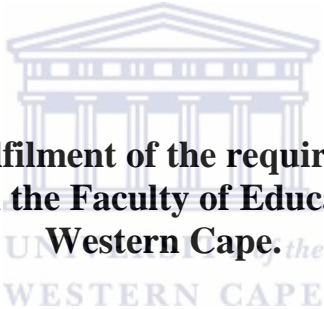


CROUCHING LEARNERS, HIDDEN VALUES:

Values in school Mathematical Literacy lessons.

SHEENA RUGHUBAR-REDDY



**A thesis submitted in fulfilment of the requirements for the degree of
Doctor Philosophiae in the Faculty of Education, University of the
Western Cape.**

Supervisor: Professor C. Julie

November 2012

KEYWORDS

Values

Values education

Mathematical Literacy

Policies

Integration

Teaching

Curriculum

Identify

Implement



ABSTRACT

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Sheena Rughubar-Reddy

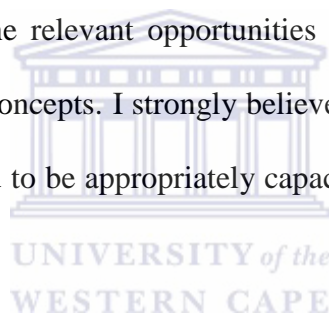
School of Mathematics and Science Education, University of the Western Cape

Local and international pundits concur that education systems play a pivotal role in fostering and developing values in learners. In some countries, like South Africa, the values and rights enshrined in the Constitution and the Bill of Rights resonate in the Schools Act. As one of the concerns of education is nation-building, my study investigates if the integration of the values does achieve tolerance and co-operation in the classroom by examining how learners make sense of values in the Mathematical Literacy curriculum. While I firmly believe that educational institutions have a responsibility to integrate positive values into all aspects of the school curriculum, it is my contention that learners cannot fully benefit from values specifically related to the Mathematical Literacy curriculum itself on their own. All stakeholders in education need to come together to establish an informed understanding of policy documents and reconcile the complexities and challenges that surround the transmission of values, so that educators will be able to assist learners in a meaningful way.

The classroom life of a learner is intricately woven with that of the teacher. In order to unearth the views and practices of learners and teachers, I adopted a participatory approach. The qualitative study that ensued was conducted in three

Mathematics Literacy classrooms at secondary schools in Cape Town, South Africa. The observation sessions afforded me the opportunity to experience and appreciate how the teachers integrate values into the Mathematical Literacy lessons while observing learners' behaviour in the classroom. The interactions and interviews with both learners and teachers aided in further unravelling their understanding and implementation of values in the Mathematical Literacy lessons.

For learners to develop into responsible, caring and morally just citizens who are capable of critical thought, they require an education that provides them with the necessary opportunities and tools to develop. Mathematical Literacy is able to provide learners with the relevant opportunities and thinking tools to construct meaning around moral concepts. I strongly believe that for learners to accomplish this goal, educators need to be appropriately capacitated to facilitate opportunities for their learners.



I did not find any evidence in the literature that suggests a fail-safe theoretical approach to success in values education. I am of the opinion that for any measure of success in values education, a combination of these theories of learning and moral development has to be employed.

DECLARATION

I declare that *Crouching Learners, Hidden Values: Values in school Mathematical Literacy lessons* is my own work, that it has not been submitted before for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged as complete references.

Sheena Rughubar-Reddy

Signed:



November 2012

DEDICATION

This thesis is dedicated to

My beloved husband

DEENADAYALAN REDDY

for making the impossible, possible;

My beautiful daughters

SANUSHA & VIRATA JUGOO

for giving me the priceless gift of motherhood

&

My students,
past & present,
for being my teachers

ACKNOWLEDGEMENTS

Kind words can be short and easy to speak, but their echoes are truly endless.
-Mother Teresa

All glory and honour belong to my Higher Power & guru, Sri Sathya Sai Baba.

I wish to thank the following persons who made this project possible:

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Vera Frith, Robert Prince, Pam Lloyd, Kate le Roux, Jacob Jaftha, Duncan Mhakure and Jumani Clarke for giving me the time and space needed to complete my thesis and together with Nomphele Lungisa for encouraging and supporting me when the world around me was crumbling.

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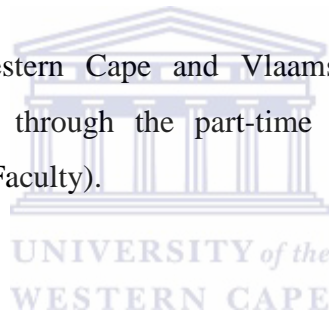
My mum, Prem Rughubar, together with Vivesh Rughubar, Rayan Rughubar, Arveen Rughubar, Premila Srikiissoon, Harsha Kathard, Priya Singh and Upasana Srikiissoon for their love, encouragement and support always.

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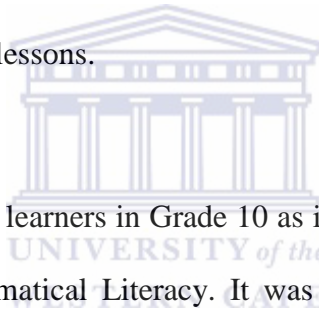
CHAPTER ONE

At the beginning

Human life is a combination of morality, spirituality and righteousness. - Baba

1.1. Introduction

As one of the concerns of education is nation-building, this study sets out to investigate if the integration of the values does achieve tolerance and co-operation in the classroom by examining how learners make sense of values education in the curriculum. The study specifically investigates how learners understand, identify and implement values inherent in the Mathematical Literacy curriculum and lessons.



I decided to focus on the learners in Grade 10 as it was the first time that they were exposed to Mathematical Literacy. It was also the first time that the teachers were teaching the subject. At this stage of schooling, learners' ages range between 15 and 17 years. The theories of moral growth as proposed by Piaget (1932) and Kohlberg (1976), suggest that the use of logic in moral reasoning starts with learners aged 7 to 11 years while the adolescent stage (older than 11 years) brings cognition to its final form. Hence, I wanted to observe how the learners at this level assimilate values evident in the Mathematical Literacy curriculum.

In this chapter I explore the context and rationale of this study. An exposé of the context will enable a clearer understanding of both the results and analysis

that unfold in the study in later chapters. Furthermore, I will present the key research questions that guided this study, together with the rationale for the study, drawing on the research literature on values education and values in mathematics education. This will be followed by an outline of the practical significance of this study and the limitations that I stumbled upon during my journey. The chapter concludes with a summary of the chapters that follow.

1.2. The context and rationale behind the study

Over the years values education has been a contentious issue in many countries around the world. The main bone of contention is that there does not appear to be any significant results illustrating the impact values education has made on society. Values education has never been given the same status as other subjects in the school curriculum. Academic excellence, technological advancement and industrial development have driven the direction of the educational system. Ethical challenges experienced by society are still on the increase.

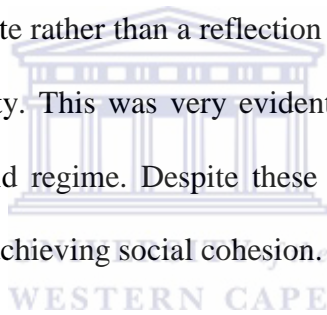
It is important to note that the general consensus is that schools ought to play a vital role in the moulding of children's character. In February, 2001 the Department of Education held a conference in Cape Town entitled: *Values, Education and Democracy in the 21st Century*, in which concerns about the role values play in our education system and the need for these values in the quest for nation-building were expressed (Asmal, 2002; Morrow, 2002; Chisholm, 2001; Nkomo, 2001; Waghid, 2001; & Jansen, 2001). Kader Asmal, voiced his observations as the Minister of Education at the time,

... because a clearly-articulated value-system to which everyone subscribes is absent from our places of learning, fundamental human rights are being violated everyday in our classrooms (Asmal, 2002:5).

Issues associated with a high crime rate, drug abuse, poor discipline (within and outside school) amongst the youth, and a diversified society led to the conference delegates identifying the gaps in the education system of the time and the need for values education.

An issue of contention is that the transmission of values may result in moralizing, indoctrination and “authoritarian forms of imposition” (Morrow 2002:21). It must be remembered that the majority of South Africans were victims of apartheid. A characteristic of this era was the attempt to curtail critical and creative thinking amongst sectors of the population. This pervasive and malicious form of governance was very evident in education (King & Van den Berg, 1991). The history textbooks reveal that the first schools in the country were established by missionaries. Since churches funded these schools, they also determined the curriculum which was Christian in nature. Christian National Education, the educational philosophy of the day (pre-1994), saw the child as a “non-adult ... en route to that point where he will live the life of a proper adult” (Ashley 1989:10) while the teacher was considered as “one of an authority ‘ ... not afraid to exert authority over the young” (Ashley 1989:11). This accentuates the notion of an ‘adult’ moulding the ‘non-adult’ where a learner (child) should not express an opinion without the approval of the teacher (adult).

Whilst national values address issues of nation building, Christianity promotes a specific religious belief. Despite the fact that Christian values are useful in the moral development of a nation, it must not be forgotten that the South African population comprises of various ethnic and cultural groups, some of whom ascribe to very traditional value systems while others are more modern. Values education has always been a contentious issue since teachers have to work in multiethnic and multicultural contexts. In addition, the values curriculum has featured in varying forms ranging from Right Living to Guidance in the school timetable, without much success. The values education curriculum has largely been skewed in favour of the beliefs, culture and ideology of the ruling elite rather than a reflection of the diversity prevalent in the South African society. This was very evident during pre-1994, with the practices of the apartheid regime. Despite these concerns, values education may hold the answer to achieving social cohesion.



The post-1994 era has seen the birth of a new Constitution (1996) and a transformed South African educational philosophy called Outcomes Based Education (OBE). Central to OBE is the latest version of the Curriculum 2005, namely, the Revised National Curriculum Statement (RNCS). The National Curriculum Statement Grades R-12 (Department of National Education, 2002b) is based on the principles of human rights, inclusivity, environmental and social justice while infusing the principles and practices of social and environmental justice and human rights as defined in the Constitution of the Republic of South Africa. It is sensitive to issues of diversity such as poverty, inequality, race, gender, language, age, disability

and other factors. Within the RNCS teachers are projected as “key contributors to the transformation of education in South Africa ... dedicated and caring ... mediators of learning” (Department of National Education, 2002b: 3). At the same time the learner is seen as one who adopts the values of

... democracy, equality, human dignity, life and social justice. The curriculum seeks to create a lifelong learner who is confident and independent, literate, numerate, ... compassionate, with a respect for the environment and the ability to participate in society as a critical and active citizen (2002b: 3).

Curriculum 2005 requires educators to instil in learners knowledge, skills and values. The Critical Outcomes require learners to be able to work effectively as a team, organisation or a community, while the Developmental Outcomes seek to produce responsible and sensitive citizens. Vital to this development, are the values that give meaning to the individual’s spiritual and intellectual journey. The National Curriculum Statement (Grades 10-12) for Mathematical Literacy (Department of Education, 2001: 4-5), states the following about education and values:

Values and morality give meaning to our individual and social relationships. They are the common currencies that help make life more meaningful ... An education system does not exist to simply serve as a market ... its primary purpose must be to enrich the individual.

The above sentiments are based on the anticipation of creating an education system that will assist learners internalise the values that underpin the South African Constitution.

This philosophy of education is congruent with that of Mahatma Gandhi, who back in 1917 stated “all education must aim at building character” (in Morrow 2002:20) and Sri Sathya Sai Baba who holds the view that “the end of education is character” (SSEHV Newsletter 2002:1) and “true education should make a person compassionate and humane” (Taplin 2002:34). From the views expressed by other scholars, the challenge appears to lie in the implementation of values education, not only in South Africa. The challenge is firstly, to ensure that the curriculum is relevant to South African needs and secondly, to determine the most appropriate pedagogical style for implementation. This raises the question of the role of the teacher in implementation. Morrow (2002:21) expresses concern over the tendency of this theory “to undermine the centrality of the development of knowledge in our conception of education” while Gandhi, in his book *True Education* speaks of the value of education being assessed in the same manner as the value of land (in Morrow 2002). Schools are not value-free or value-neutral and processes such as discipline and classroom control techniques impact on the child’s development (De Vries and Zan, 1994). They are the “embodiments of values and ethical commitments” about how people wish to live their lives (Mandela 2002: ix).

A severe challenge to education in South Africa is that the majority of the teachers who are required to implement this new values-based curriculum have not had prior training in the philosophy underlying Outcomes-based education. Their own schooling has not exposed them to a similar form of education either. It was assumed that teachers would accept and make sense

of this new curriculum then implement it in the Mathematics Literacy classrooms. Learners, as well, need to be continuously exposed to ways of working with both, a new educational philosophy and new subject matter.

Considering these factors, it feels as though the social, emotional and personal undercurrents encountered by both teachers and learners in their efforts to come to grips with the Mathematical Literacy curriculum may have been overlooked. No clear definitions of roles have been given nor have these individuals' perceptions been considered. As a result, the approaches for the promotion of values in a classroom are left to the discretion of individual schools or teachers. A country should consider the education of its citizens to be of paramount importance and hence a major investment. There are certain expectations on returns of investment, by both the state and parents. These are that education should equip an individual with (i) the correct moral attitude to become a respectable member of society and (ii) the skills that enable him or her to become an economically active member of that society. Despite the double-barrelled goal of educating children, one cannot deny the fact that in the current climate, a greater emphasis is placed on the material benefits of attaining an education.

I therefore propose that the learners who come from varying ethnic, religious and social backgrounds have a formidable task of meeting the challenges that the new curriculum demands of them. It is therefore, salient to mention that values education will remain a dynamic and contentious issue in South Africa.

1.3. The research dilemma

To reflect on values is a difficult task since words such as ‘virtues’, ‘morals’, ‘ethics’, ‘values’, ‘principles’ and ‘ethical behaviour’ may be used synonymously. Values may be aesthetic, economic, material, moral, political, religious, social, spiritual or technological and have a surfeit of definitions. Their meanings and interpretations vary conceptually and in practice, within and across cultures and contexts. Veugeles (2000) suggests that even an individual may, with time and circumstances, assign varying meanings to the concept of value. In setting out to examine the values that students in mathematics literacy classes extract from their lessons, this study recognises the variable meanings of “values” within and across cultures and context. Taking cognisance of these facts with regard to the multicultural South African society, this study is guided by the question:

How do learners in mathematical literacy classrooms in Cape Town, South Africa, understand, interpret and implement the values inherent in the Mathematical Literacy curriculum?

This question provides the origin of my investigation into the interpretation of values and values education in the Mathematical Literacy classroom from the learners’ perspective. In an attempt to elucidate the guiding question, the following questions were asked:

- i. What are the values inherent in the Mathematical Literacy lessons?
- ii. How do these values manifest in the lessons?
- iii. Do teachers’ integrate values into the Mathematical Literacy lessons?

iv. Are learners able to ‘distil’ values from the content of the lesson?

Through the observation of classroom practices, I wish to glean more insight into the learners’ (and teachers’) perspectives. Literature on values and values education, inter alia, Lickona (1991) and the Institute of Sathya Sai Education (ISSE), point toward the teacher as the primary source of information on values in the educational arena. The ISSE has developed a list of five basic human values: truth, right conduct, peace, love and non-violence; and one hundred and five sub-values (Sathya Sai Education in Human Values). Values lie on a spectrum from the material to the moral/spiritual. The spiritual/moral values, considered to be universal and embrace the diverse social, cultural and philosophical traditions of mankind, may form the foundation for both cordial interpersonal and international relations. There is no denying that ‘material values’ play a role in an individual’s life, nonetheless they are very specific to an individual’s culture and personal preferences. These values will not be considered as they lie outside the ambit of this study.

Despite South Africa’s population comprising of varying races, religions and ethnic groups, they must be able to live and work together in harmony. Education can play a key role in removing conflict and promoting a sense of mutual respect for the differences amongst the youth, thereby fostering a keen sense of patriotism. With an increase in the number of individuals and organisations concerned with the ‘decline’ in the moral fibre of society, values education appears to have become foregrounded. As a result, schools are under greater pressure as they are being put under the microscope. Teachers,

who are at the heart of the classroom, have to err on the side of caution when dealing with values education as they are not always recognised for the vital role they play in this arena.

The purpose of values education in the classroom is to assist learners to become disciplined and morally responsible citizens. If so, why is there an uproar from society for more to be done at schools? This gives rise to the following questions. Is there a problem with the interpretation and implementation of policy documents? Do pre- and in-service teacher courses accommodate for training in this domain? Despite the implementation of the RNCS, there is no evidence to reveal changes in the classroom in this regard. In the quest to ensure the completion of the subject content and satisfying the assessment requirements, educators spend little time on student participation in the hope for transformation. Despite the emphasis on values in the curriculum statements, there is a lack of evidence to support the fact that time consideration have been given to the development of implementation techniques or to issues of the socio-politico-cultural environment that drive the teachers' handling of values education in the classroom. This gives rise to a conceptual gap. Teachers are left to their own devices resulting in varied interpretations of what to teach with regard to values.

This dilemma with values is not unique to South Africa. Newell (2003) alludes to the assumptions in the obvious agreement on universal values with his example from an American secondary school science educator who is

confused as to the values he has to teach when he is struggling with the content (science) itself.

It must be remembered that values are defined by context and vary across time and culture. In attempting to comprehend the concept of values, I am treading on very complex and heavily debated territory; one which tries to take into cognisance the personal tensions experienced by both the teacher and the learner(s) and accepts that these individuals have their own attitudes, beliefs and prejudices. The teacher has to learn to strike a balance between his or her professional and emotive self, especially when faced with the choices on values education. This study, inter alia, sets out to assess whether the implicit values held by both the teachers and learners become evident in the classroom interactions and pedagogy. If, for example, an individual places greater emphasis on the meaning rather than the value attached to the concept of respect, it suggests the implicit beliefs that the individual holds. Connelly and Clandinin (1990:184) speak of teaching as a “narrative in action”, I will go further to suggest that learning is also a “narrative in action”.

What then are the values that may be found in the Mathematical Literacy classroom? Seah and Bishop (1999:4) constructed the following definition specifically for mathematics classrooms:

...values in mathematics education may be taken to represent one's internalization and 'cognitisation' of affective variables (such as beliefs and attitudes) in the context of the culture of one's community.

Despite the fact that I may be using a similar point of departure for my study, I am situating the values (beliefs and attitudes) in the Mathematical Literacy classroom. The nature of the content of the subject and the experiences one has in a Mathematical Literacy classroom aid in developing these values, which in turn inform one's decisions and behaviour.

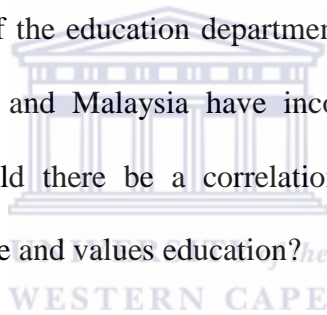
Mathematics has always been regarded as a subject that is reserved for an elite group of individuals. The mention of the subject causes many learners to cringe with a response such as: 'maths is too difficult for me'. In my opinion, the curriculum of the Christian National Education Policy of 1948, which was responsible for legally placing different values (both implicit and explicit) on children of different colour and gender may have compounded this negative attitude toward the subject. The content, curriculum and method of teaching played a significant role in reinforcing the views of cultures as "separate but equal in different spheres, and the superiority of whites and inferiority of blacks" (Chisholm 2001:2). Competence was associated with race and gender. Values have, therefore, been instrumental in the character-development of the learner.

