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Learners' perspectives on the incorporation of the everyday in Mathematics

Sethole, Ismael Godfrey

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CHAPTER 1

BLURRING THE BOUNDARY BETWEEN MATHEMATICS AND THE EVERYDAY

INTRODUCTION

The first non-racial elections in South Africa, held on 27/04/1994, ushered in a government whose political framework is grounded on principles of democracy, non-racism and non-sexism. The 'rainbow people of the South' is a phrase popularized by Archbishop Desmond Tutu to describe the new post-apartheid South African society. The 'rainbow' metaphor captures both the different backgrounds of South Africans and the common non-racial values to which the nation should strive. Underlying both this rainbow metaphor, and the new South African political framework, is an implied intention to de-emphasize the boundaries or partitions which kept different races or population groups of one nation apart.

It is this quest for blurring the boundaries between different categories which is mirrored in the new South African Education curriculum, Curriculum 2005 (C2005). As stated in one of the early policy documents emerging in the post-apartheid education:

> In the past the curriculum has perpetuated race, class, gender and ethnic divisions and has emphasized seperatedness, rather than common citizenship and nationhood. It is therefore imperative that the curriculum be restructured to reflect the values and principles of our new democratic society.
>
> (DoE, 1997:1)

The substance of this statement is that an educational policy is embedded in and shaped by a political framework of a country.

Within a ten-year period (1995 – 2005), the new curriculum has already undergone two major waves of curriculum change. The first wave reached its peak in 1997 when the

first* education policy documents were publicized. It was followed, in 2000, by a second curriculum wave characterized by the publication of the Revised National Curriculum Statement (DoE, 2001). Both sets of documents signal clear intentions of blurring the boundary between:

1. The mathematics and the everyday and
2. The roles of the learner and teacher

It is necessary to step back and reflect on an historical perspective regarding mathematics and the role of the learner. Dating back to some ancient societies, mathematics was viewed as a special subject to which access was limited to a few. Volmink, for example, argues that the social arrangement of early civilizations were such that "only the rich, the powerful, the influential, had access to mathematical knowledge" (1993:123). Seleoane also observes that Plato's ideal society, the republic, was arranged in such a way that only people at the top, or the philosopher kings, "were taught thought-provoking subjects like mathematics, astronomy and dialectics" (1988:08). Apartheid education was also informed by intentions to reserve mathematics for a few. Dr. Verwoerd, the then Minister of Native Affairs, stated his views on the role of education and mathematics unambiguously:

> When I have control of native education, I will reform it so that natives* will be taught from childhood that equality with Europeans is not for them. There is no place for him (a black child) in European society above the level of certain forms of labour…What is the use of teaching a Bantu child mathematics when it cannot use it in practice.
>
> (Quoted by Khuzwayo, 2005:315)

Verwoerd's statement was about the way in which education was to be used as a means for preparing learners from different races for different roles in their lives. It is curious though, that mathematics is singled out as a subject which is irrelevant for a 'Bantu'

* A number of draft publications were issued in each wave of curriculum change. I use 'first' to distinguish this document from numerous education policy drafts produced between 1995 and 1997.

* The words Natives, Blacks and Bantu in this context are used interchangeably. Each refers to non-white South Africans.

child; as if to suggest that access to mathematics will enable access to a European way of life.

This study thus takes place within a context of political transition from an apartheid-informed education system to a new post-apartheid political context. In this chapter I briefly introduce arguments made in relation to the way in which South African education policy views the mathematics-everyday boundary on the one hand and the learner-teacher role boundary on the other. I will also outline arguments, within the mathematics education realm, in relation to the mathematics-everyday boundary. I will suggest that throughout these debates, the learners' voice on the consequence of shifting the boundary between the everyday and mathematics is silenced. This apparent silence is an angle through which this particular study enters the debate. The study does not purport to resolve debates or disputes around the mathematics-everyday boundary nor provide a representative learners' voice on this matter. However, the study intends to further illuminate and contribute towards these debates, informed by an interpretation of a learners' voice.

1.1 POLICY ON SHIFTING THE MATHEMATICS-EVERYDAY AND TEACHER-LEARNER BOUNDARIES

In the introduction above, I have separated the learner and the mathematics. However, Bernstein cautions:

> We should look at the way schools *select* subjects for the curriculum, the way they *teach* these subjects, and the way they examine them. These things tell us about the distribution of power in society. They also tell us about social control.
> (My emphasis)
>
> (Bernstein, 1975:85)

Bernstein suggests that in a school setting, there is a close link between what is learnt (content like mathematics) with how is taught (access to learners). Separating the learner and mathematics oversimplifies the complex way in which the two influence one another.

Notwithstanding this realization; I will keep the two notions separate, at an analytical level, in order to assist argument.

Boundary-blurring with respect to mathematics: With particular reference to contents (like mathematics); the first policy document announced the need to collapse the boundaries separating different school subjects. “This most radical form [of Outcomes – Based Education] implies not only that we are integrating across disciplines into learning areas but we are integrating across all learning areas in all educational activities.” (DoE, 1997:31). Along with this position was a name change of the subject Mathematics to Mathematics Literacy, Mathematics and Mathematical Sciences (MLMMS); suggesting that “the boundaries have been collapsed between pure and applied mathematics, and Statistics” (Adler, Pournara & Graven, 2000:2). The policy position and the name change signaled a de-emphasis on the uniqueness of mathematics and accorded it (mathematics) the same status as other subjects. This blurring of the boundary between mathematics and other subjects was coupled with another boundary-blurring: between mathematics and the everyday reality. In this regard, mathematics was defined as a “human activity that deals with patterns, problem-solving, logical thinking etc, in an attempt to understand the world and make use of that understanding”. (DoE, 1997:2). In this way, mathematics is construed as a subject through which reality is captured and not an isolated subject concerned only with itself.

