful not to be suggestive of the answers expected of the teachers.)

Group E

1 In the questionnaire you filled in July, some teachers gave the case of shopping as a relevant everyday context for mathematics teaching. For example, if a student is selling oranges, apples and peanuts, he or she should be able to use the information on her sale to say which fruit makes the most profit.

(a) Would you use this kind of context for your mathematics teaching? _____ give reasons

(*Note*: The facilitators should be careful not to be too explicit about what is expected of the teachers in their discussions. But, you might have to probe deeper if the group is not generating good data. A possible probe could be: "Should students be made to believe that mathematics is necessary for the students in their everyday lives and why?")

(b) What mathematics (content) would the activity help with?

(*Note:* If necessary you may have to explain that this is asking which topics teachers would use this activity to teach.)

(c) Some people say that students enjoy this kind of context but that it is difficult to get them to write the mathematics involved. Do you agree with this? Give your reasons.

(*Note*: This question is meant to lead to a discussion on whether such a context would necessarily make mathematics easier and more meaningful. Therefore, you might have to probe along the lines that: "If students enjoy a context does it necessarily makes it easier to understand?").

(d) What might be some of the limitations of such a context to teach mathematics?

Give your reasons.

(*Note*: If the discussion is not making progress, you might have to probe as to how the teachers might try to overcome the limitations).

After writing down your views about the context above, discuss those views in your groups.

(*Note*: Please, look after the time carefully so that you allocate 10 minutes for the writing, and 20 minutes for the discussion, for each of the activity.)

2 In the questionnaire you filled in in July, you did not have enough time to develop a lesson that is relevant to students' everyday experiences. Spend about 10 minutes developing a lesson on introducing parallel lines or alternate angles of parallel lines. The lesson must be in such a way that it is relevant to students' everyday experiences. Thereafter, spend 20 minutes discussing your lessons in your groups.

(Note to the facilitators: The group should develop its own meaning as far as possible. Therefore, unless the discussion is dull or you detect a serious misunderstanding you do not have to probe. An example of a possible probe, if necessary, would be whether the teachers would expect any problems with the lesson and how they would minimise such problems. But you must be careful not to be suggestive of the answers expected of the teachers.)

Group F

1 The following was an exam item for grade 9.

Based on the log tables below, students are asked to say whether Spar Amazulu is doing better than Moroka Swallows on the 5th of May explaining their answers

Castle League Log 26-04-93

Name of club	P	W	D	L	F	A	Pt
Moroka Swallows	10	6	2	2	11	9	14
Santos	9	3	5	1	10	6	11
Amazulu	8	4	3	1	10	7	11
Umtata Bucks	10	3	5	2	8	8	11
Albany City	9	3	2	2	10	8	10
Pirates	7	4	1	2	10	6	9
C. T. Spurs	7	4	1	2	7	3	9
Celtic	7	3	3	1	7	5	9
Ratanang	8	3	3	2	11	8	9
Sundowns	5	4	0	1	10	2	8
Dynamos	7	3	2	2	3	5	8
Chiefs	6	3	1	2	9	8	7
Hellenic	6	3	1	2	9	8	7
Jomo Cosmos	9	2	3	4	5	8	7
Wits	9	2	2	5	8	7	6
Callies	8	2	2	4	3	13	6

Castle League Log 25-05-93

Name of club	P	W	D	L	F	A	Pt
Moroka Swallows	12	6	4	2	13	11	16
Amazulu	10	4	5	1	13	10	13
C. T. Spurs	9	5	2	2	11	3	12
Ratanang	10	4	4	2	13	8	12
Santos	11	3	6	2	11	9	12
Albany City	11	4	4	3	13	12	12
Umtata Bucks	11	3	6	2	10	10	12
Celtic	9	4	3	2	11	9	11
Sundowns	5	5	0	1	14	4	10
Pirates	7	4	1	2	10	5	9
Wits	7	4	1	2	10	5	9
Dynamos	7	3	2	2	8	5	8
Chiefs	8	4	0	4	10	10	8
Callies	9	3	2	4	10	13	8
Vaal Pros	11	2	3	6	9	12	7
Jomo Cosmos	10	2	3	5	5	10	7

(a) Would you use this kind of context for your assessing students' mathematics knowledge? ____ give reasons

(*Note*: Facilitators should be careful not to be too explicit about what is expected of the teachers. But you might have to probe deeper if the group is not generating good data. A possible probe could be: "Would this kind of examination item be easier for all students and why or why not?")