1.4. The significance of the study

This study on the integration of values into the Mathematical Literacy curriculum carries implications for theory, policy, research and practice. It also joins the few but growing number of research studies on values education. Furthermore, the study is situated in a Mathematical Literacy

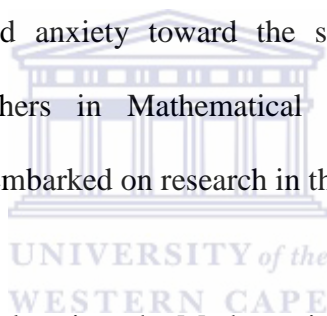
classroom on African soil. This is of significance since most of the work done in this arena is of either a western or eastern origin.

The idea that learners in South Africa are not capable of performing in mathematics is reinforced by results offered by the Third International Science and Mathematics Survey (TIMSS) for grades 7 and 8 (1996) (Howie & Hughes 1998) and TIMSS-Repeat (2001) for grade 12 learners where South Africa featured last out of the 38 countries that participated in the study. The children in schools in East-Asian countries such as Japan, Singapore, South Korea and Taiwan appear to be performing at a much higher level; what is the reason for this? Many of the education departments in the Eastern countries, for example: Indonesia and Malaysia have incorporated values into their education policies. Could there be a correlation between their results in mathematics performance and values education?



South Africa has introduced Mathematical Literacy into the Further Education and Training school curriculum. Does the word ‘mathematical’ conjure up the same emotions in learners as mathematics does? A greater concern is whether the content and mode of delivery creates the notion that the learners taking Mathematical Literacy are inferior to those taking mathematics? We as mathematics educators may be able to: (i) assist learners in overcoming any fears toward the subject, (ii) dispel the view that this subject is not a watered-down version of the mathematics syllabus, and (iii) develop a means of delivery that does not exclude any student from becoming mathematically literate.

As an educator of mathematics, I have observed with disappointment the manner in which learners that were considered to be underachievers were disregarded by both their teachers and their peers. Even those learners that made a concerted effort were not acknowledged for their efforts. Experience has taught me that raising a child's self-esteem and self-worth increases motivation and improves results. My study of the mathematics education of youth at-risk (Rughubar, 2003) opened up questions about other interventions in mathematics education. This search became more intense when I started teaching a Quantitative Literacy course to first year students at university in 2004. Many of these students had last studied mathematics in grade nine and displayed a fear of and anxiety toward the subject. Given my active involvement with teachers in Mathematical Literacy and students in Quantitative Literacy, I embarked on research in the area of values-education.



Why the integration of values into the Mathematical Literacy curriculum? My own spiritual interests led me to the Education in Human Values (EHV) program as proposed by Sri Sathya Sai Baba and practiced by Sathya Sai Schools worldwide. The EHV program embodies the idea of integrating human values into the mathematics syllabus with the intention of enhancing the learners' affective development. This is similar to the link that was established by Swadener and Soedjadi (1998) with the principles of the 'Panca Sila' in Indonesia. In his study of the students in the Sathya Sai School in Zambia, Dr Peter Chomba Manchisi found that many of the learners who had entered the school with academic and behavioural problems had changed for the better (Kanu, 2001). This school was the first in Zambia to have 100%

of grade 12 pupils attain top division marks, allowing 12% of them university admission. In her paper *'Human values, educating the Whole Child for peace and being a citizen in Multi-ethnic Britain'* Dr Madhavi Majmudar (2002) considers the integration of EHV into the classrooms of the United Kingdom. The Sathya Sai Schools around the world, four of which are in South Africa, practice the integration of human values into the various school subjects. Both Art-ong Jumsai Na Ayudhya (*Integration of Human Values in Sciences and Mathematics, 1997*) and Margaret Taplin (*Promoting Education in Human Values in the Regular Mathematics Classroom, 1998a; Education through Human Values through Mathematics: Mathematics through Human Values, 1998b*) suggest ways in which human values can be integrated into the mathematics classroom. In a compilation of papers: *'Sathya Sai Educare Produces Kids Who Care. How Can We Elicit Educare in The Regular School Environment?'* Taplin (2002) provides a comprehensive view of the role of EHV in the classroom. Presently a project examining the integration of EHV into the mainstream school is being carried out in China.

The studies to date have been carried out in Sathya Sai Schools (which are spiritual in nature) and Chinese schools (*'monocultural'* classrooms). The classrooms in most South African schools are multicultural, multilingual and diverse in religious beliefs. The classroom is an amalgamation of different social, cultural and political backgrounds, considering the history of the country. The learners at a school may live in the same neighbourhood, yet come from homes that are culturally different and share opposing political views. The question is: will the infusion of values into a Mathematical

Literacy classroom in a mainstream school in South Africa make a difference? The idea of integrating values into all aspects of the curriculum is to develop learners as agents of social change, persons who are tolerant, humane and compassionate toward others. An understanding of the “enduring moral purpose of schooling (which is) to make a difference in the lives of students...” (Volmink 2001:7) will assist in addressing the indiscretions and imbalances of the past in the mathematics/mathematical literacy classroom. Jansen (2001:1) speaks of a “social curriculum” where students learn through observation of events in public life. He asks us to take a look at exactly what happens in the classroom and acknowledge the type of knowledge learners do not have access to (for example: life-saving knowledge about HIV/AIDS or care and consideration for those that are different). The Values Document that was presented to delegates at the conference at Cape Town in 2001, proposed values and strategies. The values suggested in this document may represent very different concepts to different groups of individuals, depending on their background. How then does the teacher in the classroom develop these values?

In his paper on “*Fostering Values and Traditions in Schools*” Dr Jagar Dorji (1997) speaks of three aspects of values – intrinsic, instrumental and technical. The manner in which the teacher presents a lesson will depend on which aspect of values he/she stresses, for example: stressing on the best method is using the technical aspect. He sees values as a part of one’s character and illustrates this in the diagram below:

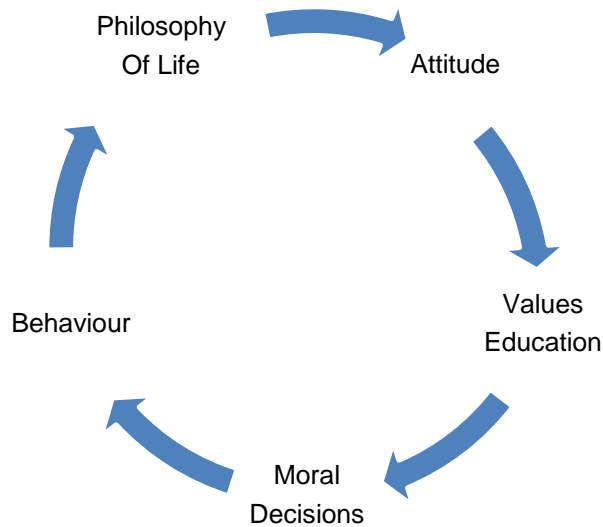
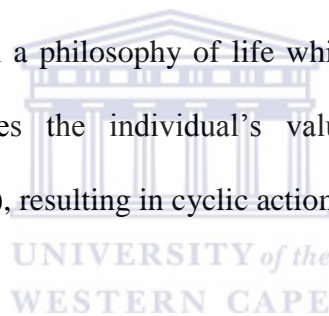


Fig.1.1: Figure illustrating the cyclical effect that may result with the integration of value education in schools. (Dorji 1997:3)

The diagram starts from a philosophy of life which in turn determines one's attitude. This influences the individual's values, moral decisions and behaviour (Dorji 1997:3), resulting in cyclic action.



Alan Bishop (2004) describes six sets of values that are inherent in the 'Western' mathematics curriculum, namely: rationalism, objectism, control, openness, progress and mystery. These are different from the kind of values that are mentioned in the Values Document produced by the Department of Education. However, for me openness, for example, will correspond to the values of truth and honesty. According to Bishop (1999) teachers are rarely aware that they are teaching values in a mathematics classroom, although value-teaching does take place. This is a consequence of the fact that many persons are of the belief that mathematics is both value-free and culture-neutral (Bishop 2004). Bishop considers values education a "crucial yet neglected aspect of mathematics" (Bishop 2003: 717), with mathematics

providing teachers with opportunities to “inculcate desirable values in their pupils” (Bishop 2003: 720). Classrooms in South Africa represent a sphere in which different values meet, not always harmoniously. One may argue that classrooms in a given school are culturally homogenous; however I do believe that values may still differ as learners are from different households. Issues such as compassion, caring and patriotism may hold different meanings to learners depending on their upbringing. These may vary inter- and intra- racially.

Bishop et al (2003:732) quote McLeod (1992) with regard to research on values in mathematics education as follows:

... research on affect in mathematics education continues to reside on the periphery of the field. If research on learning and instruction is to maximize its impact on students and teachers, affective issues need to occupy a more central position in the minds of researchers.

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Despite the increase in the number of papers related to the study of the affective factors in mathematics education, there is still a dearth of documentation on the extent of values teaching in the mathematics/mathematical literacy classroom. This affords me the opportunity to research this domain. This study sets out to examine what are the values inherent in the mathematical literacy syllabus and how are they being addressed? This study also forms a part of a funded research project: *Addressing the direct and indirect impact of HIV/AIDS on pre- and school-going children in South Africa*, that is being headed by the University of Western Cape. According to Clarkson, Bishop, FitzSimons & Seah (2000):

... (values) seem to have a deep influence on how, why and what we learn. Hence, depending on the values learnt in

mathematics classrooms, students may be helped in their lifelong learning, or may sadly learn values that inhibit their in-built creative potential.

It is evident from the above comments that there are implications for the development of theories so that curriculum changes can be initiated to take into consideration the socio-politico-cultural background of both learners and teachers. In this manner, the local and national demands can also be met.

Furthermore, it cannot be assumed that teachers and learners within the same context share the same understanding of both local and national values. Hence, policy has to take these facts into consideration.

In practice, it needs to be acknowledged that at grassroots level, schools will need to carry out their own research with regard to teacher, learner and community values and practices. Teachers and learners will have to learn to have a mutual respect for the values and beliefs held by one another.

1.5. Chapter summaries

Chapter 2 provides a review of literature related to values. Values are discussed from two perspectives, namely 'moral' values and 'mathematical' values. A description of the Education in Human Values (EHV) programme as implemented in various types of schools follows. The EHV programme is reviewed and considered within the South African context. The chapter concludes with a motivation for an appropriate intervention programme tailor-made for the mainstream South African school.

A detailed description of the theoretical framework for this study is offered in Chapter 3. I explore the works of scholars before me, in an attempt to identify factors that influence both teacher and learner understanding and practice of values education. A synthesis of all these perspectives is presented offering a coherent, interrelated theoretical base.

The research design methods of data collection and analysis used during this study is described in Chapter 4. The population and sample population are described, as well as the process by which the samples were selected. First the processes that contributed to the pilot study are also presented and then the procedures used to collect and analyse data are explained. The ethical considerations and consent requirements of the study are also discussed.

Chapter 5 sketches a backdrop of events and initiatives that have been instrumental in shaping the policy on values education. A review of the policy documents (South African Constitution, the South African Schools Act, curriculum statements and materials used in the (textbooks, assignments, tests, examination papers) follows.

Chapters 6 and 7 present the results of this qualitative study. The interpretation and analysis of the various forms of data (interviews, classroom observations, exercises and journals) is described. The classroom observations and interviews were the major source of data with the observations drawn from the interviews backed up by other forms of data. Journal entries made

during or shortly after the classroom visits and interviews are drawn upon to enhance observational findings.

The study results are discussed and interpreted in Chapter 8. The discussion of the results reflects the relationship between the aims and theoretical base of the study. The appropriateness and relevance of integrating values into Mathematical Literacy lessons in the South African context is also evaluated. In the conclusions drawn in the chapter, the findings of the study are summarised and the constraints clarified. Recommendations and potential for further research are also suggested.



CHAPTER TWO

Values and values education

To educate a person in mind and not in morals is to educate a menace to society.
- Theodore Roosevelt

2.1. Introduction

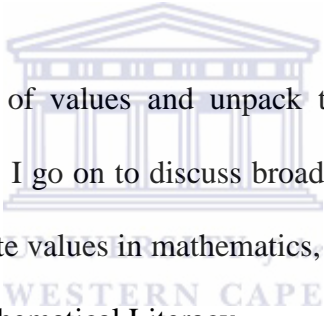
The current endeavour to examine how values, education and democracy can complement one another exemplifies the spirit of the movement that emancipated our nation and people, and gave birth to our democracy.
- Nelson Mandela in the *Spirit of the Nation* (2002: ix)

The thesis of this study centres on the question of the ability of learners in mathematical literacy classrooms in Cape Town, South Africa, to understand, interpret and implement the values inherent in the Mathematical Literacy curriculum. The aim of this chapter, therefore, is to establish the knowledge base of values and values education. In so doing, I plan to identify limitations in the field and any gaps that exist in values education. I will bring to the fore the relationship between Mathematical Literacy, mathematics education and values education.

The purpose of the literature review is three-fold. First, it locates this study among other works in the field, secondly, it serves as a point of departure for the study, and finally, it shows the contribution this research makes in scaffolding the understanding of values education in Mathematical Literacy classrooms. I also undertake to show that despite research on values and teaching dates back to the 1960's (for example, Raths, Harmin and Simon), research on values in mathematics classrooms, a domain that was previously considered non-scientific, has only recently begun. While attention may be

given to teaching methods in Mathematical Literacy, very little information on the curricular approaches that teachers choose exist. I suggest that this research oversight has minimised the complex and diverse nature of values education as it ignores the experiences and background of the teachers and learners.

The aversion to studies on educator experiences and theories may be associated with the complexity of clearly defining teacher beliefs (Pajares, 1992). It is my contention that the same reasons may be ascribed to the dearth of studies on learner beliefs and experiences.



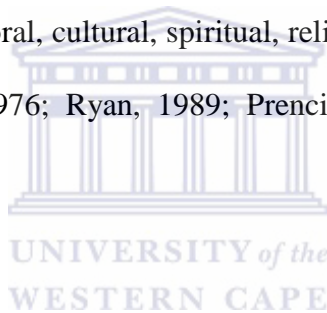
I explore the definition of values and unpack the notion of values being relative to the individual. I go on to discuss broadly the values in society and education. Finally I locate values in mathematics, mathematics education, but more specifically, in Mathematical Literacy.

Furthermore, this chapter acknowledges the other scholarly works on values-oriented education. Besides highlighting vital value-related concepts, these studies have also recognised the importance and need for values education. Some questions that have challenged the implementation of values education in the classroom are: Who is responsible for imparting values? Whose and what values are considered in the classroom? How should the values be promoted? If left unanswered, these questions result in situations riddled with uncertainty and controversy for all stakeholders.

Values and values education are complex concepts which are entrenched in personal and community beliefs and attitudes. This, coupled with the fact that the meaning of values may be quite fluid, contributes to the complexity and controversy associated with the concept of values-based education. These ideas about values and values-based education may have prejudiced the research and attention given to this arena of study.

2.2. Definition of values

To reflect on values is a difficult task as words such as “morals”, “ethics”, and “values” and “principles” are interchangeably used. Values, which may be categorised as social, moral, cultural, spiritual, religious, political, aesthetic or economic (Kohlberg, 1976; Ryan, 1989; Prencipe & Helwig 2002), have varying definitions.



The Report of the Working Group on Values in Education (DOE, 2000a: 10) states:

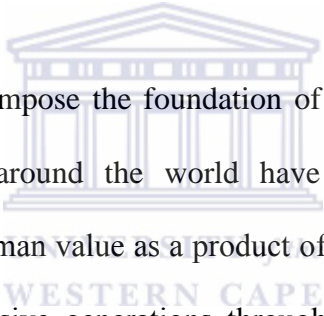
... by values we mean desirable qualities of character, such as honesty, integrity, tolerance, diligence, responsibility, compassion, altruism, justice and respect.

Huitt (2004:1) who defines values “as everything from eternal ideas to behavioral actions” is of the opinion that values are criteria that are used as a barometer to determine the level of goodness, worth or beauty. When an individual is faced with a situation where he or she must respond, values make it vital for the individual to act in a manner in keeping with that which he or she considers worth striving or living for (Rokeach, 1973; Nieuwenhuis, 2007). Halstead and Taylor propose that values refer to

... the principles and fundamental convictions which act as general guides to behaviour, the standards by which particular actions are judged to be good or desirable (1996:2).

Similarly Veugelers & de Vedder (2003:379) regard values as “judgements (decisions) based on a notion of what is good and bad”.

Raths, Harmin and Simon (1987) describe values very aptly as any beliefs, attitudes, activities or feelings that satisfy the following three criteria: choosing, prizing and acting. Choosing implies choosing freely from a group of alternatives after thorough consideration, while prizing suggests cherishing and affirming. The individual thereafter acts upon these choices.



A few key principles compose the foundation of human values upon which societies and cultures around the world have been established. Milton Rokeach views every human value as a product of society that is “transmitted and preserved in successive generations through one or more of society’s institutions” (1973:24). An institution may be regarded as a social organization that has been tasked with developing and maintaining a selected subset of values and transmitting them from generation to generation. Hence institutions that specialize in furthering these values may be the family, religious, educational, political, economic and legal institutions. The values that each of these institutions specializes in are not necessarily different and separate from each other. They may share common values. Thus, these institutions may reinforce or complement (in situations where they vary) each other’s values. Values are fundamental to religions, humanism and other belief systems in order to foster “understanding and harmonious coexistence

among different peoples and cultures” (Sri Sri Ravi Shankar, 2007). The concept central to all of the definitions is that values are always positive in nature, hence providing the individual with a sense of direction.

2.3. Values – different things to different people?

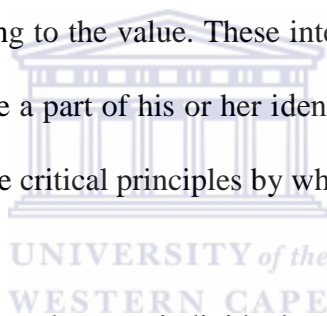
A major question associated with values is whether everybody assigns the same meaning to the values under consideration.

According to Rokeach (1973), if one is looking from a purely behaviouristic position, then one has to consider that the value represents a specific stimulus and what is of importance is whether the stimulus results in a predictable or replicable response. This approach ignores the question of meaning and concentrates on stimulus-response connections. The psychological significance that a particular value has for an individual is of greater importance than the semantic meaning. Rokeach (1973:50) posits that even if “the semantic meaning of a value were identical to two people, their psychological significance might be very different”. Since values cannot be removed from the environment in which they are held, hence no two societies will necessarily value the same behaviour in an identical way.

According to Hartman (1973) as cited in Nieuwenhuis (2007: 11), values serve a “motivational and directional” purpose in our lives. They guide and direct our actions. The values that individuals choose freely without any obligation are those that are most lasting (Kohn, 1997). When faced with a decision-making situation, internalised values, which often work at a

subconscious level, direct an individual's behaviour resulting in a spontaneous response (Nieuwenhuis, 2007).

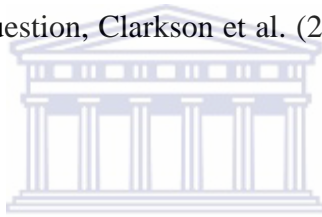
Values are inherent and cannot be taught to others (Sprinthall & Sprinthall, 1990) but Morrow maintains that they “emerge gradually, if at all, out of community life” (Department of National Education, 2001:13) However, individuals can be made more aware of them. Values can be imparted by example (Mandela, 2002; Drake, 2006; Nieuwenhuis, 2007) or clarified through discussion, debate and negotiation (Asmal, 2002; Nieuwenhuis, 2007) but in order for a value to be internalised the individual needs to redefine, attach and impart meaning to the value. These internalised values reflect who the individual is; they are a part of his or her identity (O'Connor & Seymour, 1990). Values provide the critical principles by which an individual lives.