Owing to public feedback and following the state-commissioned C2005 Review Committee, the boundaries between different learning contents were re-emphasised. For mathematics, this was symbolized by a name change from MLMMS back to Mathematics. It was also implied in a revised definition of mathematics as a distinct subject “Which has its own specialized language that uses symbols and notations for describing numerical geometric and graphical relations.” (DoE, 2000:16). At a pedagogical level though, the boundary between mathematics and the everyday remained blurred: “In teaching Mathematics” highlighted the policy document in an apparent reference to mathematics teachers, “try to incorporate contexts that can build awareness

of human rights, and social, economic and environmental issues relevant and appropriate to learners' realities." (ibid).

In sum, the rigid boundary in the curriculum between mathematics and the everyday ensured that the distinct nature of mathematics was realized; but in enabling access to this knowledge, the boundary between mathematics and the everyday was to be blurred.

Boundary-blurring with respect to the role of the learner: Both in the first and revised policy documents, the new curriculum views learners as active participants in knowledge acquisition. Therefore, whilst teachers are expected to be "professionally competent and in touch with current developments, especially in his/her area of expertise" (DoE, 2000:06), the statement further advises that teachers should be "open to views and opinions held by learners which may differ with his". This view challenges the asymmetric relationship between learners and teachers.

By presenting an argument in favour of a learner-centred pedagogy (Adler, 1998:04), the new curriculum has specified a new teacher-learner relationship and has therefore redefined the learner's role. Notwithstanding some concerns regarding the practical aspects of this pedagogy (Brodie, 1998:166; Nkhoma, 2003); it presents the learner as an active participant in the learning situation and not as a passive listener.

Though oversimplified, the above discussion suggests that the movement from apartheid education policy to post-apartheid education policy was informed by a shift in political paradigms. The development of post-apartheid education policy was, in addition, a result of public participation. As a result, "For the first time," brags the Revised National Curriculum Statement, "decisions were made in a participatory and representative manner" (DoE, 2001:08). What is silenced, ironically, is the learners' voice on the possible value or significance of curriculum change. In a new curriculum that creates space and encourages more active learner participation, one would anticipate some aspects of the curriculum to be informed by learners' concerns. It is on the grounds of this observation that this study emerges. In particular, I reflect on the learners'

perspectives on the value of incorporating the everyday in mathematics. I address this broad concern through a study guided by the key questions outlined in the section below.

1.2 KEY QUESTIONS FOR THE STUDY

Both in the title of the study and discussion so far, I have made reference to the 'everyday'. However, everydayness, as Moschkovitch (2002) and Arcavi (2002) argue, is contextual. For example, exploring the nature of mathematical patterns is an everyday activity for mathematicians (Moschkovitch, 2002:01). I use the term 'everyday' to refer to learners' out-of-classroom daily experiences. The term "everyday mathematical tasks" refers to mathematics activities which draw in or incorporate these out-of-school aspects.

There are various factors, within a classroom context, that may influence learners' perspectives about the role of the everyday in mathematics. One source of influence is the type of activities incorporated in mathematics texts used by learners. In this regard, Dowling (1998:43) asserts that pedagogic texts are not only produced for learners, they also produce learners. Following their study on the role and use of textbooks in improving the quality of education in schools, Crouch and Mabogoane (1997) concur that learning materials are amongst the most important predictors of cognitive development. The type of texts, activities and materials learners use thus shapes their views and perspectives about the content of the subject.

Within a classroom setting, however, teachers also play a role in what learners read and perhaps prioritize in a text. Though using the chalkboard as an example of a material resource, Adler (1998:14) suggests that it is not that the chalkboard is good or bad, "but how it is used, for what and for whose benefit". How a resource, like the mathematics textbook is used in the classroom, determines access or lack thereof to mathematics. In relation to this study, it is not simply the incorporation of the everyday but also its use, which may influence learners' perspectives about its role in mathematics learning.

The following key questions are based on the premise that both the everyday and its treatment in the classroom shape and are shaped by the learners' perspectives. These two aspects, the everyday and its treatment by learners are addressed respectively, by key questions 1 and 2. Key questions 3 and 4 are motivated by the need to summon learners' opinions on the inclusion of the everyday in mathematics. Question 5 focuses on the need to provide as coherent account of the sense made about learners' perspectives on the inclusion of the everyday in mathematics.

1. What type of the everyday is incorporated in mathematics texts used by learners? This question provokes a reflection on the nature of the context(s) recruited in activities and its relation to learners' experiences.
2. How do learners describe lessons in which the everyday is incorporated? The particular focus of this question is on whether learners foreground the mathematics content of the lesson and/or the everyday focus of the lesson.
3. How do learners reason and discuss mathematical activities which incorporate everyday knowledge? This question seeks to explore the way in which learners act and argue in class when faced with a mathematics activity which incorporates the everyday. The question will also explore the kind of written texts produced by learners in response to tasks that incorporate the everyday.
4. What value or significance do learners attach to the inclusion of the everyday in mathematics? This question seeks to find out whether and in what way learners find the incorporation of the everyday in mathematics enabling or inhibiting access to mathematics.
5. How can learners' perspectives on the incorporation of the everyday, as gathered in the first three key questions, be explained? This question will provoke a generation of a coherent theoretical account of the learners' perspectives on the inclusion of the everyday.

Debates around the relative merits and demerits of incorporating the everyday in mathematics have occupied mathematics educators for over 20 years. What it means to

incorporate the everyday in mathematics and its effects on the learning of mathematics remain largely unresolved. In the following section I elaborate on some of these debates.

1.3 WHEN THE BOUNDARY BETWEEN MATHEMATICS AND THE EVERYDAY IS BLURRED?

It is possible to discern two extreme positions regarding the effects of incorporating the everyday in mathematics. At the one end are studies and arguments highlighting the necessity and learning benefits of incorporating the everyday in mathematics (for example, D'Ambrosio, 1991; Santos & Matos, 2002); at the other extreme, are studies and arguments against (See, for example, Gellert, Jablonka & Keitel, 2001:57). These two extremes sandwich a range of studies which present a cautious inclusion of the everyday in mathematics. Whilst desiring the value of incorporating the everyday in mathematics, these studies acknowledge "that there are several conceptual and practical difficulties in this regard that first need to be addressed" (Volmink, 1993:122). This section elaborates and reflects on each of the three positions above.