(b) What mathematics (content) would the activity be assessing?

(*Note:* If necessary you may have to explain that this question is asking which topics teachers would be assessing the students in with this item.)

(c) Some students answered that Moroka Swallows would still be on top of the log table, it is a good team, they had seen it play. How would you have assessed such answers?

(*Note*: This question is meant to lead to a discussion on whether such an examination item would not be difficult to assess as students might bring in their feelings. Therefore, you might have to probe along the lines that: "If students believe that they know about a context, would it make school mathematics easier for them and why or why not?").

(d) What are some of the limitations of such an examination item? Give your reasons.

(*Note*: If the teachers' discussion is not making progress, you might have to probe beyond the limitations to ask how the teachers might try to work with these limitations).

After writing down your views about the item in 2 above, discuss those views in your groups.

(*Note*: Please, look after the time carefully so that you allocate 10 minutes for the writing, and 20 minutes for the discussion, for each of the activity.)

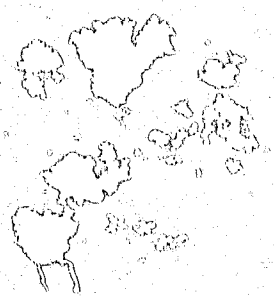
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circle. The lesson must be in such a way that it is relevant to students' everyday experiences. Thereafter, spend 20 minutes discussing your lessons in your groups.

(Note to the facilitators: The group should develop its own meaning as far as possible. Therefore, unless the discussion is dull or you detect a serious misunderstanding you do not have to probe. An example of a possible probe, if necessary, would be whether the teachers would expect any problems with the lesson and how they would minimise such problems. But you must be careful not to be suggestive of the answers expected of the teachers.)

Appendix A1 Responses to Questionnaire

Key to types of responses	
Mot	Motivations, attitudes & perceptions towards mathematics education
tcr	teacher approaches, commitment & professionalism (both daily as preparation & improving self
mean	mathematical meaning, especially epistemological access
instr	instrumental as in preparing students for daily & future activities
cnstr	constraints such as human & material resources (students & teacher preparation) & other factors



Appendix 1A1 the greatest challenges in mathematics education (teaching & learning)

Design.	*mot*	*tcr*	*math*	*instr*	*cnstr*	*explanation*
T1	0	1	0	0	0	updating teacher
T2	0	1	0	0	1	to face challenges from pupils & colleagues
T3	0	0	0	1	0	prepare engineers etc. for the country
T4	1	0	1	0	0	creative & instil love for maths in pupils
T5	1	0	0	0	1	finding resources for small group activities
T6	1	0	0	1	0	students to be encouraged for daily lives
T7	1	0	1	0	0	to encourage pupils' independent thinking
T8	1	0	1	0	1	overcrowded slow & fast learners without fundamentals
T9	0	0	1	0	0	manipulating numbers and symbolic form
T10	0	0	0	1	0	to bring awareness of maths in everyday
T11	0	1	0	0	0	always prepare, learn, prepare, use many methods
T12	0	0	0	1	0	to prepare students for lacking doctors, scientists etc.
T13	0	0	1	0	0	to change past maths theory emphasis to practicals
T14	1	0	0	1	0	to create students' confidence to become scientist
T15	0	0	0	1	0	more real contexts like buying and selling (percentages)
T16	0	1	0	0	0	finding clearer ways of introducing topics like trigonometry
T17	1	0	1	0	0	letting students grasp what I'm saying
T18	0	1	0	0	1	underqualified but competent teaching in full classrooms
T19	1	1	0	0	0	improving my teaching to help my students
T20	1	0	0	0	0	motivating my students and making them at ease in maths
T21	0	0	0	1	0	to get students to interpret everyday information
T22	1	0	1	0	0	less abstract, more concrete, enjoyable & interesting
T23	0	0	0	1	0	keeping students up-to-date with fast changing technology
T24	0	0	0	1	0	teaching maths as a tool for science and technology
T25	0	0	0	0	1	closing the gap for insufficiently prepared students
T26	1	0	1	0	0	increasing pupils' love & participation to make maths easier
T27	1	0	1	0	0	maths to be enjoyable and easy
T28	0	0	1	1	0	deal with demanding maths for daily technological life
T29	1	0	0	1	1	redress, develop teachers for students' love and application
T30	0	1	0	0	0	consult books & others for maths as organisational
T31	1	0	0	0	1	instil love and work in constraints of ill-prepared students
T32	1	0	1	0	0	to make subject friendly and students competent
T33	1	1	1	0	0	love & upgrade skills: be able to impart
	16	8	12	11	7	
	mot	*tcr*	*math*	*instr*	*cnstr*	