Values and the meaning that an individual attaches to life are closely associated with his or her spiritual being. An individual comprises of mind, body and soul (or spirit). The spirit of the human being ought not to be defined solely in the realm of theology. Newby (1996) who disagrees with the belief that the spirit of the human being belongs solely in this sphere regards the spirit or spirituality as referring to the inner person. While Hillman (1989) associates the spirit with something which inspires, motivates or gives meaning to life, Lickona (1993) suggests that there is need for a synergy between body, mind and spirit when people have to take moral decisions. In the context of Nieuwenhuis' study, the spirit refers to “the inner person that constantly seeks self-understanding and the differentiation between the self as

a product of the environment and the creative self” (2007:14). A distinction ought to be made between valuable and value and between value as an attribute and as an experience. The experience may be considered as primary and the attribute as a “projected derivative” (Parker, 1931: 21). There tends to be confusion between what value is suggested by a lesson and how valuable the lesson is.

According to the research literature there have been attempts to link teachers’ beliefs to their teaching of mathematics (Clarkson, Bishop, FitzSimons & Seah, 2000). Does this suggest that teacher’s beliefs are their values? In an attempt to answer this question, Clarkson et al. (2000) suggest that values are beliefs in action.



The role that education can play in developing the human spirit has not been given sufficient attention. Fox (1994) and Black (1999) (as cited in Nieuwenhuis, 2007:15) believe that objectivity, rationality and efficiency were vital aspects of scientific materialism. This approach did not allow for spirituality as it was considered to be based on non-rational elements such as feeling and sentimentality. This theory is in line with the split between reason and affect which argues that only things that are measurable are worth pursuing (Lincoln & Guba, 1985). This split aided in furthering the divide between promoting materialistic values and retarding the growth of spiritual or human values. The call in postmodern societies is to heal this divide by developing the inner self through education. This can be achieved if the head,

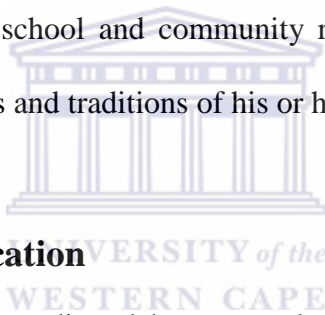
heart and hand work in harmony with one another, implying that there must be a balance between what one thinks, feels and one's actions.

2.4. Values in Society

The South African Constitution speaks of core social values and highlights the importance of human dignity. Human values do not depend on, and are not derived from, any external source. Human values are already present in every human being (Sprinthall & Sprinthall, 1990); they need only be revived in order to thrive and grow (Taplin, 1998(a), 1998(b), 2002). A close relationship exists between human rights and human values. However, despite the attention paid to human rights over the past half-century, little consideration has been given to human values. For human rights to flourish, human values must be nurtured. Rekindling human values throughout the world is essential to achieving universal human rights, peace and security on the planet, and harmonious coexistence among different peoples and cultures.

Although values are central to both our everyday lives and interactions with other people (i.e. one's personal value system), I also believe that they also function at group or community levels. Wong (2005) suggests that values may be divided into the personal, national and universal categories. Personal values, which are learnt through observation, imitation and instruction from one's family and school, will vary according to the learners' ethnic, religious and cultural backgrounds. As a personal value system gives direction to the choices in one's life, a core set of social values plays a vital role in directing members of a community to act and behaviour in an appropriate manner.

Communities derive certain principles regarding the way they live from the values that they consider important. Enduring intergenerational values are generally those that are related to the survival and growth of the human species (Mandela, 2002). In South Africa the national values are encapsulated in the constitution and include equality, justice and democracy while universal values are those which are common to all of mankind, such as compassion, kindness, responsibility and sympathy. However, these are not discrete categories as an individual is a component of society. When a young child enters school he or she becomes socialised to the school and inevitably to society as a whole. The child has to behave in a manner that is proper and acceptable to the class, school and community resulting in the child being inducted into the customs and traditions of his or her society (Jarret, 1991).



2.5. Values and education

There has been a long-standing debate on values and education (Howard, Berkowitz & Schaeffer, 2004; Nieuwenhuis, 2007). The lack of discipline and moral decay in schools today, together with the decline in the culture of teaching and learning still leave policy-makers and educationists facing this debate (Nieuwenhuis, 2007). The key questions in this debate are: whose and what values should be considered for the classroom and how should these values be taught (Kohn, 1997; Seah & Bishop, 2002). Nucci (1997:127) supports this debate with the following:

Arguments surrounding the aims of values education capture the essential quandary for any pluralist democracy attempting to construct a shared civil society without privileging the particular values of any one group. At the heart of the matter is whether we can point to a set of moral values that would form the basis of an ‘overlapping consensus’ that would permit

approaches to moral education that appeal to more than local and particularistic values. Without such consensus the incommensurable qualities of local values would render shared notions of a moral community impossible.

This approach which seems to be based on a curriculum or intervention set primarily to attain the goals of values education may be too restrictive. The issue of values in education should be dealt with from a more holistic approach (Drake, 2006). There is no denial that values have always been entrenched in education. They are an inherent element of the educational process, from the macro-level right down to the micro-level of classroom interaction (Le Métais, 1997), playing a vital role in establishing a sense of personal and social identity for the learner. Schools have their own set of implicit, authentic and powerful values (Wilson, 1986). These values in the school may not be recognized because they are so similar to the values of the culture at large. However, they become explicit through the attitudes and actions of both the educators and learners. Generally these are values identifiable with the South African culture and society. Fink and Stoll (1998) view schools as human institutions, hence policies that disregard the culture and practice of individual schools may lead to failure. The question that arises from the studies of Fink & Stoll (1998) and Hargreaves, Fullan & Hopkins (1998) is: what are the critical moral issues in the process of teaching and learning? Values specific to respective provinces, territories, individual schools and classes, linguistic and religious groups also need to be taken into consideration. In so doing, credence is afforded to the South African Constitution. Whether or not a school or teacher adopts a character education programme, they are always imparting values (Kohn, 1997). Nonetheless, if

we regard values as being an integral part of everything that is done at school, we will be able to approach values in education in a more integrated and holistic manner (Nieuwenhuis, 2007).

Some educationists object to the idea of bringing values into the school curriculum (Nieuwenhuis, 2007). Attempts have been made in the past to make education value-free by omitting value statements from the curriculum. According to Kohlberg (1981) the basic function of the school is the maintenance and transmission of some of the consensual values of the society. People who oppose the teaching of values in schools usually are against teaching values that are not their own or the manner in which the values are taught (Nieuwenhuis, 2007). Some people are of the opinion that modern educational institutions do not focus sufficiently enough on the role education ought to play in promoting socially acceptable values. The increase in violence, drug and alcohol abuse, teenage pregnancies, etc. is an indication of the moral degeneration in society. This is seen as a call for educationists to reinstate old traditional values in an attempt to address the problems (Heenan, 2003, Kirschenbaum, 1992 as cited in Nieuwenhuis 2007). The South African Department of Education's *Manifesto on values, human rights and democracy in education* (2002) also suggests a similar trend of thought. Waghid (2004: 535) points out that while the South African programme

... highlights the importance of teaching pupils to become democratic, *socially just* individuals ... it does not mention the necessity for pupils to become ... *morally just* individuals.

He adds that South African education requires fostering a sense of compassion and caring about other people's suffering amongst the learners.

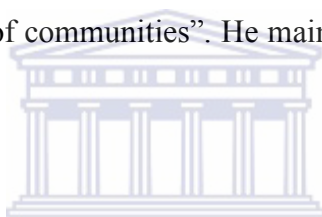
South Africans have emerged from living with apartheid's racial and social barriers. Solomons (2009) contends that a caring and compassionate society is able to challenge and dismantle barriers that have historically been set up and tolerated.

Although education plays a vital role in values education, a set of values cannot just be passed on from one generation to the next. Despite the fact that there may exist a set of enduring values or principles which ties one generation to another, cognisance must be taken of the fact that contexts change. Hence there is a need to redefine the values in the light of the contexts in which they are to be lived. It must be remembered that even though values may be learned within a given context, they may subsequently be applied to relevant contexts hence rendering them context-free (Seah, 2000). The successful integration of these enduring values into the lives of the younger generation depends on how well they manage the afore-mentioned process. Even though education may support the process of societal transformation, it cannot be expected to solve all the social problems. Education can only make a meaningful contribution to moral regeneration if all the role players (parents, community leaders, politicians, etc) become actively involved in the process (Nieuwenhuis, 2007).

According to Nieuwenhuis (2007:6) social reproduction implies that "society reproduces its unique culture and identity over time by developing, maintaining and nurturing it through education". A country that values democracy will use education to promote democratic values to ensure that

education's social reproduction function is met. Values education in democracies is challenged by striking a balance between freedom to choose personal values and commitment to common democratic values (Forster, 2001). An individual's values and belief needs to be in accordance with what society considers morally good. Waghid (2004:528) supports this view with the comment that individuals cannot "pursue their own self-interest without regard for the common good".

In response to the debate on personal or common values Njabula Ndebele (2002:16) argues for "an approach to values, education and democracy that focuses on the building of communities". He maintains that such an approach provides social cohesion.



Education is the substrata of all humanity. One of the constants in a time of global challenges and uncertainties is the continued emphasis on education as a vehicle to achieve greater economic progress, improved living standards and social stability. Classroom teaching carries with it a moral dimension, irrespective of whether it is acknowledged or not (Falkenberg, 2006, Buzzelli & Johnston, 2002 & Hansen, 1995). Jackson, et al (1993) have recognised that classroom teaching, independent of the subject content, influences the moral life in the classroom. However, a less obvious issue is whether the content of both the mathematics and mathematical literacy curricula allows for the explicit development of human values in learners. Sri Sathya Sai Baba, a social reformer and international educationist, believes that "the end of education is character" (SSEHV Newsletter, 2002:1) and maintains that

“raising the standard of living means raising ethical, moral and spiritual standards” (Divine Discourse: March 8, 1981); only then can education lead to progress in human values and social harmony. Hence, in my opinion, a good education system should stimulate in an individual the fundamental human values inherent in every person.

The Sathya Sai Education in Human Values (SSEHV) programme, which is purely spiritual in nature, endeavours to attain this through the advancement of self-development by focussing on the basic universal human values of truth, right conduct, peace, love and non-violence (Majmudar, 1998). It aims to elicit the inherent goodness in a child and help sustain it through the difficult period of emotional growth (Majmudar, 1998). This programme which offers a holistic approach to child development and education has specific underpinnings of universal values (Majmudar, 1998). In its endeavour to redress the injustices created by the apartheid regime, the South African educational system attempts to ensure that all South Africans receive a sound education. Moodley (2009:13) suggests that for education to be relevant, it ought to address “moral regeneration by using an integrated approach focusing on human values”.

The Indonesian education system is based on the five principles of Panca Sila. While Indonesian teachers are not solely responsible for the learners’ education, they ‘strive to develop positive values’ to enable all learners to make constructive contributions to society (Swadener & Soedjadi, 1998:196). All teachers work together to achieve this goal developing the values inherent

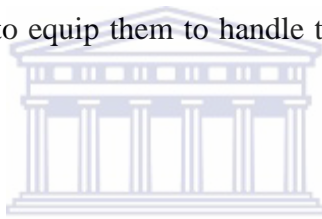
in the academic subject. It is felt that this is the most appropriate environment to understand values and facilitate the learning of positive social values.

Schools often face a dichotomy between achieving academic excellence (quantified by their results) and developing the learner into a socially acceptable individual. It is therefore important that an appropriate learning environment is created (Ritchie, 1998). While the effectiveness of the classroom programme depends on the teacher, its complete success is reliant on the learner-teacher-parent alliance.

Like Sri Sathya Sai Baba, Gandhi also forged a binding link between education and character-building. South Africa's concern with how to achieve social cohesion in a diverse society characterised by deep-rooted historical divisions speak directly to Gandhi's way of thinking. Morrow (2002: 20) cites Gandhi as follows: "there is something radically wrong in the system of education that fails to arm boys and girls to fight against social and other evils." One may argue that character is not always positive. However, there is an underlying assumption in the philosophies of both Sathya Sai Baba and Gandhi that the aim of education is to develop the positive character of an individual and in so doing the negative character traits will be negated.

Morrow (2002) is of the opinion that the notion of character and character-building ought not to be prioritised in the debate on values and education as it detracts from the real issues on hand. Values and character or character-building are so intertwined that it would be difficult to isolate one from the other in the discussion. It would be naïve to consider character-building the

principal aim of all education as this would undermine the development of the intellect. The idea is to develop both character and the intellect simultaneously as they are the two fundamental characteristics of human beings. A highly developed intellect may not always be associated with a morally upright character; the inverse relationship may exist. I am of the opinion that when Sri Sathya Sai Baba said that “the end of education is character” (SSEHV Newsletter, 2002:1) he did not imply that the development of the physical and intellectual components of the individual be ignored. Just as the evolution of one facet only will not allow an individual to function fully in society, so too would the exclusion of an aspect. Hence learners are expected to receive a well-rounded education to equip them to handle the demands of the world in which they live.



Sathya Sai Baba contended that education should “serve to develop powers of discrimination” (critical thinking) and “foster patriotism so that the educated may engage themselves in service to society” (Taplin, 2002: 81). He believed that teachers should not turn learners into “experts in mathematics, unable to add up a simple domestic bill; ... prodigies in Algebra who are helpless when asked to find the area of their own room ...”, but rather prepare them for the challenges of life (Taplin, 2002: 81). As the Sai philosophy does not discriminate against race, colour, creed or religion and no reasonable critiques against the philosophy were found, I thought it very apt for the use in the South African classroom. However, SSEHV programmes are generally used in Sathya Sai schools around the world. At no time do I make the claim that Sai schools provide the ‘best’ methodology for imparting values. In fact, I am

cognisant of the fact that these schools have been established on the Sai philosophy. Teachers at the Sai schools are trained to incorporate values into all aspects of the curriculum. To be able to implement a similar programme in mainstream classrooms in South Africa will require (i) the buy in of teachers into the programme and (ii) the training of all teachers in the area of values education.

The current situation of education in South Africa is reflected in the following extract from Gandhi's book '*True Education*' (in Morrow, 2002:21)

The real difficulty is (that) the people have no idea of what education truly is. We assess the value of education in the same manner as we assess the value of land or of shares in the stock-exchange market. We want to provide only such education as would enable the student to earn more. We hardly give any thought to the improvement of character of the educated ... As long as such ideas persist there is no hope of our ever knowing the true value of education.

Individuals are so consumed by materialism that everything is measured in monetary terms. Morrow (2002) suggests that the value of one's actions may be assessed in terms of the ends to which they are directed. Considering the ethos that presently exists in our schools and society in general, there will be many individuals who will appreciate the (re)introduction of education in values and character-building as a primary aim of education. While Morrow (2002:23) believes the promotion of character development may come across as a 'faint-hearted rear-guard action', the view that values and character development play a vital role in the education of learners is still supported (Gandhi: Sathya Sai Baba, 1981, 2002; Taplin, 2002; Asmal, 2002; Ndebele, 2002).

2.6. Mathematics, Mathematical Literacy and Society

The mathematics that is taught at schools is closely associated with the society in which it is taught (Seah & Bishop, 2002). For a period of time, school mathematics has played a vital role in preparing youth around the world to face the various economic, technological and social challenges and changes (Seah & Bishop, 1999). Society is making greater demands on its citizens to be numerate and demands that learners become more engaged with school mathematics (Bishop, 2007). The introduction of Mathematical Literacy into South African classrooms further reinforces this engagement by students. The OECD/PISA defines mathematical literacy as:

... an individual's capacity to identify and understand the role that mathematics plays in world, to make well-founded judgements and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen. (OECD, 2003:10)

In many countries, including South Africa, the relationship between learning mathematics (or mathematical literacy as in the case of South Africa) and living a meaningful life in society has been made explicit in their mathematics curriculum statements. The cover designs of and illustrations that appear in mathematics and mathematics literacy textbooks accentuate the importance of mathematics and numeracy in society. Seah & Bishop (2002:1) are of the view that while the link between mathematics and society may be interpreted as the "applicability of mathematical concepts and skills in everyday life and in the workplace", there is another perspective relating society to school mathematics through its values. A question which then arises is: Do teachers who do not share the same culture as their learners experience value differences in the mathematics classrooms?

2.7. Values and Mathematics Education

Many mathematics educators find it difficult to think about values in relation to their educational repertoire because professional development support in terms of conceptualising and discussing values are deficient (Seah & Bishop, 2002:1). Since a greater amount of attention has been given to the rational rather than the emotive side of the teacher and teaching, an abyss in values education has been created. The popular public image of mathematics is that of an objective, abstract, inhumane subject independent of any human activities and values (Goguen, 2003 & Wong, 2005). The role of mathematics and mathematical literacy is not only to inculcate conceptual understanding and technical skills within the subject itself, but it is also concerned with the development of the learners' attitudes and values (Wilson, 1996). Ernest (1991) maintains that every mathematics curriculum implies certain values and ideologies. He suggests that values, whether overt or covert, play a significant role in both the choice of mathematical problems, methods of solution and the notations and concepts that are constructed in the process (Ernest, 1991). According to Leu & Wu (2004) values are implied in mathematics, mathematics curriculum and mathematics teaching. In spite of the fact that education has always been value-laden, teachers, learners, parents and even university mathematicians considered mathematics to be the most value-free of all subjects offered at schools (Bishop, FitzSimons, Seah & Clarkson, 2001; Ahmed, 2007). The result is a lack of discussion and teaching of values in the mathematics classroom (Bishop, FitzSimons, Seah & Clarkson, 2001; Seah & Bishop, 2002.) However, a closer examination of the mathematics/mathematical literacy classroom reveals the human and cultural

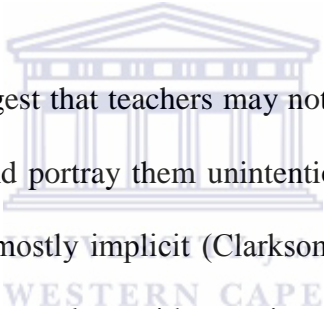
aspects associated with the subject(s). Brooks and Kahn (1992:24) state that “teachers not only have values, they smuggle them into their classrooms every day”. On the same note I would like to suggest that learners also smuggle their values into their classrooms. They come to school in the morning carrying the baggage of their various ethnic, class and gender identities. Both teachers and learners bring to the classroom the values that they have acquired over the years. Interaction between teacher-learner and learner-learner sees an exchange of these values between the individuals in the classroom. Mathematics is therefore no longer considered an impersonal subject (Seah & Bishop, 1999). Teachers’ experiences influence their outlook towards the purpose of education and the implementation of values through the teaching of mathematics/mathematical literacy (Bishop, et al., 2001). Various (sometimes overlapping) influences in the classroom give rise to values. I favour the view of Clarkson, Bishop, FitzSimons & Seah (2000) that values learning and teaching takes place in mathematics classrooms as in any other classroom. Basically I believe that the quality of both mathematics teaching and learning, will improve if there were more understanding about values and their relevance in the classroom.

It is more difficult to conceptualise, identify and discuss values in mathematics, mathematical literacy and mathematics education than to talk about values in society. Alan Bishop and associates (1999:1) defined values in mathematics education as “the deep affective qualities which education aims to foster through the school subject of mathematics”. In the South African context, this definition may be further extended to include the school subject

of mathematical literacy. Seah & Bishop (1999, 2001) suggested that values held by mathematics educators represent their internalization and ‘cognitisation’ of affective variables (such as beliefs and attitudes) in the context of the culture of one’s community. The nature of mathematics and one’s experience in the mathematics classroom facilitate the inculcation of these values. The values equip the learner and/or teacher with a pair of cognitive and affective lenses that shape and modify his or her perception and interpretation of the world. Values are an integral part of a classroom’s affective environment. They are a vital influence on learners’ interaction in the classroom and engagement with mathematics/mathematical literacy. Seah (2003) further elaborated that the values related to mathematics education may be inculcated through an individual’s socio-cultural environmental experiences. These values can influence the development of other affective constructs which are not only related to mathematics education but to life in general.