Mathematics and its teaching should draw from the everyday

Critical mathematics education, ethnomathematics and realistic mathematics are some of the most notable perspectives which offer inspiration and a theoretical base for the blurring of the boundary between the everyday and mathematics. Though differently motivated, these perspectives engage the epistemological nature of mathematics (what mathematics is) and the pedagogic value of recruiting the everyday for teaching and learning purposes.

Critical mathematics education: Critical mathematics education is a perspective which argues for embedding mathematics within the socio-political context. One of the main postulates of critical education is that education should be a platform for developing a critical attitude among students towards a technological society (Skovsmose, 1994:338). Mathematics has the potential to both contribute towards democracy and deny informed

participation in democracy (Skovsmose & Valero, 2001). It is also central to technological development which is both beneficial and destructive to mankind. In this way, mathematics is seen as having lost its innocence. This point is stressed by Skovsmose and Valero (2001:52), "Mathematics cannot be assumed any more to be the 'queen of sciences', sleeping in the limbo of neutrality, a-sociality, a-morality, and a-politicy."

With regard to mathematics curriculum, Skovsmose emphasizes that the problems should relate to the fundamental social situations and conflicts and the students should be able to realize the problems as their own. He rejects the problems that belong to 'play-realities' with no significant purpose "…except as an illustration of mathematics as a science of hypothetical situations" (1985:338).

Inspired by Paulo Freire and some aspects of critical mathematics education, Mukhopadhay (1988) presented elementary mathematics teachers with an investigative task whose context had strong social implications. Students were required to sketch an equivalent of a popular doll, Barbie, according to real-life scale. Most students were familiar with the Barbie dolls because its distribution in class (to these students) sparked 'giggles and laughter in spontaneous sharing of numerous personal anecdotes of Barbie" (Mukhopadhay, 1998:156). On completion of the task, "the students recognized how shockingly different, even unreal and unnatural, Barbie looked compared to themselves". (Mukhopadhay, 1998:157). Barbie, they observed, had a pelvic area which is way too small to bear a child. This activity served as a model for validating the usefulness of mathematics beyond its usual abstract, context-empty existence.

Ethnomathematics: The concept of ethnomathematics draws from the realization that mathematics is practiced among different cultural groups and that its "identity depends largely on focuses of interest, on motivations" (D'Ambrosio, 1991:22) which do not belong to the realm of academic mathematics. Mathematics is thus seen as a by-product of various cultural groupings and practices. He views the rigid boundary between mathematics and other disciplines as largely Eurocentric. He argues, "It is preposterously

Eurocentric to try to identify mathematics or zoology or other disciplines as compartmentalized pieces of knowledge in different cultures, just as it is preposterously adult – centric to impose on young children these structured modes of explanation and of dealing with the world". D'Ambrosio's articulation views reality as the basis for developing mathematics.

Using ethnomathematics as a theoretical base for most of his research, Paulos Gerdes asserts that geometrical exploration constitutes the area of mathematical activity 'par excellence' in the history of Central and Southern Africa. These activities include hair braiding, basket weaving, tattooing etc. (Gerdes, 2001:03). The substance of Gerdes' argument is that ethnomathematics opens up a dialogue between mathematics and various cultural activities. As part of the Ethnomathematics Research Project at the Higher Pedagogical Institute in Maputo, Marcos Chirenda (1993) participated in a research project entitled a 'Circle of interest in ethnomathematics'. The study was aimed at showing student teachers that "it is possible to introduce mathematical concepts using artifacts of local traditions" (1993:142). The research team led pupils[*] to examine trajectory patterns of straw strips in artifacts such as hats, baskets and mats and observed that the creation of these geo-shapes heightened the pupils' confidence. As Chirenda argues (1993:147), "In this way, they begin to feel that the maths they learn at school also comes from their lives and society". Such examples, Chirenda claims, dispel the myth that mathematics has exclusively European roots. In a study that took place in the rural parts of Brazil, Knijnik (1993) reflected on the value of what she terms popular mathematics. She participated in the Landless Movement whose task was to "produce and market goods in the settlements" (1993:149). Working as a mathematics educator within this context, she was exposed to what she terms popular mathematics, which is part of cultural knowledge produced by subordinate groups and not legitimated by dominant groups. In this project, students who knew the popular methods were the ones who were assigned to teach them. This process allowed "the birth of a 'synthesis-knowledge', which is constructed by taking popular knowledge as its starting point, and which however, transcends it." (1993:152).

[*]Grades and/or ages of pupils who participated not specified.

Underlying both these studies is the value placed in recognizing and embracing cultural-based practices and activities in the teaching or learning of mathematics.

Realistic mathematics: Hans Freudenthal argues in favour of a mathematics curriculum which recruits the everyday in the teaching of mathematics. With respect to mathematics, he calls for mathematics fraught with relations, "I stressed the relations with lived-through reality rather than with a dead-mock reality that has been invented with the only purpose of serving as an example of application" (1973:79). With respect to the teaching of mathematics, he asserts that a mathematician should never forget that mathematics is not only meant for future mathematicians.

The Dutch school of Realistic Mathematics Education was developed along Freudenthal's ideas of mathematization, consisting of vertical and horizontal mathematization. Vertical mathematization consists of "formalizing students' constructions and productions, moving them towards generalities of content and method (Arcavi, 2002:21) and horizontal mathematization consists of "moving a problem from its context towards some form of mathematics" (ibid). Arcavi considers mathematization as a powerful idea to bridge the gap between everyday mathematics and academic mathematics because there is provision for students' idiosyncratic ideas to serve as springboards towards a more formal mathematics. The success of this approach, claims Arcavi, is backed up by "a respectable amount of evidence" (2002:22). What is not clear from the article, both in terms of describing the tasks or providing examples of tasks, is whether the nature of the context (dead mock reality or lived experience) matters or not. The crux of the arguments though, is that the learners' everyday realities have a role in their understanding of mathematics.