Appendix 1A21 How students feeling closer to the subject assist maths ed

Design.	*mot*	*tcr*	*math*	*instr*	*cnstr*	*explanation*
T1	0	0	1	0	0	easier to face challenges
T2	1	0	0	0	0	creating love for subject
T3	1	0	1	0	0	making subject interesting & challenging => love
T4	0	0	1	1	0	when practical in life students will better understand
T5	0	0	0	1	0	for preparation of tomorrow's leaders
T6	1	0	1	0	0	students should be motivated by making maths real
T7	0	0	1	1	0	maths should be taught in real situation as context
T8	1	0	1	0	0	will develop love & skills
T9	1	0	0	1	0	love, identify with & apply
T10	1	0	0	0	0	give opportunity for pupils to participate in groups
T11	1	0	0	1	0	for enjoyment & daily use
T12	1	0	1	0	0	for understanding & love
T13	1	0	1	0	0	broaden attitudes that maths is for all
T14	1	0	0	1	0	to own & enjoy maths as life
T15	1	0	1	1	0	helps make maths real & lovable
T16	1	0	1	0	0	help a sense of belonging & understanding
T17	1	0	0	0	0	will help develop the love for maths
T18	1	0	0	0	1	will only help if students cooperate & think positively
T19	1	0	0	1	0	liking & positive attitudes will help students live better
T20	1	0	0	0	0	enjoyment as in any other subject
T21	1	0	1	1	0	students must follow & enjoy useful maths
T22	0	0	1	0	0	for not parrot-like understanding
T23	1	1	0	0	0	teachers must be available and boost not boast
T24	1	1	0	0	0	to motivate not make maths difficult
T25	1	0	0	0	0	for relaxed & sharing students
T26	1	0	0	0	0	love would benefit students
T27	0	0	1	0	0	for better understanding & knowledge
T28	1	0	1	0	0	students see, are not lost & want to know more
T29	1	0	1	0	0	games help close gap between students & subject
T30	1	0	1	1	0	when students see importance, they listen
T31	1	1	0	0	0	no intimidation will help those with natural ability
T32	0	0	0	1	0	for day-to-day application
T33	1	0	1	0	0	for attractive and simple maths
	26	**3**	**17**	**11**	**1**	158/165 (rating) most popular
	mot	*tcr*	*math*	*instr*	*cnstr*	

Appendix 1A22 how attention to formal maths can assist in maths education

Design.	*mot*	*tcr*	*math*	*instr*	*cnstr*	*explanation*
T1	0	1	0	0	1	few qualified teachers so unqualified given maths
T2	1	0	0	1	0	maths must be informal for free & real application
T3	1	0	0	1	0	maths must be informal for easy real application
T4	1	0	0	1	0	maths must be in all perspectives
T5	0	0	1	1	0	students must grasp maths & correlate it with home
T6	0	1	1	0	0	teacher as guide to increase maths knowledge
T7	1	0	0	0	0	maths must be informal like all other subjects
T8	0	0	1	0	0	for sound knowledge to pursue science careers
T9	1	0	0	0	0	must be informal to do away with maths phobia
T10	0	0	0	0	0	NO RESPONSE
T11	0	0	0	1	0	formal maths used daily
T12	0	0	0	0	1	problem with lack of facilities
T13	0	1	0	0	0	teachers need direction on how to do it
T14	0	0	1	0	0	to solve problems with understanding not routine
T15	0	0	1	1	0	everyday, not formal, mathematics informs capacity
T16	1	0	0	0	0	formal maths will narrow students' scope
T17	0	0	0	0	0	NO RESPONSE
T18	0	0	0	0	0	NO RESPONSE
T19	0	0	0	0	0	NO RESPONSE
T20	0	0	0	0	0	RESPONSE: I don't understand this one
T21	0	0	1	1	0	gains insight from maths developed as instrumental
T22	1	0	0	0	0	less formal will not intimidate
T23	0	0	0	0	1	we need to cover syllabus as many teachers unable
T24	0	0	1	0	0	to help students cope with the demands of maths
T25	1	0	1	0	0	developing maths important, but also other views
T26	0	0	1	1	0	maths not only what happens in class, non-formal too
T27	0	0	1	1	0	relate formal & home informal maths activities
T28	0	1	1	0	0	teachers must in-service & develop maths in schoo
T29	0	0	1	1	0	formal does not provide foundation & takes away life
T30	0	0	0	1	0	passing & students must play a role outside school
T31	0	0	1	0	1	relevance not enough for knowledge; many still fail
T32	1	0	1	0	0	undeveloped informal makes maths appear abstract
T33	0	0	1	0	0	basics first in order to understand matter quicker
	9	4	15	11	4	116/165 (rating) least popular
	mot	*tcr*	*math*	*instr*	*cnstr*	