Values are a vital component of the affective environment in any classroom; hence the mathematical literacy classroom is no exception. Values are therefore a major influence on the manner in which learners wish to engage with mathematics (and mathematical literacy) (FitzSimons, Seah, Bishop, & Clarkson, 2001). Students’ engagement with the learning area is further compounded by the importance the teachers attach to values in the discipline and their level of consciousness of imposing their personal values (Pritchard & Buckland, 1986). While accepting that values, beliefs and attitudes are related (Bloom, Krathwohl & Masia, 1964; Raths, Harmin & Simon, 1966;

Bishop, FitzSimons, Seah & Clarkson, 2001) my concern is with the social and moral values within the mathematics, and more especially the mathematical literacy classrooms. As much as I acknowledge the importance of the values of mathematics, mathematics education and education in general, my concerns also lie with how the values that are embedded in the mathematical literacy curricula enhance the learning process of the learning area. There exists a relationship between the values of mathematics and education and the social and moral values which becomes more meaningful to the student when he or she has understood the content and context of mathematical literacy.



Bishop et al. (2001) suggest that teachers may not be aware of certain values present in the context and portray them unintentionally in their lessons. The “teaching” of values is mostly implicit (Clarkson et al, 2000). Furthermore, the teacher may implement values with negative connotations. Discrepancies may also arise between what was the intended value and that which was understood by the learner(s). The question that arises is whether there are any strategies available to overcome this problem. The fact that values drive decisions (Seah & Bishop, 2002) which impact on one’s actions (Krathwohl et al., 1964), has certain implications for the mathematics educator. Firstly it is his/her responsibility to become familiar with both the implicit and explicit values that underlie the content of curriculum statements and the content and contexts of mathematics/mathematical literacy textbooks. This empowers the educator to reject or implement the values in the mathematics classroom. Secondly, a clearer understanding of one’s own values relating to

mathematics, mathematical literacy and mathematics education, and education in the broader sense, will help the educator make more informed decisions regarding one's professional practice in the classroom (Seah & Bishop, 2002).

The mathematics educator is then faced with a set of challenges, the first of which is whether to make the values that emerge explicit to the learners or should they be implemented implicitly. A second challenge for the teacher is to find ways in which to more explicitly relate values, mathematics and society (Seah & Bishop, 2002). Thirdly, not all South African mathematics and mathematical literacy classrooms are homogenous. Learners and the teacher in a single classroom may come from differing cultural, linguistic and religious groups (for example, learners from English, Afrikaans and isiXhosa households may all be in the same classroom). This may result in conflicting values between learners or teacher and learners; i.e. the teacher's personal value system versus that of the learners. Nonetheless, the manner in which values will be incorporated into a mathematics lesson will be specific to the type(s) of values that are being implemented (Seah & Bishop, 2002). By discussing and sharing their professional experience, teachers will better understand how values relate to affective factors and how they "complement cognitive learning in improving student mathematics learning as a whole" (Seah, 2000:2). The subject of values ought not to be associated with judgement and fault-finding.

2.8. Mind the Gap

Although much has been written about values education, little is known about it (Australian Government, 2003). There appears to be a disparity between policy and practice. Malen and Knapp (1997) suggest that the solutions to problems which may arise due to different social conditions of the implementers are neither apparent nor addressed by the policy makers. Everything that educators do in the classroom is a reflection of their personal beliefs (Roger & Louzencky, 2003). According to Mortimer *et al* (1998) despite schools having the environment and curriculum, they produce different outputs. All the studies focus on the teachers' beliefs. The questions that arise are: how do the personal beliefs of the learners play themselves out in the classroom and what are the reasons behind the differences and similarities found amongst the learners from different schools?

Although these studies may highlight crucial issues associated with values education, they do not elucidate the reasons for classroom practice. In the words of a Baltimore head teacher (Saterlie, 1988: 45): "If you want to know what your school values are, look at what you give awards for in your June assembly". In addition to knowing the choices teachers make in implementing values, the values education debate will benefit from ascertaining what implicit and explicit values the learners are acquiring in the classroom.

From the literature reviewed, it is evident that the majority of the scholarly work in the values education arena has been conducted in countries in the Northern Hemisphere (Taylor, 2003). Despite the plethora of documentation

of research on moral development in adolescence being available, very little research on values education in Sub-Saharan Africa is available. According to Halstead & Taylor (2000) research does not pay enough attention to some areas of school practice. Nucci (1987) is concerned that over the years teacher education has neglected the role of the teacher in the transmission of values.

By the statement:

Our conversation is dominated by mechanistic language: ... but technique in teaching itself implies a view about what a human being is, what a person is, and that is at the very least evaluative and certainly moral,

Buzzelli (1996: 14) observes that not many studies have explored the moral implications of the teaching and learning that transpires in a classroom.

Most studies favour the argument that classroom practice is built on the beliefs, backgrounds and frustrations of the teachers. Who then considers the beliefs, backgrounds and frustrations of the learner? Scholars like Manke (1997) and Allard & Cooper (2001) propose that the methods which the teacher uses to promote values rely on the power relations between teacher and learners in the classroom. The manner in which the teacher engages learners in classroom activities has moral implications on the children's learning and development (Buzzeli, 1996). Although the studies speak of the teacher-learner power relation in the classroom, answers to questions such as how these relations influence values education are not clearly evident. In her study of values education in Kenyan schools, Okore (2007) laments that it would have been more beneficial to the discourse on values education had previous studies identified moral elements of the classroom relationships in

their discussions. In my study I hope to add to the small but growing literature on values education by offering specific moral elements in both the context of the classroom and content of the subject material.

Some studies have provided suggestions into how values education may be implemented in the classroom. According to Bishop (1999) the values that are presented in a mathematics classroom may be classified as mathematical, mathematics educational and general educational. Mathematical values are associated to the epistemology of the discipline of mathematics for which he suggests three complementary pairs of values, namely: rationalism – objectivism, mystery – openness and control – progress (Bishop, 1988, Seah, 2005). Mathematics educational values, which include, inter alia, accuracy, open-mindedness and flexibility, relate to the institutional norms within which school mathematics is taught. Finally, mathematics educational values refer to values which are generally expected to be inculcated in learners by their teachers (Seah, Bishop, FitzSimons, & Clarkson, 2001). It is, however, my belief, that these values do not exist in isolation separate from human values but rather that they co-habit in the classroom.

While some people advocate for values to be integrated into all aspects of the curriculum, there are those that are opposed to the idea. Sommers (1993) uses the example of the Japanese system to illustrate the success of integrating values in everyday activities rather than having values taught in a separate class. She claims that the Japanese approach has allowed them to instil basic values into their schooling system. Holt (1976), on the other hand, proclaims

that currently learners are drilled to behave in a given manner, resulting in their inability to engage critically.

There are teachers who believe that the specialist teacher is responsible for the fostering of values and they have no role to play (Kohn, 1997). In my opinion, this debate which is supported by the separatists, illustrates that the teachers themselves do not comprehend the notion of values.

As I trawled through the literature I found, inter alia, studies analysing teacher understanding of values, the emotive nature of the teacher and even the personal and professional practice of the teacher. The literature review process opened up a number of questions regarding the issue of values education and the learner in the classroom. There are two very important components in the classroom, namely the teacher and the learner. If the South African Constitution and Children's Act of South Africa place such importance on the rights of children, then why is there so little attention given to the values that learners bring into the classroom?

Despite the lack of research in values education on the learner, it is worthy to mention that scholars have debated pedagogy and advanced strategies that may be used in schools to promote values education. Some of the contributions made to the debate are presented in the next three paragraphs.

Checkoway (2001) proposes that values education should be integrated into the curriculum rather than be presented as a separate programme. This

concept is supported by Nucci (1987:3) who believes that “moral education cannot be isolated to one part of the school day, or to one context, but must be integrated within the total school experience”.

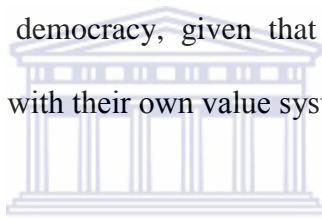
Checkoway (2001) also comments on the development of good character over a period of time. Mncwabe (1987) joins the debate by interjecting that “the aim of education should not be to impose moral standards on the youth, but to teach them a process through which they can set standards and make moral decisions for themselves within the context and demand of their relevant culture”. According to Huitt (2004), the moral and social discernment which is already instinctive in children should be cultivated at an early age so that learners can function independently both as children and adults.

Another issue to be considered in values education is that of the hidden curriculum. Haydon (1997) maintains that the ethos and climate of the school influence the determination of values education. The level of understanding and use of the hidden curriculum impacts on the strategies employed in the classroom. In a study by Powney and Schlapp (2003) to ascertain teachers’ ideas on the implementation of values education it was found that teachers favoured a system that encouraged learners to think independently. However, Haydon (1997) cautions that learners’ thinking has to be guided.

2.9. Summary.

In conclusion, the literature has shown that only recently have scholars started highlighting the importance of values education in the classroom, and more

especially in mathematics classrooms. Teacher training programmes strive to broaden the knowledge base of prospective teachers in anticipation that they will successfully transfer this knowledge to learners. Despite the fact that teachers wield power and authority in a classroom, learners bring in their own set of values and beliefs. Teachers have to learn to make sense of the learner's values. Jansen (2002), in a Critique of South African values education, states "Can white teachers in a former white school in a conservative community be trusted with conveying the kind of values that signify the new demands of a changing democracy?" In reply I ask, "Can any teacher in a South African classroom succeed in conveying the kind of values that signify the new demands of a changing democracy, given that learners are from varying backgrounds and imbued with their own value systems?"



While the literature has helped establish the general meaning of values, the specifics relating to the learner still need to be clarified. Issues such as the conceptual definition, whose and what values and pedagogy remain to be answered. The alleged homogeneity of universal values is a simplistic view as it overlooks the political and epistemological complexities elicited by values and values education. In the next chapter I present an explanation of the theories underpinning this study.

CHAPTER THREE

Values education: Theory

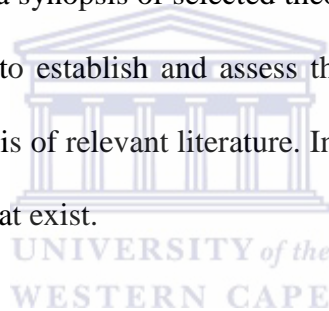
Education is the means of unfolding the moral and spiritual potentialities of man.
Sathya Sai

3.1. Introduction

Outwardly, we are a people of many colours, races, cultures, languages and ancient origins. Yet we are tied to one another by a million visible and invisible threads. We share a common identity from which none can escape because together we are human, we are South African.

- Thabo Mbeki in his State of the Nation address (2001).

In this chapter I present a synopsis of selected theories of moral and cognitive development. I attempt to establish and assess the knowledge base in these arenas through an analysis of relevant literature. In so doing, I plan to identify limitations in the field that exist.



This chapter provides an exposé of the theoretical concepts of the theorists identified, illuminating similarities and differences between these theories. First I present an outline of each theory followed by the debates surrounding them.

3.2. The marriage of socio-moral and cognitive development theories

In an attempt to understand the socio-moral and cognitive development of the learner in the classroom, I examined views espoused by various theorists. Since education, work and family are shaped by historical forces which, in turn, impact on behaviour and development (Elder, 1998), the life course theory may

have been applicable to a study on values education. The life course theory, also referred to as the life course perspective, relates “to a multidisciplinary paradigm for the study of people's lives, structural contexts, and social change. This approach encompasses ideas and observations from an array of disciplines, notably history, sociology, demography, developmental psychology, biology, and economics. In particular, it directs attention to the powerful connection between individual lives and the historical and socioeconomic context in which these lives unfold”. Conceptually, a life course is defined as "a sequence of socially defined events and roles that the individual enacts over time" (Giele & Elder, 1998: 22). However, life course theory was not a choice in this study as it is more suited for studies over a period of time.

I chose to refer to the work of Jean Piaget, Lawrence Kohlberg and Lev Vygotsky. Kohlberg's work continues to influence research on moral development as it elucidates the apparent relationship between morality and reasoning. His non-subscription to the view that values education comprises of a moral agenda that prescribes a list of values to be learnt (cited in Nucci, 2001), resonates with my view on values education. Nucci asserts that a strength Kohlberg's approach to moral education in schools is the fact that “it was grounded in research on moral development and associated philosophical analyses” (2001:9). In her opinion this is important for moral education, as it reveals a vital limitation present in most approaches to moral education; an expectation for the provision of methods for moral teaching by psychologists without questioning the approach. These insights have guided my decision in fusing psychological and philosophical frameworks in this study on values education.

Piaget (1932), whose focus was the moral development of children, was of the opinion that all development emerges from action. He believed that all children proceed through a series of stages of thought which differ from each other. The sequence of these stages is the same for all persons and cultures (Lickona, 1976). Jean Piaget was of the view that individuals use their interactions with the environment to construct and reconstruct their knowledge of the world. He considered morality to be a developmental process after observing children applying rules to games they played. His theory, if applied to values education, suggests that the teacher's task is to provide students with opportunities for personal discovery through problem solving rather than indoctrination through societal norms (1932). He regarded moral development as the product of interpersonal interactions by which individuals resolve issues in a fair manner and maintained that all children reach a morality of co-operation unless their development is retarded (Piaget, 1932).

According to Piaget, before children construct the ability to perceive reason and understand in a mature, rational manner, they pass through four cognitive development stages, namely, the sensorimotor, preoperational, concrete operational and formal operational stages. Characteristics of children in the formal operational stage (11 years and above) are the ability to solve abstract problems systematically and logically, to reason hypothetically and the development of concerns over social issues (Driscoll, 2005). Driscoll's beliefs are supported by Siegler (1986, cited in Driscoll, 2005: 198) as follows:

... at least some of them do think about alternative organizations of the world and about deep questions

concerning the nature of existence, truth, justice, and morality.

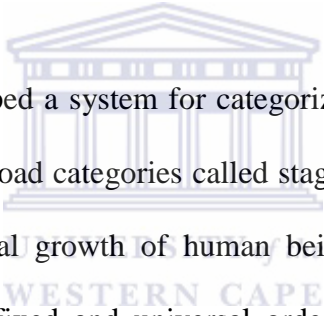
Piaget's theory offers an elaborate and valuable theoretical basis from which to explore cognitive development. The concepts of assimilation, accommodation and equilibrium play a pivotal role in understanding how he interpreted the process of development. Assimilation refers to the taking in of information while accommodation is the result of the environment acting on an organism causing it to reorganise itself. Wood (1990) observes that an element of accommodation is associated with every act of assimilation. Piaget referred to the changes that have to take place in pre-existing schemes of activity to allow the assimilation of a new experience as accommodation.

In an attempt to define moral development in terms of cognitive growth, Piaget identified the following four moral judgment dimensions which demonstrate a distinct correlation to his concept of cognitive development: (i) absolutism of moral perspective, (ii) concept of rule as unchangeable, (iii) belief in immanent justice, and (iv) evaluation of responsibility in terms of consequences (Lickona, 1976). Piaget identified two major stages of moral development: heteronomous morality and autonomous morality.

The heteronomous or first stage of moral development in Piaget's theory, known as the morality of obedience, applies to children younger than 10 years (Piaget, 1932). These children believe that the rules given by parents or other persons of authority are sacred and cannot be altered (Sigelman & Rider, 2009).

The second stage of moral development according to Piaget is autonomous morality or morality of co-operation and is exhibited by children older than 10 years (Piaget, 1932). Children begin to appreciate that rules are agreements between individuals and may be changed through mutual consensus (Sigelman & Rider, 2009). According to Piaget (1932) during this stage children follow their own moral rules.

Piaget's theory suggests that the teacher is instrumental in the moral development of a learner. He paved the way for the theory of moral development advanced by Lawrence Kohlberg.



Kohlberg (1984) developed a system for categorizing the moral reasoning in human beings into six broad categories called stages. Central to this theory is the notion that the moral growth of human beings progresses through an invariant sequence – a fixed and universal order of stages, each of which represents a consistent way of thinking about moral issues that differs from the preceding or following stage (Sigelman & Rider, 2009; DeVries & Zan, 1994). The age of the individual, regardless of cross-cultural moral norms and beliefs, plays a vital role in this development. The six stages, as identified by Kohlberg, relate to moral thinking and not moral action, and may be grouped into three broad levels. He further suggested that associated with moral judgement is the concept of sociomoral perspective; a reference that is made to the point of view an individual takes in defining both social facts and sociomoral values (Kohlberg, 1976). There are three broad levels of social

perspective that correspond to the three levels of moral judgement, as shown in the table below:

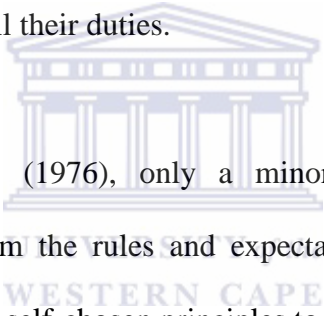
Table 3.1. Kohlberg’s classification

MORAL JUDGEMENT		SOCIAL ORIENTATION	LEVEL OF SOCIAL PERSPECTIVE
LEVEL	STAGE		
Preconventional Morality	1	Punishment-and-Obedience Orientation	Concrete individual perspective
	2	Individualism, Instrumental Hedonism	
Conventional Morality	3	“Good Boy” or “Good Girl” Morality	Member-of-society perspective
	4	Authority and Social Order-Maintaining Morality	
Postconventional or principled Morality	5	Morality of Contract, Individual Rights and Democratically Accepted Law	Prior-to-society perspective
	6	Morality of Individual Principles of Conscience	

There are three levels of moral thinking, namely, pre-conventional, conventional and post-conventional. The word ‘conventional’ suggests conforming to and upholding the rules, expectations and conventions of society or authority (Kohlberg, 1976). Children under 9 years of age generally belong to the pre-conventional level of moral thinking and do not fully understand society’s conventions, rules and expectations. For these individuals, societal rules and expectations exist externally to the self. During the first stage children behave in a socially acceptable manner as directed by a

figure of authority, for example, a teacher or parent, for fear of punishment. By the second stage of this level, children recognise that people have varying interests and points of view. Hence they do the right thing in order to serve their own needs and interests.

Most adolescents and adults in society are at the conventional level as they are able to identify with and internalise the rules and expectations of others. The stages are characterised by distinct behaviour. Persons at stage 3 display concern for the feelings of others and an attitude that seeks to do that which will gain the approval of others while those at stage 4 will ensure that they abide by the law and fulfil their duties.

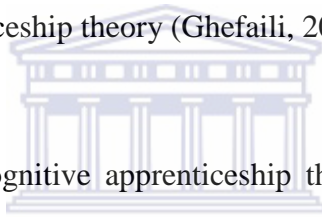


According to Kohlberg (1976), only a minority of adults is able to differentiate the self from the rules and expectations of others and define his/her values in terms of self-chosen principles to reach the post-conventional stage. At the fifth stage, individuals show a genuine concern for society and the welfare of others. The last stage (stage 6) is based on the validity of universal moral principles and a sense of personal commitment to them.

Like Piaget, Kohlberg acknowledged the influence of cognitive growth and social interactions with peers on moral development. Both were of the opinion that social interactions with peers had a greater impact on moral growth than biased interactions with persons of authority (Walker, Hennig & Krettenauer, 2000). Kohlberg advocates that if children engage sufficiently in independent

thinking they will ultimately learn to conceptualise rights, values and principles by which to assess existing social behaviour.