Even though critical mathematics education, ethnomathematics and realistic mathematics influenced a notable number of researchers in reflecting on the incorporation of the everyday in mathematics; there are other studies with similar agenda, which cannot be associated with any of these three perspectives. Boaler (1997) for example, draws from a

range of theoretical constructs (including Bernstein's) to relate a comparative analysis of two schools, Amber Hill and Phoenix Park. She particularly focuses on the different ways in which mathematics was taught at each school and the different forms of mathematical knowledge prevalent at each. At Amber Hill, "the individual 'contents' of mathematics were well insulated from each other". (1997:25). The lessons "conformed in terms of the explicit hierarchy which was established between teachers and students and the disconnection of **l**essons from everyday realities". (ibid). At Phoenix Park, the boundary between mathematics and other subjects was less distinct. Mathematics ideas were introduced as part of meaningful activities. Boaler (1997:81) concludes that:

> The Phoenix Park students did not have a greater knowledge of mathematical facts, rules and procedures, but they were more able to make use of the knowledge they did have in different situations. Furthermore, the students at Phoenix Park performed better than or the same as Amber Hill students in various applied situations, conceptual questions and within more traditional questions.

She does not make much reference to the type of activities in the two schools; however, the general implication of her study is important: Insulating mathematics may lead to underachievement of students in applied and more traditional questions. She elaborated this position in a more focused reflection regarding the implementation of reform-orientated curricular. She argued that reform-orientated curricula, exemplified by among others, the use of contextual tasks, can achieve a reduction in linguistic, ethnic and class inequalities in schools (Boaler, 2002).

Other studies motivate for the incorporation of the everyday in mathematics on the basis that such incorporation will lead to positive pedagogic spin-offs. Foxman and Beishuizen (2002) suggest that the use of contextual tasks provides a useful diagnostic tool for teachers regarding learners' difficulties in solving mathematics tasks. In their reanalysis of mental calculation strategies by a sample of 247 11-year olds in a national survey of schools in England, Wales and Northern Island; they observed that questions which recruited contexts encouraged the use of more informal strategies. Learners' engagements of these tasks, they conclude, "invite more informal strategies and more snapshots of

children's inadequate use of calculation strategies, which can give the teacher more clues on how to address them". (2002:67). The incorporation of contextual tasks is argued for on account of the pedagogic value they add. Similarly, though with a different focus, Garner and Garner (2001) compared outcomes of traditional and reform calculus in terms of students' retention of basis concepts and skills. Traditional calculus emphasized rote memory and symbol manipulation whilst reform calculus' emphasis was on conceptual understanding and practical application. They conclude that though the students' retention showed no significant statistical difference, reform calculus students retained better conceptual knowledge whilst traditional calculus students retained better procedural knowledge. Thus, the use of reform calculus on the one hand, and traditional calculus on the other, seem to lead to different outcomes.

The studies cited above highlight the different benefits likely to be secured from the use of tasks characterized by a blurred boundary between the mathematics and the everyday. There are other scholars whose argument for the incorporation of the everyday in mathematics is accompanied by a caution. In other words, these studies highlight not only the possible advantages of incorporating the everyday, they also emphasise the conditions under which these tasks should be considered.

Cautious incorporation of the everyday

In this section I elaborate on studies which, similar to those cited above, are sympathetic towards the notion of school mathematics which incorporate the everyday. However, these studies question or caution against the pedagogic benefit of such incorporation. These studies draw from a variety of empirical data and theoretical bases. In this section I distinguish between studies which

1. Draw from word problems
2. Draw from school and out-of-school experiences and
3. Question the feasibility of mathematization (as previously cited).

Word problems: With specific reference to word problems, Verschaffel and De Corte (1997) observe that there are some implicit rules and assumptions that learners need to

understand when “playing the game of word problems”. Non-awareness of these rules, they argue, may lead to ‘bizarre’ errors and reactions. As an example of such bizarre reactions, they make reference to some learners’ responses to the following task (1997: x): “Pete has three apples. Ann also has some apples. Pete and Ann have 9 apples altogether. How many apples does Ann have.”? Some of the answers provided by learners included “some apples’, “a few’ and ‘a couple’. Their argument is that whilst such responses are not totally incorrect, they are inappropriate for the context of word problem-solving in school.

Wiest’s (2001) study suggests that there are certain types of word problems which elicit creativity from children. Wiest focused on the use of fantasy contexts and real world contexts. She observed that students expressed interest in fantasy contexts and solved problems which incorporated this context better than tasks which incorporated real world contexts. She suggests that fantasy contexts should be included among those used for word problems in the teaching of mathematics since many children like fantasy. This observation is in stark contrast with Freudenthal’s call for the use of lived through realities. But it also highlights the different conditions under which various researchers view the possible success of context-based mathematics tasks.

In responding to mathematical word problems, De Corte asserts that school children believe that real world knowledge is irrelevant. In one of the studies involving items that drew from the real world, one learner expressed this belief, “Maths is not about things like that [real life aspects]. It’s about getting sums right and you don’t need to know outside things to get the sums right” (De Corte, 2000:37). This belief, according to De Korte, is also observable amongst teachers too, a finding which supports the view that the opinions about doing and learning mathematics of the teachers themselves “are at least partially responsible for the development in students of misbeliefs that have a negative impact on the regulation of their problem-solving approach and strategies”. (ibid).

These studies do not discourage the use of word problems in mathematics classrooms, however, they share a perspective that it should be coupled with attention to a number of

factors. These include the type of word problems used (see Wiest above) and the benefit of the context drawn in may be concealed to learners and some teachers.

School and out-of-school experiences: Civil and Andrade (2002) conducted a study which focused on the development of teaching innovations to promote students' learning of school mathematics by building on their knowledge and experience of the everyday. The subjects for the study were Mexican–Americans whose performance in mathematics was low. The researchers firstly tried to understand the learners' household background which they could use as the basis for developing the mathematics. They summarise their impressions from trying to make these connections: "As much as we enjoy the wealth of information that comes out of these household visits, we find ourselves constantly wondering about the connections to the teaching of mathematics in school" (2000: 156). The point made by Andrade and Civil is that school and out-of-school mathematics should be seen as different discourses, therefore blurring the boundary between these two categories may not be desirable.