Appendix 1A23 how teacher competencies can help in maths education

Design.	*mot*	*tcr*	*math*	*instr*	*cnstr*	*explanation*
T1	0	1	0	0	1	not enough workshops to develop competencies
T2	1	0	1	0	0	the way in which teacher present important to pupils
T3	1	1	0	1	0	competent teacher gains students' respect & leads to adulthood
T4	0	1	0	0	0	teacher should always find new teaching ways & be competent
T5	0	1	0	0	0	teachers should gain knowledge & ideas from NGO's & share
T6	1	1	0	0	0	teachers should always upgrade for competence & confidence
T7	0	1	0	0	0	a mathematics teacher should be well-informed with subject
T8	1	1	0	1	0	this will equip teacher to be confident & face change
T9	1	1	0	0	0	good students are often from good hands (teachers)
T10	1	1	1	0	0	a competent teacher is an effective teacher
T11	0	1	0	0	0	teachers should be empowered so that they are accountable
T12	0	1	1	0	0	this will help teachers impart maths to the children
T13	0	0	0	1	0	teachers must compete for products who are able to use maths
T14	1	1	0	0	0	teachers must be able to deal with most situations
T15	0	1	0	1	0	professional teacher can help student for technological world
T16	1	0	0	0	0	self-confidence of teacher will rub to students
T17	0	1	0	0	0	teacher should always work towards being better
T18	0	1	0	0	0	helps for teachers to upgrade their standard of teaching
T19	0	0	1	1	0	helps teacher be aware of outside progress & gain knowledge
T20	1	1	0	0	0	needs to develop or they will bore students with same teaching
T21	1	1	0	0	0	maths teachers need to know more to impart with confidence
T22	0	1	0	0	0	teacher need to change & increase knowledge in workshops
T23	0	1	0	0	0	courses for teachers to upgrade & read must always be held
T24	1	0	0	0	0	motivated teachers can teach better than those who are not
T25	0	0	1	0	0	it helps learners to be broader thinkers
T27	0	1	0	0	0	teachers must continue developing as they teach
T28	0	1	1	0	0	this give teachers ways of making students understand teaching
T29	0	1	0	0	0	teachers should always be competent to teach maths
T30	0	1	1	0	0	directly working with students, teachers should facilitate learning
T31	0	0	0	1	0	need for skills, not competencies, in new SA's economy
T32	0	0	0	0	1	even competent teachers fail because of ingrained attitudes
T33	0	1	0	0	0	teacher competencies make life easier for students & teachers
T34	0	1	0	0	0	teachers would be able to cope & have no fear of unkown
	11	25	7	6	2	154/170 (second most popular)
	mot	*tcr*	*math*	*instr*	*cnstr*	