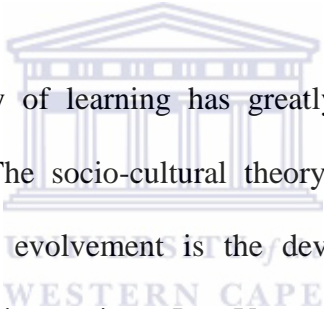
Kohlberg's theory is supported by the cognitive apprenticeship theory whose aim is to "address the problem of inert knowledge and to make the thinking process of a learning activity visible to both the students and the teacher" (Ghefaili, 2003:1). I believe that the socio-cultural theory of learning, Vygotsky's Zone of Proximal Development (ZPD) and situated learning underpin the cognitive apprenticeship theory. However, I do not dispel the fact that there are other philosophies which have influenced the development of the cognitive apprenticeship theory (Ghefaili, 2003).



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A cornerstone of the cognitive apprenticeship theory is the concept of the situated learning. Knowledge is produced as an individual interacts with his or her immediate environment (Orgill, 2007). Lesser & Blake (2006) are of the opinion that Mathematical Literacy allows learners to use mathematical tools such as data handling and modelling to interact with and explore real life contexts in their immediate environment. In the process of the production of knowledge, learners become exposed to issues of social justice. Gonzalez (2009) goes further to suggest that Mathematical Literacy serves as a tool for learners to analyse their social environment with the hope of promoting an awareness of values and principles. Knowledge as a product of situated learning requires learners working in communities of practice to engage with each other and the learning materials (Jaftha, Mhakure & Rughubar-Reddy, 2012). Communities of practice afford learners the opportunity to share and

deepen understandings, and create knowledge from collective learning opportunities in the classroom (Orgill, 2007; Ghefaili, 2003; Macklin, 2007; Wenger, 1998). Hence the challenge with the cognitive apprenticeship theory is to situate learning activities in contexts that are relevant to the learners. I argue that if the aim of the cognitive apprenticeship theory is to “produce graduates with equal thinking and performance capabilities” (Bockarie, 2002:48), then it can produce learners with similar capabilities. This theory aims to give the learner the chance to generalise the skill, know when to apply it and transfer that skill to solve new problems in varying settings or contexts (Ertmer & Cennamo, 1995; Collins, 2006; Hendricks, 2001).



The sociocultural theory of learning has greatly influenced the cognitive apprenticeship theory. The socio-cultural theory of learning suggests that characteristic to human involvement is the development of higher order functions through social interactions. Lev Vygotsky (1978) was of the view that in order to understand the human development of an individual, a study of the individual and the external social world associated with him needs to be undertaken. He acknowledged Piaget’s revolutionary impact on child psychology (Kozulin, 1991). Amongst others, Vygotsky has illustrated that when placed in collaborative or cooperative situations, children are able to perform at an intellectually higher level (Fisher, 1991). Vygotskian theory (Vygotsky, 1978) suggests that each developmental stage is determined by genetic, maturational and socio-cultural factors. Socio-cultural theory (Vygotsky, 1978) differentiates between experiences produced by the individual’s contact with the environmental stimuli and those shaped by

interactions with symbolic mediators. Central to Vygotskian theory is the Zone of Proximal Development (ZPD). Vygotsky (1978:86) defined the ZPD as the:

... distance between the actual development 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.

Within the ZPD, through social and cultural interactions, learners receive instructional support from experienced peers and teachers in a particular mathematical literacy context. Throughout these interactions social tools play a vital role in the cognitive development and learning. (Ghefaili, 2003; Bockarie, 2002; Dennen, 2002; Zuengler & Miller, 2006; Tudge, 1990). A crucial element in Vygotsky's theory of learning and development is internalisation. He considered all higher functions as "internalised social relationships" (Vygotsky, 1981:164) and viewed thinking as the product of internalisation (Vygotsky, 1981). After internalising the skill or information the learner will be in a position to independently carry out a similar problem solving situation. The social and cultural interactions within the ZPD are critical to the cognitive development and culture of the learners allowing them access to learning activities that they would have been otherwise inaccessible to. It is suggested that the cognitive apprenticeship learning takes place in the ZPD and that the ZPD is an important factor to consider when scaffolding learning activities (Rogoff, 1990; Rogoff & Wertsch, 1984).

I am of the opinion that the cognitive apprenticeship theory has important implications to cognitive and moral development. First, learners internalise the skills they have learnt to enable them to carry out tasks and/or solve problems independently. Thereafter they are able to generalise concepts learnt and apply their acquired skills to identical contexts. Furthermore, their current knowledge base forms the springboard for further learning (Bockarie, 2002).

3.3. Debates around these theories

It must be acknowledged that the above theories are not devoid of criticism. Piaget thought it more essential for an individual to progress through each cognitive stage rather than the chronological age at which a stage happens. Nonetheless Gardener, amongst others, has argued that differing cognitive skills develop at differing rates (Cohen 2002). Another criticism leveled at Piaget is that he paid very little attention to the impact of social interactions and differing cultures on development (Sigelman & Rider, 2009). Sutherland (1992: 42) states that

a child's intellectual development cannot be considered in a vacuum ... Cognitive development takes place as a result of mutual interaction between a child and those people with whom he has regular social contact.

In my opinion, the above sentiments will also apply to the stages in Piaget's moral development theory. The classroom space is conducive to collaborative and creative learning as regular social contact occurs therein.

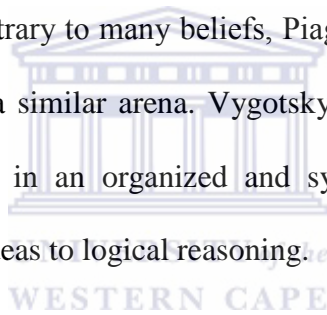
I share the sentiments of DeVries and Zan (1994) when they claim that the theoretical foundation for Piaget's (1932; 1965) socio-moral and cognitive development theories lie in parallel. First, a learner constructs psychosocial

knowledge and knowledge of the objective world in the same manner. Secondly, as affect serves as the stimulus in intellectual development, so do socio-affective bonds stimulate social and moral development. Finally, both forms of development have an equilibration procedure associated with them. While Schweder (1982) claims that Kohlberg dislikes relativism, Sullivan (1977) is of the view that the theory is rooted in certain societies and circumstances. Simpson (1974) suggests that Kohlberg's stages are not culturally universal as they are based on western philosophical tradition. Her proposal for the transformation of his cognitive-developmental theory into a cognitive-affective-conative developmental theory is based on the claim that it will give equal regard to three facets of the human personality: thought, emotion and motivation (Simpson, 1976). Carol Gilligan (1982) points to a gender bias in Kohlberg's theory, observing that it reflects a greater understanding of male personality development than female personality development as most of the data was generated from male respondents. Gilligan (1982) contends that the moral orientation characteristic differs for men and women. While most persons frame moral dilemmas using both orientations, females are likely to employ a care and response orientation with males primarily using rights and rules (justice) as theirs. According to her, women's morality is more contextualised and associated with interpersonal relationships rather than solving hypothetical problems.

Criticism levelled against Vygotsky is that the availability of quantitative information about his work is limited (Grigorenko & Sternberg, 1998) and that the reader finds difficulty in trying to establish the issues that he was

addressing as he was always updating his thinking with each paper he presented (Shayer, 2003). However, Minick (1987) sees this as an evolution of Vygotsky's theory. In response to Shayer's critique that the ZPD limits the potential of a learner, Minick suggests that the ZPD is a framework for the analysis of the child's current level of development and the prediction of the next level that the child may reach.

Piaget (1969) observed that development was entrenched in social relationships and felt that there was "no longer any need to choose between the primacy of the social or that of the intellect" (Piaget, 1970:114). Smith (1996) suggests that contrary to many beliefs, Piaget and Vygotsky's theories on social origins share a similar arena. Vygotsky agrees with Piaget that as development progresses in an organized and systematic manner, thinking changes from intuitive ideas to logical reasoning.



The Values Education Study Report of the Australian Government (2003:35) states that cognitive-developmental theorists' argue in favour of values education being "promoted through the development of reasoning" while critics of this approach focus the on the neglect of the behavioural and emotional components of character and the absence of any attempt to determine whether the stated values resulted in behavioural change". I do not claim that any one approach to be most effective. The adoption of an approach is context dependent. At times a combination of approaches could prove to be more effective than the adoption of any single theory. While the literature does offer suggestions about possible strengths and weaknesses of approaches, I did not

find any strong claims in the literature to warrant my not using the cognitive-developmental approach.

Despite the criticism levelled at these theories, they continue to stimulate much research and guide many studies in the area of moral development. Gibbs (1979) and Habermas (1979) both suggested additions/revisions to the theories of Piaget and Kohlberg. Gilligan's theory (1982) on gender differences in moral development gives rise to the question: 'Do male and female learners understand and interpret the values inherent in the Mathematical Literacy curriculum differently?' This study will consider the gender claim on moral considerations.



3.4. Summary

A fundamental feature of Piaget's learning theory (1932), co-operative learning, may be found in the National Curriculum Statement Grades R - 12 as it calls for learners to work effectively with other members of a team. Unfortunately, I was not able to find much literature on studies documenting the association between classroom practice and these theories.

In the next chapter I present the design of this study. The methodologies chosen for the study are based on the fact that I would seek to ascertain learners' perceptions of values in the Mathematical Literacy classroom. In this regard, I will also use learners' stated responses, together with their responses

during lessons and interviews. The observation sessions will serve to determine the sensitivity of both the teacher and the learners to values.

I will now present a detailed exposition of the design adopted in this study. It must be noted that multiple qualitative methods were employed to compile the data in order to accommodate the subjective nature of the investigation.



CHAPTER FOUR

Research Design

Methods of data collection and analysis

Be careful how you tread it, for every step will show. - Anon

4.1. Introduction

This chapter presents the issues that arose and choices that were made in translating the theoretical framework presented in the previous chapter into a workable design. An explanation of the research process is followed by an account of the various data collection techniques used. The intention is to provide an appreciation of the framework for this study and to document how I arrived at the findings. The chapter commences with an outline of the research design, followed by an explanation of the research methods chosen, and concludes with an outline of the strategies undertaken to manage the validation processes.

I chose qualitative research methods, as I wanted to capture the various dynamics of the classroom. Creswell (1998: 15) is of the opinion that

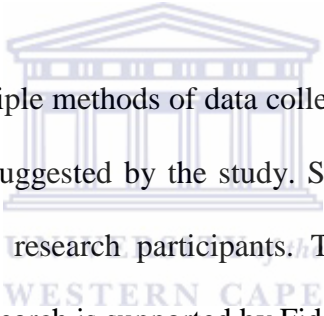
Qualitative research is an inquiry process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem. The researcher builds a complex, holistic picture, analyzes words, reports detailed views of informants, and conducts the study in a natural setting.

I believe that the qualitative methods would allow me to reveal the awareness of both the teachers and learners to the values embedded in the Mathematical Literacy curriculum. Furthermore, I chose the interpretive approach to qualitative research. The interpretive approach is useful when the researcher

wishes to understand the experiences of the research participants by interacting with and listening to what they have to say (Terre Blanche and Kelly: 2002). Another appealing aspect of the interpretive approach is the notion of the researcher being an ‘insider’ and an ‘outsider’. Kelly (2006: 401) adds that the “understanding of a situation needs to be developed both from the perspective of being in the context (empathy) and from the perspective of distancing, using interpretation”. Furthermore, according to Terre Blanche and Kelly (2002:126), the researcher is the “primary instrument for both collecting and analyzing the data”.

The choices that I made have been guided by two stances, the first of which is reflexivity. Reflexivity means “a turning back on oneself, a process of self-reference. In the context of social research, reflexivity at its most obvious level, refers to the way in which the products of research are affected by the personnel and process of doing research” (Davies, 1994:4). I take cognisance of the advice offered by other researchers who have engaged in qualitative methodology (Steier, 1992; Denzin & Lincoln, 1998; Alvesson & Skoldberg, 2000; May, 2011) who suggest that in order to enhance quality researchers become more reflexive. Reflexivity not only assists in producing knowledge that helps the researcher understand the workings of our social world, it also provides “insight on how this knowledge is produced” (Pillow, 1999: 178). Researchers are a part of the social world that they study. Hence, as I play such a pivotal role in producing data in this project, it becomes essential for me to acknowledge and declare my values, interests, embedded assumptions, choices and their influences on the research process.

Linked to this notion of reflexivity is that of ‘circularity’ of the research process (Kathard, 2003). Research processes are often described as a general linear model, proceeding from the theory and hypothesis to operationalisation and culminating with the interpretation and validation of data. Circularity, on the other hand, requires the researcher to reflect not only on the whole research process but also on specific steps in the light of others and to modify and make decisions about how to proceed, while still remaining reflexive (Flick, 1999). Despite the fact that the steps presented in the research process appear sequential, there has been constant interaction and revision between them, hence influencing my decision making.



The employment of multiple methods of data collecting is two-fold. First, it is to support the findings suggested by the study. Secondly, it serves to verify statements made by the research participants. The idea of using multiple methods in subjective research is supported by Fidel (1993).

Before expanding on each of the data collection strategies that were employed in this study, a discussion of the preparatory stages of data production in the research process will ensue. Issues pertaining to participant selection (both schools and learners) and initial contacts are discussed.

4.2. Getting in

Having taught on the Advanced Certificate in Education (Mathematical Literacy) programme at the University of Cape Town, I approached teachers

who had completed the course. The volunteers would have to be comfortable with having me in their classrooms as they were new to the learning area themselves. Permission to conduct research in schools in Cape Town where these teachers were based was sought from the Western Cape Education Department. Visits to the classrooms were granted and had to be concluded by the end of the third quarter of the year.

Ethical issues have to be considered when working with human subjects. The Ethical Code of Professional Conduct published by the Professional Board for Psychology in South Africa was used for this study. This Code is available from the following website:

<http://web.uct.ac.za/depts/psychology/research/resm.html>. An ethical code for this study was drawn up by selecting elements from the aforementioned Ethical Code. Taking into consideration the requirements of the ethical code, permission to carry out the study was sought from the teachers of the Grade 10 Mathematical Literacy classes and from the principals of the schools. Permission was granted by both the teachers and the principals (see Appendix 1).

Consent forms which briefly described the study were drawn up for both parents and learners as well (see Appendix 2). Since learners were under the age of 18 years permission to participate in the study had to be obtained from their parents. Thereafter the learners had the opportunity to agree or decline to participate in the study. All students in the classes that I visited were prepared to be a part of the project.

4.3. Participant Selection

As the purpose of this study is to investigate the values imparted in Mathematics Literacy classrooms at secondary schools in Cape Town, it was decided that the research take the form of case studies. It made sense to me to concentrate on a small number of schools rather than carry out a large survey research. Two stages of sampling were necessary to facilitate the study; first the choice of schools and then the selection of learners who would participate in the focus group discussions/interviews. Purposive sampling was used in the first stage and the choice of schools was guided by the following criteria:

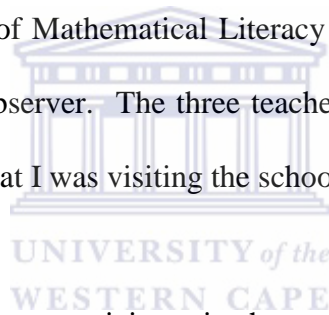
- ◆ The school had to offer Mathematical Literacy to its Grade 10 learners.
- ◆ Teachers had undergone formal training in teaching Mathematical Literacy.
- ◆ The school had to be a state school as opposed to a private school.

Besides the above, the selection criteria considered the social, political and cultural environments in which teaching and learning takes place.

The geographical area of the study was limited to secondary schools in Cape Town, South Africa. For practical reasons, only schools situated in the urban region were selected. Given that classroom observation would continue over a period of two weeks at a time, I selected schools that I could access easily given my time and budgetary constraints. I had requested permission to visit twelve schools in and around Cape Town, but these were reduced to three as many of the schools had already been allocated to other researchers. For the purpose of maximal variation sampling (Flick, 1999), I chose three schools that were situated in very different socio-economic areas, hence providing the

study with a wider spectrum of students, teachers and life experiences.

The literature shows that studies exploring values teaching included both male and female teachers. I deliberately included both in order to investigate whether the gender of the educator influenced values in the classroom. Therefore the selection of the school had to resonate with the gender of the teacher. Two of the three teachers were female. Teacher participants were required to be willing to participate in the study. They had to be prepared to have me in their classrooms for a two-week period twice during the year. Although all three of the teachers that I invited were experienced, they were novices in the teaching of Mathematical Literacy and were very comfortable with having me as an observer. The three teachers also volunteered to keep journals for the period that I was visiting the schools.



The issue of willingness to participate in the study was the most important criteria used in selecting learner participants. All learners were willing to have me as an observer in the classroom. Students were invited to keep a journal about the Mathematical Literacy lessons. The teacher in each class suggested the names of some students. Five volunteers from each class were enlisted to keep the journals. These students would also form a part of the focus group interviews. Although no specific ratio was used to choose male and female learner participants, more female than male students were selected for the focus groups. This was representative of the total number of learners in the three classes that were participating in the study; forty one males and fifty six females.

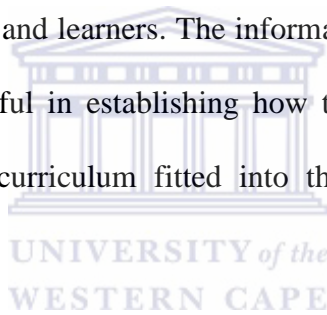
Taking into consideration South Africa's history of racial segregation, I felt it essential to engage with participants from all apartheid-defined race groups. However, there were no Indian learners in the Grade 10 Mathematical Literacy classes at the schools selected. As a novice researcher I did not want to use an interpreter as I felt that I would lose vital information during translation. It was therefore necessary for the participants to be able to speak and understand English; even if it was not their mother tongue.

I corresponded with a member of the Institute of Sathya Sai Education of Hong Kong. By virtue of the fact that this individual's research interests lay in values education (in general) and mathematics classrooms in particular, I was interested in gaining information associated to the process of translating theory into practice. I was looking for guidelines for the implementation of values education into the curriculum. Her research in this area in other parts of Africa is of importance in analysing data produced in this study.

To supplement the information gathered from the correspondence above, I also interviewed the principal and teacher of mathematics from a secondary school in Prashanthi Nilayam, India. The principle governing the school is character development with academic excellence. In the process the school strives to develop the physical, mental and spiritual aspects of the personality of the student. Questions posed to the principal were aimed at ascertaining how values education was implemented across the school. The teacher was questioned on how he implemented values into his Mathematics lessons. The school was using the set of values developed by the Sathya Sai Institute of

Education. As I was using the same set of values in my study, the information gained from these two participants was to enable me to understand the implementation of these values in the classroom.

A visit to a private school in Kwazulu-Natal which is structured on the same principles as the school I had visited in India was also undertaken. This was to build on the knowledge that I had ascertained in India. I focused on the teachers and learners in the Mathematical Literacy classroom. As I was interested in knowing how values education was integrated into the Mathematical Literacy lessons, I observed a lesson in the Grade 10 class and interviewed the teachers and learners. The information I generated from these interviews was also useful in establishing how the values education in the Mathematical Literacy curriculum fitted into the larger picture of values education in the schools.



I also sought the views of the three secondary school teachers whose lessons I was observing. These were the people who would have the greatest impact on what happens in the classroom. It was thus important for me to capture their thoughts on values education within and outside the classroom environment. The aim of the classroom observations was two-fold; (i) to inform me of the teachers' practice, and (ii) to observe learner behaviour.

Focus group interviews were conducted with learners from the three schools in my study. Each focus group was constituted of learners from one school only. There were no more than seven learners in each of the three groups. This

allowed for maximum participation from each member and also facilitated the capturing of their responses.

4.4. Data Collection

The following data collection methods were utilised in this study: document analysis, individual and focus group interviews, video recordings, classroom observation and reflective journals. The information obtained from data analysis will provide a richer background to the understanding of values education. A discussion of each strategy will follow.