That school mathematics and home mathematics, characterized by the everyday, should be seen as two different discourses is also supported by De Abreu, Cline and Shamsi's observations (2002). In a study involving 24 school children (Pakistani-British and White-British), their parents and teachers, they focused on the transitions between home mathematics and school mathematics. They point out the 'double character' of mathematics in these two environments. One of the conclusions they draw relates to the importance of viewing the home and school mathematics as different practices. This realization, they argue, enabled a mother to adjust her help at home in a way that was supportive of her child's success. "A clear contrast in Kashif's and Rachel's parents' accounts was their degrees of awareness of specific differences in their and their child's school mathematics. It was as if for Kashif's parents there was no transition between home and school mathematics, as if after you master a mathematical concept you could apply it everywhere" (2002:141).

In these two studies, the value of incorporating the everyday in mathematics is acknowledged. However, the conclusions drawn suggest that in order to succeed or cope with school mathematics, the everyday and mathematics should be viewed as two different discourses consisting of different rules of engagement.

Sullivan, Zevenbergen and Mousley (2003:118) draw attention not only to the "situation in which the mathematics is embedded" but to the "learning environment in which the task is used". They observe that the situation in which the task is embedded may be inappropriate or irrelevant to some learners. They write:

> We are not arguing that contexts should not be used; indeed we believe that contexts have much to offer. The issue for us is that the teachers need to be fully aware of the purpose and implications of using a particular context at a given time, to choose a context that is relevant to both the problem content and the children's experience, and to have strategies for making the use of the context clear and explicit to the students.
>
> (2003: 118)

Implicit in their argument above, is a consideration of and attention to some form of pedagogic practice in enabling engagement with tasks that incorporate the everyday.

In 2002, the three authors offered a more focused elaboration on the value of both the situation in which the mathematics is embedded and the learning environment in which the task is used. They make particular reference to a task which entailed the context of a bank robbery. This context was viewed as abhorrent to indigenous people by indigenous educators. A more appropriate context, they suggest, may have been a team of footballers or netballers. "Such a context was more likely to resonate with the students as this was an activity central to their life experiences," (Zevenbergen, Sullivan and Mousley, 2002: 527).

The central argument presented by Sullivan, Zevenbergen and Mousley is that two contexts are at play. The first one is the context of the task and the second one is the

classroom context. Both these contexts influence how the everyday or context is engaged in the classroom.

Feasibility of mathematization: In one of the studies previously cited, I highlighted Arcavi's argument wherein he viewed mathematization as one of the key concepts contributing towards explaining the merging of the everyday and mathematics. The studies that follow question the possibility of drawing generalizations from contexts. In other words, they question a process which resonates with horizontal mathematization as described by Arcavi(2002).

Brenner invited four teachers and their junior high school students to engage a worksheet which drew from the everyday context of Pizza. Her particular focus though, was on the take-up by teachers of this worksheet as it made new instructional demands on them. She observed that the invitation to use everyday mathematics incorporated into the Pizza unit was often declined by teachers and learners. " When this invitation was accepted," Claimed Brenner (2002:87) , "we began to see the kind of reasoning that we wanted to promote, in which students used the everyday or informal knowledge to support their problem solving…". Shortage of time led to the use of traditional recitation. The benefit to be derived from the everyday, the study implies, can be realized if the invitation to consider the everyday is accepted and there is sufficient pedagogic time.. Consideration of the everyday and subsequent movement from the everyday to mathematics is not 'a given'.

In a study whose participants were fifth graders, Civil attempted to find out whether a teaching innovation would enable students to advance in their learning of the prescribed school mathematics " in ways that are true to mathematicians' mathematics while building on students' knowledge of and experiences of everyday mathematics". (2002:47). Civil distinguished between school mathematics and mathematicians' mathematics. The former is characterized by an overreliance on paper-and-pencil computations, prescribed algorithms and clearly defined tasks; the latter consists of ill-defined tasks requiring persistence and collaboration with other mathematicians. She

observed that “students participated when the activity was related to the everyday mathematics but withdrew as the discussion moved to more formal mathematics”. (2002:51). Thus, the movement from the everyday to the mathematics was not welcomed.

Moschkovitch, unlike Civil and Brenner (cited above) does not reflect on the difficulty of moving from the everyday to mathematics. However, she illustrates that the classroom situation shapes the sense that learners make of context-based mathematics activities. She carried out a project which linked the use of mathematics activities as a result of which students “might engage during the course of their present daily lives or to future activities in which students might engage as adults at work” (2002:95). The participants in her study (The Antartica Project) were seventh-graders. She focused on ways in which different classroom settings shape mathematical activities. She presented students with expanded mathematics activities beyond traditional school mathematics problems. These activities involved solving open-ended problems, applying mathematics to real world problems and communicating about mathematics (2002:97). One of the observations she made is that “ the nature of students’ mathematical activity, however, depends not only on the curricular activities used in the classroom but also on the nature of the classroom practices, especially on the didactical contract between the teacher and students” (2002:107).

Inclusion of the everyday is not necessary

I began this section by citing ethnomathematics, critical mathematics education and realistic mathematics education as notable (but not only) perspectives upon which arguments in favour of incorporating the everyday in mathematics hinge. With respect to critical mathematics education, Skovsmose admits that the use of the everyday tends to conceal the mathematics. It is for this reason that he argued for mathematical archaeology (1994: 151). With regard to realistic mathematics education, I will elaborate on arguments in this section, in which the use of ‘lived-through experiences’ is not regarded as significant. With regard to ethnomathematics ; Rowlands and Carson (2002) argue that it is only through the lens of the formal academic mathematics that the real value of mathematics inherent in different cultures can be understood. They view mathematics as

a universal subject which "transcends the civilizations of Ancient Greeks and China, the France of Pascal and it is this universalism that has to be emphasized in the classroom, rather than the geometrical patterns in traditional crafts, for example" (2002:98). The literature below is organized according to arguments which suggest that

1. It is the context within which the activities (which draw from the everyday) are engaged, that influences the quality of learning and
2. The everyday inhibits access to mathematics

Context of engagement has more influence than the everyday: Saljo and Wynhamn (1993) challenged 332 Swedish students to determine the cost of posting a letter. The students were provided with an official table of postage rates from the Swedish post office. The results of their study suggest that this task is interpreted as a mathematics task in a mathematics classroom and as a non-mathematical task in a social studies classroom (1993:332). Therefore, it would seem that, learners in a mathematics classroom most likely regard the tasks as mathematical in spite of these being presented in a form of everyday tasks.