Appendix 1A3 What is lacking in maths ed in reference to the three concerns

Design.	*mot*	*tcr*	*math*	*instr*	*cnstr*	*explanation*
T1	0	1	0	0	1	qualified **teachers** who can teach the subject properly
T2	0	1	0	0	0	skilled **teachers** assigned to classes properly
T3	0	1	0	1	0	**teaching** that enables students to live out of learning
T4	0	1	0	0	0	most **teachers** still using old ways
T5	0	1	0	0	0	**we teachers** do not help each other or implement skills from NGO's
T6	1	0	1	0	0	mathematics as important to teachers
T7	0	1	0	0	0	teaching, not training, of **teachers**
T8	0	1	0	1	0	without **teacher** competencies, learners cannot face technology
T9	0	1	1	1	0	maths is **taught** as something impractical
T10	1	0	0	0	0	pupils made to believe maths is difficult and undermine each other
T11	0	1	0	0	0	only **teachers** who majored in maths are sure of their teaching
T12	0	1	0	0	0	more **teachers** are lacking the skills of teaching
T13	0	1	1	0	0	most **teachers** need direction on how to teach formal maths in school
T14	0	1	1	0	0	**teachers** trained to transmit without knowledge & critical analysis
T15	1	1	0	1	0	maths would be likeable if **taught** as practical & useful in community
T16	0	1	0	1	0	most **teachers** cannot relate theory of maths teaching to daily applic.
T17	0	0	0	1	0	maths skills that can solve problems in social sciences
T18	0	0	1	0	0	school maths
T19	0	1	0	1	0	**teacher** competencies for teaching about outside world progress
T20	0	1	0	0	0	**teacher** competencies are not developed
T21	0	1	1	0	0	**teachers** should be empowered with subject knowledge in workshops
T22	0	1	0	0	0	**we teachers** must expose ourselves to new techniques
T23	1	1	0	0	0	most **teachers** say maths is for more intelligent & so students hate it
T24	1	1	0	0	0	maths **teachers** do not h[illegible] the zeal to help students learn
T25	0	0	1	1	0	relating maths to selling chickens makes it easy to understand
T27	0	1	1	1	0	maths **teachers** in isolation do not develop skills
T28	1	1	0	0	0	**teachers** do not have skills to make students like maths
T29	1	1	1	0	0	**teachers** not competent to teach subject such that students like it
T30	0	1	1	0	0	**teachers'** skills to facilitate learning
T31	1	1	0	0	0	**teachers** must be competent & confident in order to motivate pupils
T32	1	0	0	1	0	everyday experiences will bring students closer to maths
T33	1	1	0	0	0	though we have competent teachers, maths **teaching** not interesting
T34	1	1	0	0	1	motivation to remove fear of maths, and reverse **teacher** shortage
	11	**27**	**10**	**10**	**2**	
	mot	*tcr*	*math*	*instr*	*cnstr*	

Appendix 1B1 'relevance' making maths easier

Design.	*mot*	*tcr*	*math*	*instr*	*cnstr*	*explanation*
T1	1	0	0	1	0	students will love it and make it part of their lives
T2	1	1	0	0	0	creating the love for maths
T3	1	1	1	0	0	maths to be loved must be interesting & challenging
T4	1	0	0	1	0	students will understand maths if practical in life
T5	0	0	0	0	1	with help of NGO's beginning to work
T6	1	0	0	0	0	appreciation makes it easier
T7	0	0	0	0	1	with the use of teaching aids
T8	0	1	0	0	0	*might not work if teacher incompetent*
T9	1	0	1	0	0	**not lowering of maths but student motivation**
T10	0	1	0	0	1	teacher should have enough skills/time for pupils
T11	0	0	1	1	0	not really easy but relevant
T12	0	1	0	0	1	not enough teaching approaches knowledge
T13	1	0	0	1	0	pupils to be familiar with subject
T14	1	0	1	1	0	engagement & relevance help informed meaning
T15	0	1	0	0	1	*not sufficient trained personnel for teaching*
T16	1	0	0	1	0	attraction to maths for technological advances
T17	1	1	0	0	0	maths must be simplified for love by students
T18	0	0	0	1	0	maths is everywhere
T19	1	0	0	0	0	if students find subject tough, they hate it
T20	0	0	0	0	0	
T21	1	1	0	1	0	maths must be simple and relevant
T22	1	0	1	0	0	**not lowering of subject but made enjoyable**
T23	1	0	0	0	0	is easier then all students will understand maths
T24	0	0	0	1	0	if made relevant to job search
T25	0	0	0	0	0	
T26	1	0	0	1	0	students would love it & become free to learn
T27	1	0	0	1	0	the easier maths is, the more relevant it will be
T28	1	0	0	0	0	the easier maths is, the more understandable
T29	1	0	0	0	0	if easy then everyone will understand it
T30	0	0	1	0	0	**maths not easy but needs practice**
T31	0	0	1	0	0	**maths will never be made easy**
T32	0	1	1	0	0	**maths not easy but approach**
T33	0	0	0	0	0	
	mot	*tcr*	*math*	*instr*	*cnstr*	81/99 (rating) seventh of 8
	18	**9**	**8**	**11**	**5**	