4.4.1. Document analysis

The documents that I examined were related to values education and Mathematical Literacy at national (policy) and school (implementation) level. The purpose of the analysis was to determine the explicit and implicit aims and content of teaching and learning in the Mathematical Literacy classrooms. The data collected was to form the foundation for analysis at varying levels. As suggested by May (2011) the documents will allow for comparisons with classroom practice.

Firstly I reviewed policy documents such as the South African Constitution, policy documents on education and curriculum statements. These documents are to aid my understanding of the state's views, aims and objectives with regard to values education. The information derived from these documents is to be used to make comparisons with actual classroom practice. This was followed by a review of material that may be construed as implementation

documents. These included the course syllabus, hand-outs given to teachers at workshops, resources used by the teachers, textbooks and worksheets used by the learners in Mathematical Literacy. This second process was to identify cohesions and discord between practice and policy. I flagged these findings to further investigate during classroom visits and focus group interviews.

4.4.2. Individual interviews

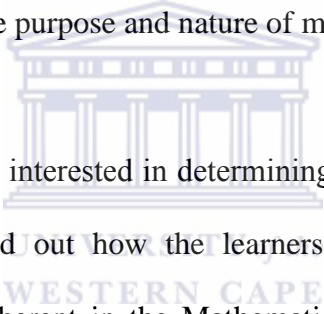
Kelly (2006) suggests using interviews for qualitative data collection. He argues that

Conducting an interview is a more natural form of interacting with people than making them fill out a questionnaire, do a test, or perform some experimental task, and therefore it fits well with the interpretive approach to research. It gives us an opportunity to get to know people quite intimately, so that we can really understand how they think and feel (2006: 297).

The interviews held with the interviewees in India and Kwazulu-Natal were semi-structured in design allowing the participants to pursue a line of thought while I listened to learn. The process and data collected from these interviews provided me with much insight into the implementation of values education at school. The interviews with the three teachers in Cape Town, whose lessons I observed, were more unstructured and informal in nature and took place throughout my stay at each of the schools. Questions asked during these discussions were not pre-planned and usually stemmed from my observations during the lesson. These interviews provided some very significant data on the teachers' perceptions and views regarding values education and its integration into the Mathematical Literacy lessons.

4.4.3. Focus group interviews

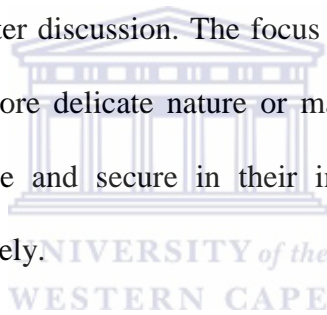
The use of focus group interviews for data collection proved to be a wealth of crucial information. Besides allowing me to collect information from various respondents in a single sitting, these sessions also afforded me the opportunity to clarify issues and observe the participants' gestures, facial expressions and body language. A total of twenty learners participated in the focus groups. The guarantee of anonymity to all interviewees impacted on the richness and depth of the data collected. In order for me to obtain sincere and truthful responses from the learners, there needed to exist a relationship of trust. This was achieved during my visits to their classrooms where I was able to interact with them and explain the purpose and nature of my study.



In these interviews I was interested in determining learners' understanding of values. I wanted to find out how the learners understand, interpret and implement the values inherent in the Mathematical Literacy classroom and curriculum. The learners had to list the value(s) that they felt had emerged during each of their Mathematical Literacy lessons. These values may be inherent in the content and/or context of the Mathematical Literacy curriculum or in the general classroom environment. Learners had to support their choice of value with an example from the lesson. To this end, they viewed video footage of each of the lessons that I had observed in their respective classrooms. I wanted to find out what guided the learners in their thinking on values. To help the process questions such as 'why did you choose that value?' or 'explain what you mean by that' were often posed to the learners. I also wanted to investigate how, if at all, the learners

implemented these values in their classroom, within the school terrain and outside of school. The discussions were designed to ascertain from the learners how they would respond to situations in the real world. This method encouraged interaction and conversation amongst the participants.

Initially during the focus group interviews, I became aware of the issue of the power relationships between researcher-participant and participant-participant. Since some of the learners appeared to dominate the discussion I considered conducting one-on-one interviews. Discussions with fellow researchers suggested that the focus group interview provided a thicker data set as it opened up greater discussion. The focus group enabled me to probe issues that were of a more delicate nature or may have been omitted. The learners felt comfortable and secure in their interaction as a group and expressed their views freely.



Developing observation, listening, interviewing and interpretation skills is a vital tool in data production. As an educator I have much experience in observing lessons presented by fellow and trainee educators and conducting interviews with students. However, it was necessary to develop skills for observing, listening and interpreting these lessons in the classroom. Since it was more than just content that I was interested in, I had to listen to the meaning and observe the gestures/tone of voice and not just the words. I realised during the focus group meetings that I needed to have video recordings of the interviews. I had to learn to minimise the extent of my own frame of reference to allow for the clearer understanding of the participants'

perspectives. It made me aware of how in my role as researcher-as-instrument I was shaping and (mis)guiding the process. Instead of affording the participants the opportunity to point out aspects of the lessons that they associated with a value, I was directing them to particular places in the lessons. Clarity with regards to these issues was obtained during my discussion with a fellow mathematics educator, Professor Erik de Corte, who suggested that I allow the participants to view the video recordings of the lessons and select incidents/statements that they associated with a value.

4.4.4. Classroom observation

I observed the lessons of three secondary school teachers over a period of three months. Each school was visited in blocks of two weeks; hence there was a break between the two sets of visits. The aim of the classroom observations was to ascertain how both teachers and learners comprehend values/values education in the Mathematical Literacy curriculum. The correspondence with the member of Institute of Sathya Sai Education in Hong Kong, my own training in values education and information gathered from the documentary search provided the lens to my observation in the classroom. The three teachers and their learners who had volunteered to keep journals were given copies of the list of values as suggested by Institute of Sathya Sai Education and briefed on how to identify these values in a lesson. At the end of each lesson short, unstructured interviews/discussions were held with the respective teacher to allow him/her the opportunity to elucidate issues that may have arisen.

As the number of lessons that I observed increased, the learners became more at ease with my presence in their classroom. All three teachers were very interested in my study. As I had lectured to these teachers in their in-service course on Mathematical Literacy, two of them approached me for feedback on their teaching. Research dictates that one should abstain from personal involvement in the research process. Hence I had to refrain from sharing my views with them for fear of influencing the process.

Both the teacher and learner participants developed a relationship of trust with me. The students felt that their opinions were being valued and that someone was listening to them.



4.4.5. Video recordings

Video recordings played a vital role in visually capturing the interactions that took place both in the classrooms and the focus group interviews. It presents a picture of exactly what transpired in the unique settings at each of the schools. The recordings illustrate the feelings of the learners through facial expressions, gestures, tone of voice and posture. In this way I was able to capture the interaction between and the language used by teacher and learners. These recordings also served as a form of triangulation and validation to the comments made by learners in the focus groups and teachers in their discussions with me. Permission for the use of the camcorder was obtained from both learners and educators (in all schools). The recordings, which are referenced as video recording followed by the date and lesson number, provided me with the necessary information to construct the context for the

writing of this report. It provided much of the information for the compilation of chapters five and six.

4.4.6. Reflective Journal

I, as the researcher, kept a journal (referenced as RJ followed by the date of entry and day of lesson when cited as data). This journal captured the daily reflections, experiences, perceptions and descriptions. It proved to be an invaluable source in the construction of the context and supplemented the information that had been captured visually. The following extracts from the journal illustrate the type of entries made and the purpose each served:

- Descriptions of the environment –
These children have to live in and work under such difficult conditions ... yet many are enthusiastic about learning. (RJ: 2/07/2006 – day 1 at school C)
- My role as a researcher -
I found it difficult to restrain myself from assisting the learners during the lesson. I had to remind myself that as the observer it was not my place.
(RJ: 21/7/2006 – lesson 2 at School B).
- Concerns about the collection of data –
Another day lost ... will not be able to collect sufficient data for the study ... How can she be an example to her students? (RJ: 30/08/2006 - lesson 6 at School C).
- Concerns about the progress of the study –
I have no idea as to where to go from here ... seems like a dead end. I will have to abandon my study. (RJ: March 2010 – at a point of a major crisis in my life)

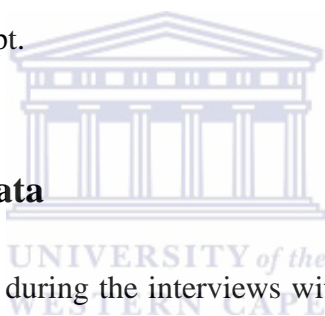
- Teaching practices of teachers –

... The only time the English speaking teacher spoke to the class in isiXhosa was when she reprimanded them for being too noisy (RJ: 2/07/2006 – lesson 1 at School C).

- Pupils attitude toward the Mathematical Literacy lessons –

A group of learners seated at the front of the class worked together assisting one another, explaining concepts in isiXhosa when necessary. (RJ: 2/07/2006 – lesson 1 at School C).

An attempt to get teachers and learners at all three schools to keep a journal did not prove very successful. The learners from one school only gave me the journals that they had kept.



4.5. Managing the data

The data that I collected during the interviews with teachers and focus group sessions is presented individually for each of the three schools that I visited in the Cape Town region, namely: School A, School B and School C (to preserve anonymity). The information obtained from the classroom observations, video footage and my reflective journal plays itself out differently for each of the schools. The information for each of the schools is presented through a different lens. For School A I have used that of the classroom environment while School B is presented through that of the learners in the classroom. The data for School C is presented using the environment in general and some of the incidents that occurred during my visits.

The material collected through my interactions with the Sathya Sai schools rears its head in Chapter 8. This together with data from the literature reviews, curriculum analysis, observations and interviews allows for a cross synthesis of the information gathered.

4.6. Validation and reliability

As a researcher it is important to remain objective when during the stages of data collection for qualitative research. Merriam (2001) suggests that to ensure validity and reliability one should conduct the investigation in an ethical manner. There are those researchers who question the reliability and validity of the qualitative approach. The subjectivities of the researcher and her reflections on observations may become data in their own right (Silverman, 2000). Critics of qualitative research contend that these researchers are influenced by their political values, while Silverman (2000) is of the opinion that flexibility encourages the qualitative researcher to be innovative. As a measure to ensure that my own beliefs, attitudes and prejudices did not influence the data collection process, the following strategies were implemented:

4.6.1. Peer review

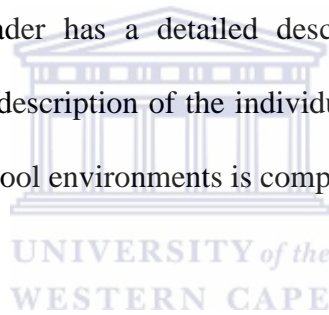
I consulted with peers during the various research processes: the interviews, transcription process and data analysis. While the discussions that ensued challenged my thinking and findings, they sharpened my skills as a researcher. These processes forced me to engage reflexively on the research process.

4.6.2. Triangulation

The interviews with the teachers and focus groups helped elucidate the classroom observation sessions. This was further verified and clarified by the video footage. During the interview sessions, I consistently checked my interpretation of comments by the learners and teachers.

4.6.3. Thick descriptions

I provided thick descriptions of the contents of the discussions, interviews and observations. A thick description is one that captures details in depth so as to bring the experience to life for the reader. It contributes to the credibility of the research as the reader has a detailed description of individuals and contexts. Although the description of the individuals in this study is limited, that of the respective school environments is comprehensive.



4.7. Ethics

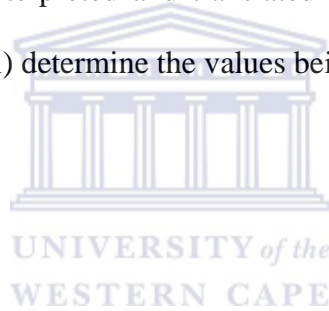
In this study both teachers' and learners' comprehension of values/values education in the Mathematical Literacy curriculum was investigated. The concept of values is a sensitive, personal and delicate issue. Therefore, I had to tread lightly and observe a high level of confidentiality with regard to my observations and interactions with the participants.

From the outset all the participants were made aware of the purpose of my study. I promised both confidentiality and anonymity to these individuals. To this end I have used pseudonyms for the schools and participants, where applicable in the text.

4.8. Summary

In this chapter I have explained how the study unfolded. It provides a description of my data collection procedures and the measures taken to enhance the quality of the research process are explained. Although the data collection process was interesting, issues such as time-table changes caused me to become frustrated.

In the next chapter I present an analysis of documents and texts used in the classroom. This process enabled me: (i) establish the degree to which policy documents have been interpreted and translated into user-friendly materials for the classroom, and (ii) determine the values being promoted by the state.



CHAPTER FIVE

Values in South African Education

An analysis through a Mathematical Literacy Lens

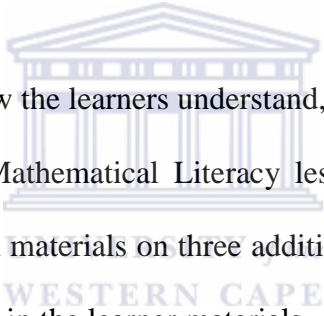
Our progress as a nation can be no swifter than our progress in education.
-J.F. Kennedy

5.1. Introduction

Before presenting a review of the policy documents and materials used in the classroom, I believe it important to understand the rationale for the inclusion of values education into the South African curriculum. This chapter initially sketches a broad backdrop of events and initiatives that been instrumental in shaping the policy on values education. The analysis of the policy documents such as the South African Constitution, the South African Schools Act and the curriculum statements for Mathematical Literacy that follow add to my understanding of the state's views, aims and objectives with regard to values education. Several strategies form the basis of the analysis of the classroom materials.

First, I examine the writing style. As I am trying to determine how the learners in Mathematical Literacy classrooms understand, identify and implement the values inherent in the Mathematical Literacy lessons, an analysis of the writing style will assist me in ascertaining the impact of the school materials (texts, worksheets, tests) on practice at grass root level. The writing style of the curriculum statement will also indicate the level of involvement expected from both teacher and learner in the classroom.

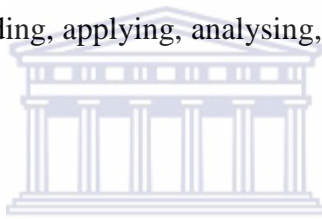
The second aspect of analysis was the use of language in the materials. In my discussions with colleagues and in my own experience as an educator, the use of language has been identified as crucial in the understanding of the context and content. This analysis was done on two levels. In both the policy documents and classroom texts, I looked at the use of language to promote the values as advocated by policy makers. My second concern was the relevance and appropriateness of the context in comparison to the environment. In my opinion, sound educational practice will espouse the use of contexts that are appropriate and relevant to the learner to increase the opportunity for learning to take place.



In order to appreciate how the learners understand, identify and implement the values inherent in the Mathematical Literacy lessons, I carried out further analysis of the classroom materials on three additional levels. I first looked at the mathematical content in the learner materials. A content review of the two textbooks, learner worksheets, assignments, tests and examination papers was conducted. Once all the content areas were listed, I classified of the content areas into the following five content areas: compound growth and finance; measurement; numbers and calculations; patterns, relationships and representations; and statistical data representations. Table 5.1 (Appendix 4) provides details with regard to the content areas and the specific sections associated with each.

As mentioned in an earlier chapter, the content in mathematical literacy may be situated in contexts. Learners are required to complete context-based

activities that demand both mathematical and critical thinking competencies. See Table 5.2 (Appendix 5) for a more detailed description of each competency category. A replication of the approach engaged to identify the five content areas was employed to determine the six competency categories from the activities. The revised two dimensional framework of Bloom's Taxonomy (consisting of the knowledge dimension and cognitive process) was also used in the analysis the cognitive levels of activities from the learner materials. While this study acknowledges the knowledge dimension to be represented by the competency categories: factual, conceptual procedural or metacognitive knowledge I use six cognitive process dimensions: remembering, understanding, applying, analysing, evaluating, and creating for the purpose of analysis.



In addition, I examined the mathematical content of the activities in the learner materials for evidence of values. Discussions with colleagues and observations of their lessons in the Sathya Sai schools here and abroad, together with my own study of values in education, have convinced me that values are embedded in the mathematical content. I have employed the set of human values used by the Sathya Sai schools in my analysis of the mathematical content. The values embedded in the South African constitution are integrated in this list. The one hundred and eight sub-values are pooled into five major groups, namely; truth, right action, peace, love and non-violence, as shown in Table 5.3. The complete set of values is found in Appendix 3.

Table 5.3 provides a summary of the framework I used in the analysis process.

Table 5.3: Summary of the framework

Content	Competencies	Bloom's taxonomy	Evidence of Values	Value
<ul style="list-style-type: none"> Compound growth & finance Measurement Numbers and calculations Patterns, relationships & representations Statistical data representation 	<ul style="list-style-type: none"> Comparing numbers Critical thinking skills Data representation methods Procedural competencies Reading from charts, tables, & texts Writing skills 	<ul style="list-style-type: none"> Remembering Understanding Applying Analysing Evaluating Creating 	<ul style="list-style-type: none"> Value implicit in both context and content Value explicit in either the context or content Value explicit in both context and content Value absent from both context and content 	<ul style="list-style-type: none"> Love Truth Right Conduct Peace Non-Violence

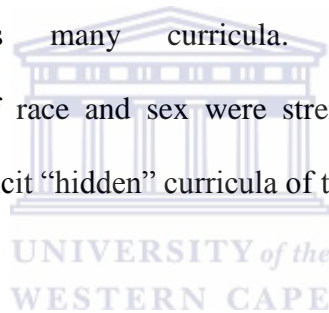
In my endeavour to determine if and how the learners in Mathematical Literacy classrooms understand, identify and implement the values inherent in the Mathematical Literacy lessons, I used the framework to:

- analyse the mathematical content embedded in the learner materials,
- analyse the mathematical and other competencies (e.g. critical thinking skills) in the learner materials,
- assess the cognitive levels of in the questions of the activities,
- assess the level to which values are integrated into the learner materials via the contexts and content.

My analysis also encompassed issues related to spirituality, ethnicity and diversity as upheld in the Constitution of South Africa.

5.2. A peep into the past: Pre-1994

The history of a country has a significant influence on its perceptions about values. As mentioned in an earlier chapter South Africans have emerged from a country governed by a system of apartheid whose underlying philosophy was that of separate (and unequal) development of races (Christie, 1986). Evidence of the ideologies of separatism being securely entrenched in education in the 1960's and 70's were the establishment of 19 educational departments and as many curricula. Perceptions about the superiority/inferiority of race and sex were strengthened through both the explicit formal and implicit "hidden" curricula of the day (Christie, 1986).



An appreciation of the hidden curriculum is critical in the understanding of how values were implicitly transferred through education under apartheid (Christie, 1986; Buckland, 1982). The hidden curriculum was the tool employed to implicitly indoctrinate learners with the values associated with separatist ideology. Christie (1986) maintains that value systems and practices in schools and society have an impact on socialization. Therefore, a legislation that divided people by race promoted division of the people by class, gender, religion and language (Christie, 1986). Furthermore, Christian National Education (the educational philosophy prior to 1994) which had its roots in the Christian National Act (39 of 1967) entrenched racism and

separatism in all aspects of life. This gave a certain race a false sense of superiority.

With the emergence of People's Education in the 1980's came the call for a democratic society that was non-racist and non-sexist (Kraak, 1998). Although the "ideal-type policies outlined in the principles of People's Education have not been successfully implemented" (Motala & Vally, 2002:187), the terminology, values and discourses of transformation rooted in People's Education has wielded a strong influence on post-1994 educational discourses (Solomons, 2009). The ideologies of Black consciousness movements, that began rearing their heads in the sixties, also played a crucial role in conscientising and mobilising South African youth (Hyslop, 1990). As the struggle for liberation gained momentum, the values and philosophies of the apartheid period were being contested, setting the scene for political and educational transformation.