In a non-teaching context, Cooper and Dunne (2000) present a discussion which focuses closely on the way children engage mathematical tasks that include the everyday - what they refer to as the 'realistic' items (2000:03). They note that one child, from a middle class family, is able to negotiate the esoteric/everyday boundary appropriately (2000:67). This seems to suggest that this child treats some 'realistic' problems as "…merely differently presented exemplars of standard arithmetic problems". The inclusion of the everyday, for this particular child does not seem to evoke the 'everyday' response. Consequently, the inclusion of the everyday does not seem to have any effect in the way this child engages the mathematical task. If the 'everyday nature' of a mathematical task does not seem to influence the way the learners engage with the task; then the effect of, and the bearing that the everyday has on the learning of mathematics does not seem clear. In contrast, Cooper and Dunne (2000) observed that a working class boy was not able to demonstrate his combinatorial competence by negotiating the boundaries between the

esoteric and the everyday in one item (2000:67). In general they noted that working class learners are more likely to draw inappropriately from their everyday knowledge when they respond to realistic items. In this respect, the inclusion of the everyday seems to inhibit the acquisition of mathematics by working class learners.

The main argument flowing from studies by Cooper and Dunne (2000) and Saljo and Wynhamn (1993) is that it is much more than the everyday in the task which determines whether or not it (the everyday) is taken seriously. In other words, the production of a legitimate response in relation to performance, and not so much a task itself, influences the way learners interpret, engage and respond to the task.

The everyday inhibits access to mathematics: Floden, Buchman and Shwille (1987) maintain that it is necessary that school mathematics remains separate from the everyday. They suggest that the everyday restricts the students' scope of vision, it exaggerates reliability and importance of close to home experience in the learning of mathematics and this makes it difficult to understand the academic disciplines. This point is elaborated in a different study whose focus was on students' arguments in explaining conceptions of division by zero. In this particular study, Tsamir and Sheffer (2000) observed that secondary school students justified, on the basis of concrete situations, that division by zero results in a number. The students did not seem to notice the irrelevance of the everyday as an explanation for this operation (division by zero). Drawing from the context of language, Pimm (1987) explores the effect of 'borrowing' everyday English words in creating a mathematics register. He makes particular reference to Tall's investigation of first-year mathematics undergraduates' interpretation of words such as *some* and *all*. His finding is that the students regard these terms as contrastive rather than inclusive i.e. *some* entails *not all*. Thus, the statement 'some rational numbers are real numbers was regularly judged to be false because all rational numbers are real numbers (Pimm, 1987:79). Even though he is not against the 'borrowing' of English words, Pimm's argument suggests that the use of the everyday may serve as barriers towards mathematics.

In Britain, a popular text series used by students includes four sets of mathematics textbooks; the Y (yellow) series, the R (Red) series, the B (blue) series and the G (green) series. Paul Dowling (1998) analyses the Y series (a scheme for the highest achieving students) and the G-series (a scheme for the lowest achieving students) of school mathematics textbooks, SMP 11-16. From his analysis, he notes that the G-series contains numerous examples meant to model the everyday. By contrast, the Y-series are characterised by the language and form of the esoteric discourse in which the reader is invited to join an international community of mathematicians. His principal argument is that the use of G-series books serves more as a stumbling block towards an understanding of mathematics. The users of the G-series are led towards a "different direction" to that of community of mathematicians. Thus, rather than enabling connections and greater mathematical meaning, these learners are effectively denied access to mathematics learning.

The preference of authentic problems over play-realities as a platform for learning school mathematics is also not viewed favourably by De Jager and De Jager. In defending their use of artificial tasks for their textbook calculus chapter, De Jager and De Jager (1985): argue that the purpose of the calculus chapter in their school textbook is to help students to develop certain skills. They elaborate (1985:199), " If they (the tasks) are not very 'real-life', it will be a pity, but not a disaster, but if they are very 'real life' and develop no skills in dealing with the problems you may meet later, that will be a disaster". De Jager et al value the development of mathematical skills more than the use of authentic context. In this regard, mathematics skills are foregrounded over the use of mathematics in lived reality and its use in acting out in social reality.

What these studies share is an epistemological approach where boundaries around varying types of knowledge are foregrounded. The main argument presented is that the epistemological boundary between the everyday knowledge and mathematics is significant and cannot easily be traversed in learning.

The above section has provided literature whose arguments with respect to the incorporation of the everyday in mathematics can be categorized into three: for, cautious and against. The benefits of drawing upon the everyday in mathematics, as implied in the arguments above, include accessibility to mathematics by making use of the familiar contexts that learners can relate to. A contrasting but equally justifiable argument is that drawing upon the everyday to represent or communicate mathematics ideas may delay or deny learners' access to the body of knowledge that mathematics represents. A third argument supports the inclusion of the everyday with a variety of cautions. Where does a mathematics curriculum in a post-apartheid South Africa, a country in which access, equity and meaning in education are desired goals, stand in these arguments? This question is explored below.

In South Africa

Long before the 1994 democratic elections, concerns were expressed by some mathematics educators over what they considered a "very formal and highly abstract" and "decontextualised" (Adler cited in Christie, 1991: 287) school mathematics curriculum. One way of making the school curriculum less abstract and more meaningful was by situating it in "the realm of everyday experiences of people" (Volmink, 1993:123). In this section I reflect on South African studies, considerations and arguments which relate to the effects of a blurred mathematics-everyday boundary. The influence of Freudenthal (realistic mathematics), Skovsmose (critical mathematics education) and D'Ambrissio (ethnomathematics) can still be discerned, respectively, in the establishment of REMESA[1], the Ethnomathematics project at RADMASTE[2] and the South African studies with a critical mathematics education orientation (Vithal, 2001 & Kibi, 1993). The structure of my argument in the remainder of this chapter will still be on studies which provide arguments for, cautiously for and against the incorporation of the everyday in mathematics.

[1] REMESA is an acronym for Realistic Mathematics Education in South Africa. It is led by Prof. Cyril Julie and operates from the University of the Western Cape in South Africa.