Appendix 1B2 'relevance' making maths passable

Disign.	*mot*	*tcr*	*math*	*instr*	*cnstr*	*explanation*
T1	1	0	0	1	0	for pupils to pursue math in tertiary
T2	1	0	1	0	0	**not passable but challenging & understandable**
T3	0	0	0	1	0	for application
T4	0	0	0	0	1	*still not passing*
T5	0	0	0	0	1	*unsure as still in implementation stage*
T6	1	0	0	0	0	for students support & motivation
T7	0	0	0	0	0	
T8	0	0	1	0	0	**maths should be applicable to daily problems**
T9	1	0	1	0	0	**not just for passing but for understanding**
T10	1	0	0	0	0	for independent & critical studentship
T11	1	0	0	0	0	for math to be regarded (as easy) as other subjects
T12	0	1	0	0	1	we are still lacking
T13	1	0	0	1	0	**once familiar pupils will participate more**
T14	1	0	0	1	0	to eliminate views that maths is difficult & for elite
T15	0	1	0	1	1	WAS aim:to pass without knowledge or application
T16	1	0	0	1	0	**students must relate maths to daily occurrences**
T17	0	0	1	0	0	*unsure passable means less challenging exercises*
T18	0	0	0	0	1	*depends on types of pupils one is teaching*
T19	1	0	0	0	0	when students like it, maths will be more passable
T20	0	0	0	0	0	
T21	1	1	0	1	0	more obtainable (in life) math, not threats of failure
T22	0	0	0	0	1	**must look at other aspects**
T23	0	1	0	0	0	if more teaching of basics dedication, more passes
T24	0	1	0	0	0	more enthusiastic & courageous teaching
T25	1	1	0	0	0	by marking working not answers in maths tests
T26	1	0	0	0	0	the more they pass, the more students love maths
T27	1	0	0	0	0	**more independent/accountable studentship**
T28	1	0	0	0	0	students should understand maths to pass
T29	1	0	0	0	0	passing will encourage everybody to do maths
T30	0	1	0	0	0	if better preparation, then students will pass
T31	0	0	1	0	0	**easy is not culture/identity of maths**
T32	0	0	1	1	0	**will have half-cooked individuals for life**
T33	0	0	0	0	0	
	mot	*tcr*	*math*	*instr*	*cnstr*	
	16	**7**	**6**	**8**	**6**	75/99 (rating) least popular out of 8

Appendix 1B3 'relevance' making maths more meaningful

Design.	*mot*	*tcr*	*math*	*instr*	*cnstr*	*explanation*
T1	0	0	0	1	0	will be better to apply maths in practical life
T2	0	1	0	0	0	meaning & not only calculations
T3	0	0	0	1	0	must be able to apply math in life to build economy
T4	1	0	0	0	0	more real & closer to the world of pupils
T5	1	1	0	0	0	groupwork & child-centredness for real & meaningful
T6	0	0	0	1	0	meaningless maths useless to pupils
T7	1	0	0	0	0	only if pupils are motivated
T8	1	0	0	0	0	only if meaningful that pupils will be creative
T9	0	0	1	0	0	meaningful only when related to life
T10	0	0	0	0	0	meaningful as used in daily life
T11	0	0	0	0	0	only when integrated "in totality with other subjects"
T12	0	0	0	0	0	meaningful to everyone in life
T13	0	0	0	1	0	meaningful when it can be implemented in life
T14	1	0	1	0	0	when relevant wont be new/foreign to pupils
T15	0	1	0	0	0	**WAS taught fragmented & no scaffolding**
T16	1	1	0	0	0	if meaningful, then maths will attract pupils' interest
T17	0	0	1	0	0	maths should be meaningful & accurate in its aims
T18	0	0	1	0	1	*sections like geometry are not meaningful at all*
T19	1	0	0	0	0	if maths is meaningful, pupils will like it
T20	0	0	0	0	0	
T21	0	1	0	0	0	CURRENTLY abstract
T22	1	0	1	1	0	pupils will be interested if know uses after matric
T23	0	0	0	1	0	pupils must see more applications of maths
T24	1	0	0	1	0	because students want to learn something practical
T25	1	1	0	0	0	learn how your learner calculates or solve problem
T26	1	0	0	0	0	students like to learn something meaningful
T27	0	0	0	1	0	to learn that maths will help them choose careers
T28	1	0	0	1	0	to be understood & used in daily lives
T29	1	0	0	1	0	to change attitudes/their lives revolve around maths
T30	0	0	0	1	0	encourages students to see importance of maths
T31	0	1	0	1	0	everyday demonstrations to make maths relevant
T32	0	0	0	1	0	that is why there arguments to make math practical
T33	0	0	0	1	0	students should correlate maths with life:counting...
	mot	*tcr*	*math*	*instr*	*cnstr*	
	13	**7**	**5**	**14**	**1**	96/99 (rating) second most popular of 8