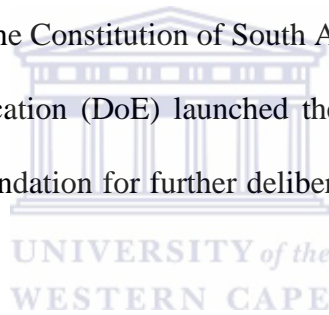
5.3. The educational and political landscape: Post-1994

According to Malcolm (1999) often the curriculum specifications of a state are implicitly aligned with its ideology. Policies concerning education in post-1994 South Africa show an alignment between the political agenda and the values enshrined in the Constitution of South Africa. Harley and Wedekind (2004) point out that Curriculum 2005 aligns itself to South African political values in an explicit manner, making evident its obvious political agenda. Considering the socio-political agenda of the post-1994 government, it is not unexpected that dialogue on values in education is firmly entrenched in the

Constitution of South Africa and the Bill of Rights. I will discuss this in greater detail during the document analysis.

5.4. Values education and policy

The general consensus across the globe on values education is that it can aid moral regeneration and social transformation. Guttman (1987) adds that education ought to play a more dynamic role in nurturing democratic values. With the founding of a new democracy in South Africa in 1994, came the call by the Minister of Education for the removal of racial discrimination and segregation from all educational institutions. In its effort to support the underlying ideology of the Constitution of South Africa and the Bill of Rights, the Department of Education (DoE) launched the Tirisano Project in 1999. This project laid the foundation for further deliberations on values, education and democracy.



It must be remembered that for the majority of the South African populace the system of apartheid had shaped their attitudes and values. In an attempt to transform these attitudes and values, the DoE initiated debates on values education. These initiatives gave rise to the Report of the Working Group on Values in Education (DoE, 2000). Based on the public debate and responses, the working group recommended the values of: accountability, equity, multi-lingualism, openness, social honour and tolerance, be included in the education curriculum. The Saamtrek Conference on Values, Education and Democracy in the 21st Century, held in Cape Town in February 2001, materialised as a result of the Report of the Working Group on Values in

Education. The recommendations from this conference culminated in the Manifesto on Values, Democracy and Education (DoE, 2001a). The ten values identified by the Manifesto to be included in the National Curriculum will be discussed later.

5.5. Documents under the microscope

A synopsis of the Constitution of South Africa reveals that though values may not be explicitly articulated all through the document, they are implied. In the Preamble it is communicated that the Constitution is adopted as:

... the supreme law of the Republic so as to heal the division of the past and establish a society based on democratic values, social justice and fundamental human rights. Constitution of South Africa, Act 108 of 1996).

The mention of God in various languages indigenous to South Africa in the Preamble also acknowledges the spiritual beliefs and diversity of the South African people. The opening chapter alerts the reader to the values on which the country is founded, namely: human dignity, the achievement of equality and the advancement of human rights and freedoms.

Values in the document are presented from a human rights or second perspective where priority is given to the rights of the individual and the values are inferred by virtue of those rights (Okore, 2007). The Bill of Rights is a cornerstone of democracy in South Africa. It preserves the rights of all people in the country and affirms the democratic values. Statements such as “all citizens are equally entitled to the rights, privileges and benefits of citizenship” (Constitution of the Republic of South Africa Act, No. 108 of

1996: 1243) and “everyone has the right to...” that appear in the Bill of Rights leads one to make assumptions about the inherent values. The key values in the Constitution revolve around fairly universal issues of co-operation, equality, good governance (accountability and transparency), national unity, preservation of human rights, respect and tolerance for diversity and social justice. Taking into consideration the cultural, historical and socio-political background of the South African people, it is understandable why prominence is given to these values.

The Bill of Rights affords the South African population (natural or juristic persons) the freedom of choice in respect of conscience, religion, thought, belief and opinion. Despite the fact that it is important for citizens to subscribe to a personal value system, they also have a responsibility to pledge allegiance to a common value system to ensure the effective functioning of the country. This may set up tensions within individuals when personal and common values are non-congruent. Emphasis on responsible citizenship by the Constitution implies greater individual responsibility. Rauch (2005) claims that the post-1994 government’s need to change negative perceptions held by the electorate led to the emphasis on responsible citizenship.

Following on the idea of all citizens taking responsibility, it would make sense for values education becoming the responsibility of everybody. In so doing, values education will need to be integrated into all facets of school life and all subject curricula.

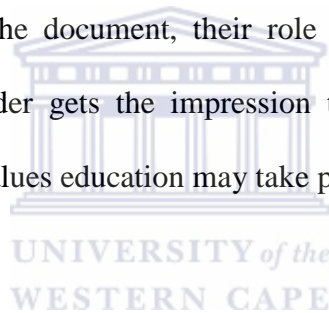
Up until now the discussion has addressed the issue of values as per the Constitution and the Bill of Rights. My review will now focus on other policy documents, namely, the Manifesto on Values, Democracy and Education, the South African Schools Act and the curriculum statements for Mathematical Literacy. As I mentioned earlier the Manifesto on Values, Democracy and Education is a product of the Report of the Working Group and as such has embedded in it the views of the South African people on values education.

With the new democratic government at the helm, the issue of values assumed a more focal point in discussions around the education table. The Manifesto identified the following values to be included in the National Curriculum: democracy, social justice and equity, equality, non-racism and non-sexism, ubuntu (human dignity), an open society, accountability (responsibility), the rule of law, respect and reconciliation. Of these, the concept of Ubuntu, the value of human dignity, takes centre stage as it expounds the key element on which the Bill of Rights is founded.

The purpose for the Manifesto on Values, Democracy and Education was to propose common social values through which education could promote social cohesion in its attempt to aid transformation. The recommendations of the various DoE initiatives, namely the Report of the Working Group on Values in Education (DoE, 2000), the Manifesto on Values, Democracy and Education (DoE, 2001) and the Saamtrek Conference on Values, Education and Democracy in the 21st Century (2001), culminated in the identification of

the following six values for inclusion in the curriculum: accountability, equity, multi-lingualism, openness, social honour and tolerance.

An appraisal of the Manifesto on Values, Democracy and Education accentuates certain underlying assumptions about values education. First it implies that values can be *'taught'* by outlining "sixteen strategies for instilling democratic values in young South Africans in the learning environment" (DoE, 2001a:1). There is an assumption that teachers have the necessary training and theoretical knowledge to undertake this task. Secondly, although mention is made of parents, government agents and community leaders in the document, their role in values education is not defined. Hence the reader gets the impression that the school is the sole environment in which values education may take place.

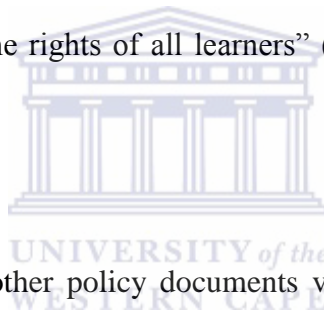


Solomons (2009) argues that there is an assumption made in the Manifesto about values being a transparent concept which can be prescribed to a society with a premise of a smooth transition to the expected state. She adds that the Manifesto ignores the fact that values are socially constructed. A further assumption is that the existing value systems embedded in society (which for South Africans is shaped by a history of differences rather than commonalities) can be replaced by new value systems.

A glaring omission in the Manifesto is the lack of attention to social context. South Africans may be living in a democracy but that does not eliminate the issues of unemployment, poverty, race and class. Social differences and

inequalities need to be acknowledged and addressed. Learning and the acquisition of values are rooted in subcultures and social contexts and need to be recognised. The Manifesto does not distinguish between the differences that currently exist in the South African society and appears to subscribe to the view of a single cure for all diseases.

The Preamble to the South African Schools Act 84 of 1996, alerts the reader to the fact that the previous education was based on racial inequality and segregation. The Act places the learners at the centre of the dialogue by promising to “provide an education of progressively high quality for all learners” and “uphold the rights of all learners” (South African Schools Act 84 of 1996: 1).



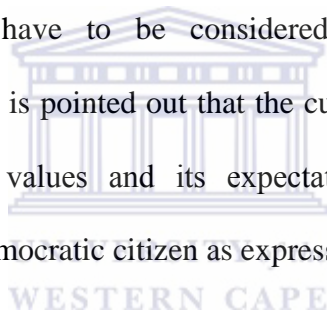
As is the norm in the other policy documents values are presented from a human rights perspective. A distinct trend and emphasis is evident in all the reports with priority given to the rights of the individual and the values inferred by virtue of those rights. The values and rights that are prescribed in the Constitution and the Bill of Rights resonate in the Schools Act and are demonstrated by statements such as “no form of racial discrimination may be practised”, “a recognised Sign Language has the status of an official language for purposes of learning at a public school” and “freedom of conscience and religion at public schools” reflect the alignment. The Act explicitly aligns itself to South African political values.

I begin my review of the curriculum statements with comments on Outcomes-Based Education (OBE) and the curriculum. The first official publication of OBE by the Department of Education was Curriculum 2005: Lifelong learning for the 21st Century. The central approach to teaching in the new curriculum, Curriculum 2005 (C2005), was outcomes-based. However, in the public arena OBE and C2005 were deemed to be synonymous and the terms were used interchangeably.

Curriculum 2005 aimed at producing literate and numerate citizens who through their creativity and critical thinking skills would be capable of meaningful participation in a united, democratic country (DoE, 1997). This approach assumed that all learners were able to reach their full potential but in differing ways at differing times. Much criticism was levelled at both the approach of OBE and the Curriculum 2005 itself. There was the expectation of learners to discover knowledge for themselves and an assumption that all learners will be able to do so in their own time. Following a myriad of problems encountered with C2005, the Ministry of Education set up a committee in 2000 with a brief to review the curriculum. The Review Committee, inter alia, recommended that the Critical Outcomes in the Revised National Curriculum Statements (RNCS)

provide the learning goals for the curriculum, and the learning programmes should be ‘designed down from them so that the values of human rights, civic responsibility and respect for the environment are infused throughout the curriculum. Special attention should be paid to anti-discriminatory, gender equity and special needs issues. (Report of C2005 Review Committee. Executive Summary, 2000b)

This very explicit pronouncement regarding values illustrates the importance the state places on values in education. The request to have the values permeate the curriculum suggests that both the teacher and learner in the classroom are expected to be committed to promoting and upholding the values entrenched in the Constitution of South Africa and the Bill of Rights. The expectations of the level of commitment from the educator is further supported by general guidelines that need to be considered for all Learning Areas as contained in The Teacher's Guide for the Development of Learning Programmes Policy Guidelines (DoE, 2003: 1-14). The document declares that to achieve the aim of Learning Programmes, Work Schedules and Lesson Plans certain aspects have to be considered during planning. Under Philosophy and Policy it is pointed out that the curriculum is an embodiment of the nation's social values and its expectations of roles, rights and responsibilities of the democratic citizen as expressed in the Constitution.



The document analysis commenced with a look at the Constitution of South Africa so as to establish a general impression of the status values and values education enjoy in South Africa. Each subsequent document considered, narrowed down the focus of the review. The Curriculum Statements for Mathematical Literacy are the final review policy documents to be considered. I commence the evaluation with the following question: Is there a relationship between Mathematical Literacy, the principles embedded in the National Curriculum Statement (NCS) and the Constitution of South Africa?

The Constitution of the Republic of South Africa (Act 108 of 1996) provides a foundation for curriculum transformation and development in South Africa. The National Curriculum Statement Grades 10-12 (General) lays the basis for achieving these goals by specifying Learning Outcomes and Assessment Standards. Further the NCS clarifies the key principles and values that underpin the curriculum. The Mathematical Literacy curriculum, in turn, supports the application of the National Curriculum Statement principles (DoE, 2008). In describing the techniques which the Mathematical Literacy curriculum uses to support the principles in the NCS, values are either expressly mentioned, for example, under the principle of Progression:

Assessment standards for each learning outcome imply an increasingly more complex, deeper and broader understanding of knowledge, skills, attitudes and values to be achieved in each of Grades 10, 11 and 12

or implied, as for the principle of Human rights, inclusivity, environmental and socio-economic justice:

The subject is designed with the aim of providing access to mathematics through contexts that interest learners and relate to their aspirations.

Despite the fact that the National Curriculum Statement Grades 10 -12 (May 2005) and the Revised National Curriculum Statement Grades R – 9 (May 2002) have been replaced by the National Curriculum Statement Grades R -12 (January 2012), the principles and values of the former documents have still been retained in the new document. The single comprehensive Curriculum and Assessment Policy Statement (Mathematical Literacy) (DOE, 2011) document, referred to as the CAPS document, developed to replace the Subject Statement, Learning Programme Guidelines and Subject Assessment

Guidelines in Grades R -12 (Mathematical Literacy) was implemented in January 2012 to improve implementation of the curriculum and assessment in classrooms.

The general aims of the South African curriculum are documented in the National Curriculum Statement Grades R – 12. Explicit mention of “values worth learning in South Africa” is made early in the CAPS document (DoE, 2012: 5). It goes on further to state that the NCS Grades R – 12 serves the purpose of, inter alia:

equipping learners, irrespective of their socio-economic background, race, gender, physical ability or intellectual ability, with the knowledge, skills and values necessary for self-fulfilment, and meaningful participation in society as citizens of a free country.

The National Curriculum Statement advocated for three sets of outcomes in the classroom; namely, the Developmental Outcomes (DO), Critical Outcomes (CO) and Learning Outcomes (LO). The Mathematical Literacy Learning Outcomes are of vital importance to the attainment of the Critical Outcomes. The teacher of Mathematical Literacy is expected to provide authentic opportunities for learners to work towards achieving these Critical Outcomes. A clear trend in the Critical Outcomes is that of values as is evident in the following outcomes (DoE, 2002: 11):

- *Work effectively as individuals and with others as a member of a team*

In the Mathematical Literacy classroom learners get opportunities to “assist each other ... learners will experience that their opinions are valued and interrogated with respect”.

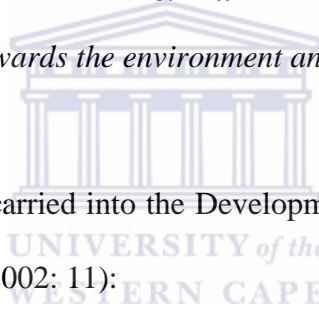
- *Collect, analyse, organise and critically evaluate information*

To achieve this outcome learners need to discuss and argue about their methods and answers. When learners actively listen to each other, they learn to respect one another. They also develop their capacity to reason and increase their level of tolerance.

- *Communicate effectively using visual, symbolic and/or language skills in various modes*

“When learners are required to share their opinions and methods with their peers, they experience the need to communicate effectively.”

- *Use science and technology effectively and critically, showing responsibility towards the environment and the health of others*



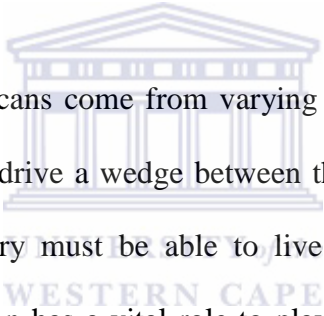
The notion of values is carried into the Developmental Outcomes, as well, as illustrated below (DoE, 2002: 11):

- *Participating as a responsible citizen in the life of local, national and global communities*

Mathematical Literacy makes provision for engaging with authentic application of mathematical concepts. Projects that can make a difference in communities where learners live and learn should be part of the learning programme.

Despite these pronouncements on values, there is no evidence of values being made explicit in the sequence of topics that follow in the CAPS document. Little information is given as to how these may be developed in the

classroom. Nonetheless, values are embedded in the content and contexts that the learners ought to be exposed to as suggested by the Mathematics Literacy curriculum, for example, RDP housing, risk and gambling, and risky behaviour. As is the norm with many policy documents, the statements regarding values in the Mathematical Literacy curriculum are not prescriptive allowing for varying interpretations. This may have been the state's strategic plan to accommodate a multicultural South African society. It must also be remembered that South Africa was a young democracy at the time when these curriculum statements were first being developed. The new government had to ensure that it won and held the support of the voters.



The fact that South Africans come from varying ethnic, racial and religious backgrounds should not drive a wedge between them. At the end of the day the people of the country must be able to live as a single nation, South Africans. Hence education has a vital role to play in ensuring that the youth acquire the tools that will foster Ubuntu and patriotism to enable people to live together in harmony.

5.6. Learner materials under the spotlight

It is expected that the authors of texts in Mathematical Literacy would develop a curriculum in accordance with the recommendations on values outlined in the various policy documents and reports, as well as, the values enshrined in the Constitution of South Africa. As mentioned previously, the statements regarding values in the Mathematical Literacy curriculum are not prescriptive allowing for varying interpretations by educators. It is assumed

that the educator's training and experiences would lead to the appropriate interpretation of the values enshrined in Mathematical Literacy. This implies that the interpretation of these values is not protected from the dogmas and values of the teacher as an individual. In the process of ensuring that the goals of a lesson are achieved, these values may consciously or unconsciously be imposed upon learners.

A review of the school-based materials shows that there is a lack of communication between the architects of policy documents and the developers of materials for learner utilization. The policy documents, being learner-centred, place emphasis on what learners should be able to do rather than providing direction on how to achieve the expected outcome. The review of the learning materials that follow will provide some insight as to how values have been interpreted and integrated into learning material for learners of Mathematical Literacy.

An appraisal of the learning materials in Mathematical Literacy used at the three schools follows. The textbooks, worksheets, assignments, tests and examinations formed the basis for the review. A point that has to be borne in mind is that at all three schools the medium of instruction is English. Although English is one of the official languages of the country, it is the second (or even third) language of communication for the majority of South Africans, including the learners at these schools. Learners in two of the schools used the same textbook, Maths Literacy for all Grade 10, while those in the third school used a different book; namely, Focus on Mathematical

Literacy Grade 10. One of the teachers used two other textbooks as reference books to supplement her lessons. These materials will reveal the respective authors' interpretation of values as outlined in the curriculum documents. The information generated will enhance the observation and interview sessions.

In the introduction to the textbook, Maths Literacy for all Grade 10, values are acknowledged in the following statement: “... *develops a Learning Programme for the first year of FET that builds on the knowledge, skills, attitudes and values developed over the nine years of general education.*” The values are not made explicit to the reader. Focus on Mathematical Literacy Grade 10 has no such introduction. However, the reader is introduced to the idea of values on the first page in the following manner: “*It is illegal to photocopy any pages from this book without the written permission of the copyright holder*”. Both books have employed contexts to develop mathematical knowledge.

An evaluation of the content of the books shows that various pertinent socio-economic issues relevant to the South African context have been addressed by the authors. These include, inter alia, issues of health (healthy living, mortality rates, HIV and AIDS), risky behaviour (smoking, gambling, alcohol and drug abuse), culture (patterns and designs using crafts), finance (saving, debt and inflation), environmental issues (global warming) and social justice. Learners are expected to critically engage with the contexts via the related questions. The philosophy behind the above approach is that learners will find it easier to understand and internalise the mathematical knowledge

through the analysis of familiar contexts. Besides the mathematical content, learners will also become sensitized to social issues within their communities and the South African people in general.

The National Curriculum Statement Grades R – 12 is sensitive to, inter alia, issues of gender and race. The names and pictures of persons of the different race groups in South Africa evident in the textbooks reveal that the authors have taken cognisance of the above. The topics in the textbooks are varied and cover a plethora of local, national and international issues. Unfortunately the authors of the textbooks missed numerous opportunities to integrate moral values. I will take the example of “Drug abuse” in Maths Literacy for all Grade 10 (page 85). The section begins with the fact that drug abuse is a common societal problem. It goes on to state that addicts can get help through rehabilitation and describes a part of the treatment. Learners are finally required to describe the elimination of cocaine from an addict in rehabilitation. The discussion could have gone on further to incorporate the effects of drug abuse on individuals, families and society especially with the abuse of drugs having reached such high proportions amongst teenagers. The section “Looking at data critically” provided much scope for the incorporation of moral values. For example, the activity “What do you believe?” makes use of charts to represent the data of crime in South Africa over a period of time. Learners are required to choose the chart that will convince people that crime is not increasing and support their decision using their mathematical knowledge. This activity has the potential to further interrogate values such as truth and honesty. These are examples of the “hidden curriculum” and the

values implicit in the curriculum should not be underrated. The way in which educators and learners interact and communicate with each other provide innumerable possibilities for modelling socially acceptable behaviour. The educator has invaluable opportunities to extract, reinforce and extend the knowledge that learners possess.