[2] RADMASTE is an acronym for Research and Development for Maths, Science and Technology Education. The ethnomathematics project, led by Prof Paul Laridon, was one of its projects.

Arguments for: The following two studies present different versions of the everyday. In one study the everyday is a cultural game whilst in the other it is a contrived situation. In an study involving three Grade eight and one Grade nine learners, Mosimege (1998) explored the use of a game, 'string figures', with the intention of reflecting on how games could be used for teaching mathematics. The use of this game at classroom level, he acknowledged, needed more time "beyond the usual one or two 30 minutes periods allocated for mathematics lessons" (1998:283). He also observed that "students tend to be more engrossed in the playing than the learning process" (1998:284). These challenges notwithstanding, Mosimege's stance on the use of games in mathematics classes is unambiguous: "The fact that ultimately, after some probing, the students were able to mention some mathematics concepts that were related to the game showed that there is a definite use for games in mathematics lessons" (1998:284). Adendorf and Van Heerden (2001:58) argue for the inclusion of the 'everyday situations' in the teaching of functions. Their particular interest was in relation to the function $y = ax^2 + c$ in everyday settings. They argue that this function can be used to describe number patterns on AIDS, the number of AIDS victims, car accidents and netball. The basis of their argument is that the use of the everyday situations "could be used to change apathy within students, stimulate interest and allow them to see a much clearer picture as to why they need to know something about the parabola" (2001:58).

Cautious incorporation of the everyday: Mogari (2001) and Vithal (2003) engaged learners in activities which required hands-on participation. They both caution against the way in which such activities may spark gender issues in the classroom. Mogari's study involved a hands-on design of a chassis for a wire car by Grade nine pupils. The mathematical value of this exercise was that "constructing the chassis of a wire car can be used to teach properties of a rectangle" (2001:205). However, he also observed that there seemed to be a belief amongst the pupils that this activity was meant for boys. In explaining this observation, Mogari asserts that boys perceived their female counterparts as inferior and unable to carry out rigorous and rough assignments such as constructing wire car artifacts. Vithal also explored what happens in a classroom when an attempt is made to realize what may be called a social, cultural, political approach to the teaching of

mathematics. In her study, two Grade six learners at different schools participated in two different projects. One class participated in a project titled the "redesigning of an agricultural garden" whilst the other class participated in a project titled "'fence building". In both activities, Vithal observed that the participation of girls was limited. She thus cautions that summoning activities which connect with learners' lived experiences, " teachers have to also deal with the 'non-mathematical' aspects that are carried in the task, content or learning material. This means that issues, such as gender, need to be addressed in the mathematics classroom" (2003: 372).

Mogari and Vithal made their observations in different contexts, both of which involved hands-on activities. It could be argued that gender issues arose not only due cultural beliefs about the roles of boys and girls but because the activities themselves resonated more with the boys' experiences and perhaps this disadvantaged or limited girls' participation. This argument notwithstanding, the caution regarding being sensitive to gender issues seems to be valid.

Nyabanyaba also highlights the need to be aware of instructional challenges that may arise due to bringing in the everyday in the mathematics classroom. He explored the way in which a context to which learners were familiar could be engaged in a mathematics classroom. The relevant context he recruited was a 'real' soccer log table. The substance of the task was for learners to predict, on the basis of the log standings, which soccer team would ultimately win the league. The exercise had the potential to elicit non-mathematical responses and arguments since soccer is the most popular sport amongst South Africans. The teachers indicated that they would not accept answers which are based on learners' everyday knowledge of South African soccer teams. However, " there was no clear indication from this study that teachers were aware of how they could assist their students across difficulties created by the use of relevant everyday contexts in school mathematics" (Nyabanyaba, 1999:24). Thus, Nyabanyaba concludes that for the new curriculum (Curriculum 2005), there should be a move from merely advocating for relevance to practically engaging teachers with the tensions of summoning the everyday.

Moodley's (1992) study was more on the learners' responses to word problems. Earlier on page 13 I elaborated on the way in which some researchers cautioned against the use of word problems. Moodley also observed that the use of word problems may not provoke reflection about the everyday amongst learners. Moodley (1992) shared his experience about a learner David, who swiftly completed eight word problems. "When asked how he managed to read (so quickly) the whole page of word problems," Moodley outlines, "he admitted he hadn't, but had simply looked for the larger of the two numbers in each problem and subtracted the other" (1992: 06). The substance of Moodley's argument is that some learners treat the everyday incorporated as a smokescreen which they need not pay attention to. He however, suggests that relentless attempts should be made to "help them [learners] to learn and enjoy mathematics-through making their experiences painless, meaningful and exciting" (Moodley, 1992: 14).

For learners and teachers, these studies suggest, summoning the everyday poses new challenges.

Arguments against the incorporation of the everyday: Though at a theoretical level, Muller and Taylor (1985) provide an account of limitations associated with "border crossing" and a "generally educated interdisciplinary man". Drawing on theoretical constructs by Durkheim, Bernstein and Bourdeou, they highlight two points. Firstly they acknowledge that for apartheid education, " writing of syllabi and textbooks was tightly controlled within white education departments and all interested actors outside the ruling party were excluded from education" Secondly, they note that the post-apartheid mathematics curriculum is guided by a hybridist model, which aims to flatten the boundary between the everyday and the mathematics. They argue that this hybridist model achieves a condition of 'false equality' between domains and participants and thus will not fare better than the discriminatory elite curriculum it is designed to replace. Taylor (1999) echoes this point again with a focus on mathematics: While admiring the political intentions of the radicals [of wishing away the boundaries], our contention is that the effects of this approach will be exactly the opposite of what is intended". The crux of Muller and Taylor (1985) and Taylor's (1999) arguments is that far from there being

benefit to be derived by removing the boundaries, there are increased dangers or threats to equity.