Appendix 1B4 'relevance' making maths likeable

Disign.	*mot*	*tcr*	*math*	*instr*	*cnstr*	*explanation*
T1	0	0	0	1	0	to promote technology and science
T2	1	0	0	0	0	students must like maths in order to participate
T3	1	0	1	0	0	to be interesting & challenging for positive attitudes
T4	1	1	0	0	0	students must be motivated to learn maths
T5	1	0	0	1	0	math important for future in world of science & tech
T6	1	1	0	0	0	maths must be fun for students to love it
T7	0	0	1	0	0	learning should be a priority
T8	1	1	0	0	0	depends on attitudes & relationships of both
T9	1	1	0	0	0	need for positive attitudes that math attainable
T10	1	0	0	0	0	raising interest of pupils & assisting them
T11	0	1	0	0	0	by not making it seem too difficult
T12	1	0	0	0	0	encouraging pupils to take more responsibility
T13	0	0	0	1	0	only if they understand what they are doing it FOR
T14	1	0	0	0	0	to do away with fear of failing
T15	0	0	0	0	0	
T16	0	0	0	1	0	they will advance our country technologically
T17	0	0	0	0	1	the teacher can help but the love must be pupils'
T18	0	0	0	0	1	**pupils' preconceived ideas cannot be changed**
T19	1	0	0	1	0	students must like maths because it is daily function
T20	0	0	0	0	0	
T21	1	1	0	0	0	to be made palatable not difficult & felt to be for elite
T22	1	0	0	0	0	formulate ways to increase interest
T23	1	1	0	0	0	presented as monster/'vulgar' teacher drive away pup
T24	0	1	1	0	1	by presenting math lesson in systematic & logical
T25	1	1	0	0	0	varied presentation & consideration of how learned
T26	1	0	0	0	0	by eliminating superiority complex from math pupils
T27	0	0	0	1	1	black population lacks math & to be encouraged
T28	1	1	0	0	0	felt as monster because of poor teacher presentation
T29	0	0	0	1	1	so that everyone can get & benefit from maths
T30	0	0	0	0	1	government to contribute by rewarding passing
T31	0	0	0	1	0	if relevant to pupils' lives, pupils will like it
T32	0	0	0	1	0	*pupils free to choose although math is in all fields*
T33	1	0	0	0	0	to be encouraged to take maths
	mot	*tcr*	*math*	*instr*	*cnstr*	
	18	**10**	**3**	**9**	6	92/99 (rating) fourth of 8 in popularity

Appendix 1B5 'relevance' assisting in moving from known to unknown

Design.	*mot*	*tcr*	*math*	*instr*	*cnstr*	*explanation*
T1	0	0	0	1	0	that's the AIM of teaching, helping students venture into life
T2	0	0	1	1	0	applying (Math) knowledge into (future) tertiary institutions
T3	0	0	1	0	0	AIM as teacher: students to understand complex subject
T4	0	0	1	0	0	teachers must ALWAYS start from known to new matter
T5	0	0	1	0	0	should move from simpler to never exposed to before
T6	1	0	0	1	0	more practical work and creativity to encourage students
T7	1	0	0	0	0	students should be encouraged to discover
T8	0	0	1	0	1	*depends on students' comprehension & creativity*
T9	0	0	1	0	0	to equip students to solve complex problems
T10	0	0	1	0	0	start from basics to get deeper in the unkown
T11	1	0	1	0	0	it becomes easier and they understand math
T12	0	0	1	0	0	we should start from known material to new material
T13	0	0	0	1	0	to realise that math can be implemented
T14	0	0	1	0	0	for link and continuity in math
T15	0	0	1	0	0	for math to be meaningful, it must not be fragmented
T16	0	0	1	0	0	to unkown
T17	0	0	1	0	0	This helped
T18	0	0	0	0	0	*unsure*
T19	1	0	1	1	0	for students to understand math and want to go further in life
T20	0	0	0	0	0	agree
T21	0	0	1	0	0	math is only understood when associated with the known
T22	1	0	0	0	0	to increase strategies that will increase the love for math
T23	1	0	0	0	0	the abstract challenges and makes one eager to learn
T24	0	0	1	0	0	makes students follow math
T25	0	0	1	0	0	to reveal things that they did not know
T26	0	0	1	0	0	Teaching SHOULD move from known to unknown
T27	0	0	1	0	0	to see math as continuity
T28						unfilled
T29	0	0	1	0	0	for problem solving skills
T30	0	0	1	0	0	math IS a link subject
T31	1	0	1	0	0	math BUILD concepts on others, not to attract hatred
T32	0	0	1	0	0	prior knowledge needed in dealing with new knowledge
T33	0	0	1	0	0	nature of MATH to apply knowledge
	7	0	24	1		92/99 (rating) fourth of 8 in popularity
	mot	*tcr*	*math*	*instr*	*cnstr*	

Appendix 1B6 'relevance' clarifying maths subject

Disign.	*mot*	*tcr*	*math*	*instr*	*cnstr*	*explanation*
T1	0	0	1	1	0	**not ONLY as subject; develop science and technology**
T2	1	0	1	0	0	no interest if not seen CLEARLY as a subject
T3	1	1	1	0	0	students must be free so as to find math simple & interesting
T4	1	0	0	0	0	now even girls are encouraged to do math
T5	1	1	1	0	0	should create atmosphere where math is simple & real
T6	1	0	0	0	0	They must not take math as monster
T7	1	0	1	0	0	if the students background is considered, math can be fun
T8	0	0	1	1	0	everyday contexts can clarify math as subject
T9	1	0	0	0	0	so that math is not seen as for a selected few
T10	0	0	1	0	0	it is already a subject with its own principles
T11	0	0	0	1	0	in all subjects, there is math
T12	1	0	0	1	0	make them like math by relating it to everyday
T13	0	0	1	0	0	even if related, students wont see any difference
T14	0	0	1	0	0	AGREE
T15	0	1	0	0	0	*teachers already good at teaching math as isolated subject*
T16	0	0	0	1	0	**math must be seen as conquering life's obstacles**
T17	0	0	0	1	0	**students must see math as part of their lives**
T18	0	0	1	0	0	*These (relevance) too plays a role*
T19	0	0	0	1	0	to fight the poor economy
T20	0	0	1	0	0	AGREE
T21	0	0	1	0	0	There mustn't be any need to face math to do other subjects
T22	0	0	1	0	0	not to be made independent but to be made challenging
T23	0	0	1	0	0	students who are good in history should find math easy too
T24	0	0	1	0	0	AGREE
T25	1	0	0	0	0	*should encourage even slow students*
T26	1	0	1	0	0	most see it as a subject already, and one they hate at that
T27	0	0	1	0	0	most see it as a subject for the chosen few
T28	1	0	0	1	0	students must not fear math as it is useful in life
T29	0	0	0	1	0	students must be prepared to apply math in their daily lives
T30	0	0	0	0	0	*all subjects are as important as math*
T31	1	0	0	0	0	**they know it is subject but have developed -ve attitudes**
T32	0	0	1	1	0	*students should see math as challenging as life, not subject*
T33	1	0	0	0	0	teachers should stop being aggressive & vulgar: "stupid"
	mot	*tcr*	*math*	*instr*	*cnstr*	
	13	**3**	**18**	**10**	**0**	85/99 (rating) sixth out of 8 in popularity

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