Murray (1992) and De Jager (1996) also argue for the maintenance of boundaries between certain content areas (negative numbers and probability) and the everyday. Murray cautions against the use of concrete or semi-concrete contexts such as debt to introduce negative numbers. She observes that the need for negative numbers did not arise out from physical context but from mathematics itself, especially in order to "determine solutions to equations such as $x + 3 = 0$" (1992:287). She particularly discourages the analogy drawn between 'film of a train going backwards is played backwards so the train moves forward' and the operation negative times negative is positive. De Jager (1996:127) also finds it nonsensical to use experiments for determining the probability that "if an event can happen in n ways and p of these are favourable, the probability that the result will be favourable is p/n". He explains this statement in less abstract terms, "If you spin a fair coin 10 times and it is heads 8 times, it means that it was 8 times out of 10 in that case, and that is all it means." De Jagers's view is that experiments are not meant to be the bases for deducing theory but to test predictions. Therefore the everyday exercise of spinning a coin will have no influence on the already established ratio or probability for a particular event.

In sum, the nature of studies cited in this section differed; some were based on empirical observations whilst others were mainly theoretical. As varied as they are, a selection of literature elaborated above suggests that the effect of the everyday on mathematics yields no single answer. Some studies suggest the everyday will enhance the learning and teaching of mathematics, other studies view the everyday as an obstacle whilst others advise for the inclusion of the everyday with caution.

What is constant across all these theoretical and empirical studies, however, is that learners' perspectives have had little influence in informing the debates on the effect of the everyday on mathematics. Will the effect of the everyday on mathematics, from the learners' perspectives be as varied? This study aims to describe, analyse and explain

South African based data through which this question may be engaged. In the next section I outline how the chapters in this study will be organized.

1.4 CONCLUSION

In this chapter I have illustrated how the everyday has entered the curriculum at the level of education policy development in South Africa,. I have also reflected, through the literature reviewed, on debates around the consequences of including the everyday in mathematics. How the incorporation of the everyday shapes both the mathematics and its learning is a contested terrain pregnant with varied studies, findings, discussions and viewpoints.

This study is motivated by what is silenced in both the policy discussions in South Africa and debates within the mathematics education field cited: The learners' perspectives. It is a study which intends to add to and illuminate the mathematics-everyday discussions from the learners' perspective.

In the following section I highlight how the chapters in this study are organized.

1.5 ORGANISATION OF THE STUDY

The argument in this study is divided into three main sections. The first section (Chapter 1 to Chapter 3) is an orientation to the theoretical and methodological aspects of the study. The second section (Chapter 4 – Chapter 6) provides a detailed account of experiences at one school, Umhlanga, and the third section (Chapter 7 to Chapter 9) focuses attention on another school, Settlers.

In Chapter 2, I start by sketching and reflecting on a theoretical framework. I define the theoretical framework which enables me to select and focus on particular aspects of my experience, at each of the schools, as theoretical framework *a priori*. Such a framework drew mainly from Bernstein's code theory (1996), particularly the notions of framing and

classification. This framework, however, did not offer sufficient language to describe data collected. I therefore complemented it with Dowling's (1998) notions of describing mathematics texts (expressive, esoteric, public and descriptive domains). I introduced additional concepts to describe the different ways in which the everyday could be viewed and called this extended theory a posteriori.

This study forms part of a larger study, named the Learners' Perspective Study (LPS) for which data collection was a collaborative effort with other researchers. In Chapter 3 I outline how I negotiate my research interest within the constraints of this larger study. Since the empirical base for this study entails thick descriptions of classroom events and learners' reflections on aspects of classroom events, Chapter 3 discusses the implications and assumptions of collecting data in this way.

Chapter 4 introduces and describes one of the two schools, Umhlanga. Detailed attention is drawn towards the broader aspects of the school: the physical structure and organization of the school, all the nine lessons observed and the worksheets used during these lessons. Even though it is the classroom events of some of these lessons which are of direct interest to the study, the broader perspective highlights the ways in which these lessons fit within the school's events. Chapter 5 narrows down the discussion to lessons which incorporated the everyday. Within a maze of classroom events in each of these lessons, I pay more attention to the way in which the teacher introduces or privileges the everyday aspects incorporated in a text and how a group of learners (different group each day) engage the worksheets. It is in this chapter that the limitation of Bernstein's concepts of weak classification in relation to the incorporation of the everyday in mathematics begins to surface. I therefore introduce and argue for the use of notions such as authentic/inauthentic and close/far (which I will elaborate on in the next chapter). In Chapter 6, I explore learners' views on what they thought each of the lessons entailed, whether they welcomed the use of the everyday in mathematics and what the role of the everyday in the lesson was. I try to explain the learners' views from drawing on the broader context in which they experienced the everyday, including the teachers' presentation of the lessons and views on the role of the everyday.

Chapters 7 to 9 parallel Chapters 4 to 6. In this way, I am able to capture and make sense of the different ways in which learners experienced their lessons. In Chapter 7 I introduce and describe another school, Settlers. This school is significantly different from Umhlanga. I describe the physical structure of the school, all the fourteen lessons observed and the worksheets used. It becomes apparent during the analysis, that the everyday used in Umhlanga and the everyday recruited in Settlers are entirely different from each other. The authentic/inauthentic and close/far notions introduced developed in Chapter 4 cannot be employed unproblematically in Settlers' lessons and worksheets. I thus complemented my theoretical constructs by appealing to Dowling's notions of text descriptions: esoteric, expressive, public and descriptive. Chapter 8 zooms in on lessons in which the everyday was recruited. I focused on how the teacher balanced the everyday-mathematics aspects and the way in which learners at this school engaged the worksheet. Given that the everyday incorporated in the two schools differ, I try to draw parallels on how the teachers introduce the everyday and the way in which learners engage activities which incorporate the everyday. Chapter 9 explores Settlers learners' reflections about the lessons, whether they welcomed the use of the everyday in mathematics and the role of the everyday in mathematics. Similar to Chapter 6, I reflect on and explain these experiences against the broader context in which learners experienced the lessons.

Chapter 10 develops and makes claims on the basis experiences drawn from the two schools. I use the word 'develop' to suggest that these claims are founded on systematic observations, though they are themselves subject to interrogation. I draw these claims on the basis of both methodological and theoretical aspects of the study. I also reflect on the study as whole; outline the possible weaknesses and suggest alternative ways of investigating the same phenomena.