Although the style of writing in the books may differ, they both afford the learner the opportunity for reflection and creativity while working independently or in a group. Each chapter either deals with one context that requires the learner to draw on a range of mathematical knowledge or a range of contexts to support the development of a particular mathematical content. The learner needs to read and understand the context before answering questions that require basic remembering, understanding or application. The learner is then required to reflect on what has been learnt by means of self-assessment or reflection. The learner's creativity and analytical ability is tested when, for example, one is required to develop a questionnaire for a survey. Unfortunately, these assessments and reflections only evaluate mathematical knowledge gained and not the values that are present in the context, as in the examples of drug abuse and crime statistics above. The exercises do not require the learner to critique the situations but merely use the data in the charts to support their answers.

The final materials reviewed were the worksheets, assignments, tests and examinations. These materials were developed by the three educators whose classrooms I visited as they were the only persons in their respective schools

teaching Mathematical Literacy at the time of the data collection. An appraisal of the worksheets revealed that they were devoid of contexts and values that were evident in the textbooks. These learner materials dealt with the mathematical content only, for example, calculations using the order of operations, average rate of change and transformations.

An evaluation of the content of the assignments, tests and examinations shows that various socio-economic issues familiar to the learners and relevant to the South African context have been addressed. These include, inter alia, sport, the benefits of physical exercise, water consumption, environmental justice (recycling and visit to the Kruger National Park), inflation, finance (costs of constructing a house and budgeting for a wedding), gambling, road safety. Unfortunately the educators also missed opportunities to incorporate moral values into their assessments, concentrating only on the evaluation of the mathematical knowledge gained. Still on the same materials, it is evident that the writing styles in the textbooks are mimicked by the educators when setting tests and assignments. The philosophy underpinning this pattern may be that the learners are familiar with the style of the textbooks and will find it more comfortable to answer the questions. On the other hand, it may be that the educators themselves are not certain on the extent to which to integrate values into their lessons.

5.7. Summary

In conclusion, I believe that the Department of Education has made a concerted effort to include values education into the South African curriculum

and filter them through to the policy documents of the various learning areas. As discussed earlier, the policy documents are not explicit on how these values are to be integrated into the lessons in Mathematical Literacy. As a result, the textbook writers were left to their own devices to interpret these policy documents when developing materials for learners. Certain content and contexts appeared to pose a challenge for authors' to integrate them with values. However, the textbook writers and teachers seemed to have found it more effortless to develop the content in contexts that are relevant and familiar to South Africans.

The review of the learner materials reflects a cautious progression of values from the Constitution of the Republic of South Africa through the policy documents into the learner materials. A summary of the contexts and implicit values point towards the promotion of social transformation and the preservation of human rights and social justice.

The next chapter will focus on the data collected through the classroom observations, and individual and focus group interviews with teachers and learners. I will also be ascertaining learners' views on Mathematical Literacy and the challenges that they meet in the classroom.

CHAPTER SIX

The Practice of Values in South African Classrooms

Mathematical Literacy

The secret of education lies in respecting the pupil. – Ralph Waldo Emerson.

6.1. Introduction

In this chapter I describe my observation of the practice in three different classrooms. The observation spanned over a period of three months. Each school was visited in blocks of two weeks; hence there was a break between the two sets of visits. The aim of the classroom observations was two-fold. First I wanted to establish if and how teachers' integrate values in the Mathematical Literacy lessons. The second was to observe learners' behaviour in the Mathematical Literacy classroom. I was interested in observing classroom practice in order to compare it with learners' reported understanding of values and values education.

To protect the identity of the educators and schools, pseudonyms have been used. Mrs Lindt taught Mathematical Literacy at School A, Mr Jacobs was the teacher at School B while Mrs Daniels taught at School C. Learners were also assured of anonymity and confidentiality as I did not want their identities to be revealed. The three grade ten classes that I observed were all in state schools.

I commence with background information on the type of schools where the classroom observations and individual and focus group meetings took place.

This is supplemented by a brief background of the three educators and a description of the learners to help glean insights about the study population. I then present my findings from the three classrooms that I visited.

My choice to observe the teaching in these particular classrooms was as a result of the three educators having been students on a mathematical literacy ACE course that I had taught at university. I was interested in observing if values, such as respect, honesty, consideration, love, forgiveness, sharing, amongst others, were being promoted in Mathematical Literacy and if so, how they were being promoted. The mathematical literacy classroom was chosen as it was the first year of implementation in grade 10. Secondly I was interested in the educator-learner and learner-learner communication in the classroom, listening for language and tone that portrayed, inter alia, values such as compassion, empathy, kindness, patience, humility. A third aspect of these sessions was to observe the educator-learner and learner-learner relationship in the classroom.

In order for me to manage the data I collected, I present the information for each of the schools through a different lens. For School A I have synthesized the data into a typical Mathematical Literacy lesson presented by Mrs Lindt. For School B, represented by Mr Jacobs, I have presented some of the lessons to show the development values in his classroom. The data for School C is presented using the environment and some of the incidents that occurred during my visits that were absent at the other two schools. Hence I commence my presentation with School A.

6.2. Mrs Lindt goes to school

Mrs Lindt is a young ‘white’ female who has practiced as an educator for 8 years. School A at which she teaches is located in an upper middle income northern suburb of Cape Town. The environment at any institution sets the tone for effective teaching and learning to take place. The traditional layout of the school buildings and the atmosphere that prevails at School A lends itself to achieve this educational aim. The well maintained school provides facilities for a variety of sport.

The classroom that Mrs Lindt occupies is large and well ventilated and serves as her home-cum-subject room. This classroom is housed on the upper level of the school building. The desks, arranged in pairs facing the chalkboard at the front of the classroom, can accommodate a maximum of thirty four learners. The relaxed atmosphere that prevails in the room is conducive to work.

The colours within the room enhance the atmosphere. The walls of the classroom are painted lilac while the desk tops are a much brighter shade of blue. One wall comprises mainly of large windows with curtains that hang down to the wooden floor. The teacher’s table and chair are placed toward the front left corner of the room with a tall cupboard for storage behind the table. The displays on the chart board reflect that both Mathematics and Mathematical Literacy are taught in this room. The aim of the display charts is to:

- inculcate an appreciation for the subject

- reinforce the mathematical content that is disseminated in the classroom
- serve as a tool of reference when learners are engaged in mathematical tasks
- inform a visitor to the classroom about the subject taught in the room.

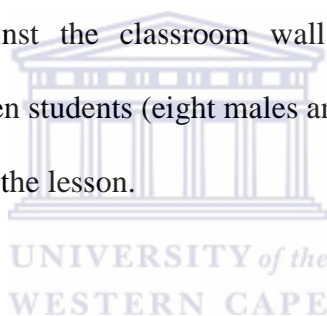
Other notices pertaining to the rules of the school also appear on the board. Both the teacher and learners have access to computers and a well-resourced library.

Twenty six learners in the grade 10 class occupy this room for Mathematical Literacy lessons. This grade 10 class which comprises of 'black', 'white' and 'coloured' learners is representative of the learner population of the school. The school is easily accessible for all the learners in the class. Each learner in the class is in possession of the prescribed textbook, stationery and a calculator.

Mrs Lindt has a degree in education and an Advanced Certificate in Education (Mathematical Literacy). Besides teaching Mathematics and Mathematical Literacy, she is very involved in sport at the school. As way of introduction to what I was going to observe during the lessons, I presented Mrs Lindt with a list of moral values together with a notebook/journal. She was to record the value(s) she thought that she was promoting in her Mathematical Literacy lessons daily. I also asked that she commence her record keeping with her definition of values and values education. However, at the end of my observation session she had nothing in the journal. Nonetheless this was not

an exercise in futility; the fact that Mrs Lindt had not kept the journal still provided me with invaluable data.

At school A the classrooms are subject-based which requires learners to move between subject rooms throughout the day. The lessons are forty seven minutes in duration. The grade 10 class has most of their lessons in Mathematical Literacy during the last session of the day after lunch. A description of the lesson presented by Mrs Lindt follows. On that day the lesson that I am describing commenced at 13h39. Mrs Lindt waited at her classroom door as the learners assembled silently in two lines outside on the balcony; the girls against the classroom wall and the boys along the balustrading. The nineteen students (eight males and eleven females) settled at their desks ready to start the lesson.



The topic under discussion in this lesson was: Simple and Compound Interest. She appeared enthusiastic about starting a new topic after having spent the last two days on reviewing the answers to the June examination papers. Learners were given a few minutes to read through an introductory paragraph on simple and compound interest. A discussion of the paragraph based on the following example ensued.

Imagine that you receive R1 000 as a gift and decide to invest it at a fixed rate of 5% interest per year for a period of 10 years.

(i). How much interest would you earn every year?

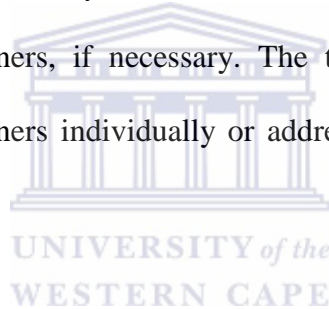
(ii) How much interest would you earn in a total of 10 years?

I listened to Mrs Lindt as she painstakingly ensured that learners understood the concepts that she was explaining. Her humour made her learners feel at ease. When asked a question that she was not sure about, she responded: “*I’ll be honest ...*”. Ten minutes into the lesson five learners arrived at the class. One of them tried to explain the group’s late arrival.

Learner: *Excuse me Miss. Sorry that we are late. We ...*

Mrs Lindt (stopped the lesson): *I do not want to listen to any excuse. Go and sit on the balcony outside the classroom and do not disturb the lesson.*

Mrs Lindt continued with the lesson as though there had been no interruptions. She completed the discussion and then set an activity for the learners to work through. They were told to work independently but could consult with other learners, if necessary. The teacher walked around the classroom assisting learners individually or addressing the class as a whole when necessary.



All through Mrs Lindt’s lesson two learners worked on an assignment activity from the previous week. This activity was to have been handed in for marking at the beginning of the lesson. These two learners did not participate in the lesson on hand as they scrambled to finish the assignment.

For the entire lesson the five students outside the classroom sat talking to one another. Only once during that time did Mrs Lindt acknowledge their presence with: “*Quiet out there! Your noise is disturbing us in here!*” Approximately five minutes before the lesson ended the learners asked for permission to come in. The teacher still refused these learners access to the class.

I waited for when she would use the opportunity to explicitly integrate values into the lesson especially as the activity that she had set for learners involved lottery winnings and investment of money. The learners arriving late at her class also presented an opportunity to include values in the lesson but this discussion did not materialise. One may argue that this was her way of getting a value across to her learners in a non-verbal manner.

As a student in the Advanced Certificate in Education course, Mrs Lindt came across as a pleasant, enthusiastic, meticulous and dedicated teacher. Being from Europe, her tone of voice may make her appear harsher than she really is. She knows her subject well and made a concerted effort to make the content enjoyable and accessible to her learners. Her style of classroom management confused me. On many occasions, she surprised me by continuing her lesson despite there being learners in the class who were not paying attention or engaging in other activities. On the other hand, she became quite annoyed when learners, on more than one occasion, came late to her class barring them from the entire lesson.

I questioned Mrs Lindt about the observations I had made during the lesson when I met with her at the end of the day. I had to remind myself that as the researcher I had to remain non-judgemental when asking her about her attitude toward the late comers and the two learners working on something else in her class. She responded:

“I don’t have a problem with learners working on other exercises in not doing any work ... but when learners who come late to class are distracting ... the others stop to watch the late-comers. Time is being wasted.”

The irony of it is that during one of the lessons that I observed there were four interruptions to the lesson when students (not from the class) came in with messages for the educator or the class. These caused a greater distraction than a group of learners arriving late to a lesson. I also brought up the issue of integration of values into the lesson. Mrs Lindt was of the opinion that:

“Many of the learners already have a problem with the content. I need to make sure that they understand the concepts ... they know which formula to choose ... they know how to do the calculations. I don’t consciously think about values when I’m planning my lesson ...”

This response later explained the reason behind Mrs Lindt not recording the value(s) that she thought she promotes in her lessons.

I left Mrs Lindt in her classroom that afternoon to prepare herself for the next day’s lessons. Having spent time in her classroom over a period of time, I realised that she did not explicitly integrate values into any of her lessons. I am not certain whether she realised the many values that were inherent in her lessons or the myriad opportunities to integrate moral values into her lessons, which she missed. Her attitude towards values and values education may be related to the fact that the policy documents are not explicit on how these values are to be integrated into the lessons in Mathematical Literacy. Notwithstanding her comment about not consciously thinking about values when planning her lessons, a review of the assignments, tests and examinations developed by her, show that she has to a lesser extent learnt to integrate values into Mathematical Literacy. For example, the use of the words ‘donation’ and ‘Arrive Alive campaign’ the following question appeared in the September Examination paper she had set:

The Arrive Alive campaign receives a donation of R1 500 000. It is decided to invest the money for 4 years. They have to options:

- *Option A: 13% p.a. compounded annually*
- *Option B: 12% p.a. compounded monthly*

Calculate which option will be the best for them.

Some of the values implied in the above question are: concern for all life, consideration, generosity and responsibility. For further examples see the examples of learner material in the Appendices.

A discussion of School B follows.

6.3. Mr Jacobs and his learners

Mr Jacobs, a young ‘coloured’ male, is a dedicated educator. His calm and pleasant demeanour is evident inside and outside the classroom. He was enthusiastic about teaching and the learners enjoyed having him as their teacher. At the time that I observed his lessons, he had been teaching for 10 years.

School B at which Mr Jacobs teaches is located in a lower middle income suburb of the Cape Flats. Although the school buildings follow the traditional layout, the atmosphere that prevails at School A is not visible at this school. Gaining access into the school grounds is difficult, as the gates are always locked and there is no system of communication between the gate and the administration building. On each of my visits to the school I had to phone the school’s secretary to open the gates. Despite the school buildings being well maintained, the school grounds and the vicinity around the school are quite barren. The school provides facilities for a variety of sport as well.

Mr Jacobs' large, well ventilated second floor classroom serves as his home room and subject room. Thirty six girls and twelve boys in the grade 10 class use this room as both their form home room and for their Mathematical Literacy lessons. The desks are arranged around the classroom in eight clusters seating up to a maximum of six learners in a group. There are girls only, boys only and mixed groups. In spite of the large number of learners, this arrangement of the desks creates a very relaxed atmosphere for learners to work in.

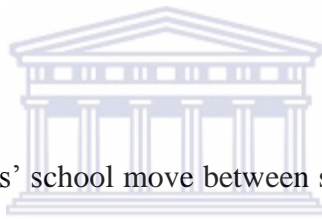
This atmosphere is further enhanced by the light coloured walls of the classroom and the double volume windows aligned on one wall. The teacher's table and chair are placed at the middle front of the room with a tall cupboard for storage to the left front of the room. The display charts reflect that Mr Jacobs teaches Mathematics, Mathematical Literacy and Biology in this room. Other general notices also appear on the board.

Each learner in the class is in possession of the prescribed textbook and an exercise book in which to work. The majority of the learners also own a set of mathematical instruments and a calculator. Both the teacher and learners have access to computers and a well-equipped resource centre. At times Mr Jacobs conducts lessons in Mathematical Literacy in the computer room to allow students to work on interactive work sheets.

Like the rest of the learner cohort at School B the grade 10 class comprises of predominantly 'coloured' learners and a small proportion of 'black' learners.

For the majority of learners at the school, English is a second language. Most of the learners live within walking distance and get to school on foot. However, a small proportion has to travel greater distances to get to the school.

Mr Jacobs has a degree in science and an Advanced Certificate in Education (Mathematical Literacy). Besides teaching Mathematical Literacy and Mathematics, he also coaches the school's junior and senior boys' teams in hockey. Like Mrs Lindt, Mr Jacobs received a list of moral values and a notebook/journal from me. Unfortunately he abandoned the journal after the initial entries.



The learners at Mr Jacobs' school move between subject rooms five times per day as the lessons are of sixty minute duration. The grade 10 class has all their lessons in Mathematical Literacy before the morning break at 10h25. As Mr Jacobs is the home room teacher to this cohort of learners, more often than not they are already seated for their lesson in Mathematical Literacy when the siren sounds at the change of lesson. The day of the lesson that I am describing was no different as the lesson commenced at 8h00.

The topic under discussion in this lesson was: Games and Hobbies. Learners were given a paper plate each during the previous lesson. In preparation for the lesson on hand, learners were required to (i) divide the plate into segments and (ii) list words that were associated with a circle. The learners appeared enthusiastic about starting this new topic since they had only just arrived back

at school after the mid-year school break. A relaxed atmosphere prevailed in the classroom. Learners were given a few minutes to collect their thoughts before responding to Mr Jacobs' question:

“In the last lesson I had asked you to list words that are associated with a circle. Can you give me some of those words?”

They collectively provided the teacher with the following list of words: *centre, circle, circumference, diameter, protractor, radius, sector, segment* and *vertex*. Mr Jacobs went on to elicit definitions of the various terms that were suggested, with explicit reference to the terms: radius, diameter, circumference and vertex. Visual representations were done on the chalkboard to enhance the learners' understanding of the concepts. He then asked the learners to *“find the measurement of the radius, diameter, circumference and a vertex of the paper plate”*. The teacher walked around the classroom assisting and correcting learners with the use of mathematical instruments.

The lesson progressed to learners having to work on an activity based on a dartboard called Bullseye! The learners' attention was aroused when their teacher produced a dartboard to assist with the activity. I listened to Mr Jacobs' meticulous teaching as he gave attention to each of his students. His humour set his learners at ease. Learners worked animatedly in groups, right until the end of the lesson. When introducing the activity on the dartboard, he confessed that he doesn't *“... know how to play darts. I don't want to go around throwing assegais”*.

Considering the topic on the dartboard, I waited for Mr Jacobs to integrate values into the lesson but this discussion did not happen. However, values education did see its way into the lesson via the backdoor. Thanks to his personality, the learners in the class felt comfortable with approaching him for advice on personal issues. This saw the transformation of Mr Jacobs from Mathematical Literacy educator to student counsellor. His advice to the learners was *“Always remain focussed ... make your studies the priority ... that’s what will get you to a better place.”*

From our initial meeting, I found Mr Jacobs to be a jovial, caring and easy-going person, who showed a passion and dedication for teaching. His enthusiasm for teaching impacted favourably on his learners. His style of classroom management worked well and for the period of time that I spent observing his lessons I found the level of discipline to be generally good.

I also brought up the issue of integration of values into the lesson with Mr Jacobs when I met with him at the end of the lesson. His response was:

“I must be honest ... I never really considered the values in my lessons ... I guess I’m so busy thinking of the content ... values was never on the agenda.”

The manner in which Mr Jacobs handled his class made an impression on me. He did not seem in a hurry to complete the syllabus; he was prepared to entertain learners bringing up personal issues in his lesson. When asked about this he said:

“It’s a problem if the student is not getting work done because of personal issues. Some of these kids come from very sad homes ... if I don’t listen to them ... then I’m failing them ... we never know what the kid is going through and we expect them to perform in class.”

I left Mr Jacobs that morning as he waited for the next class to arrive for a lesson in Mathematics. Having spent time in his classroom over a period of time, I witnessed Mr Jacobs making a concerted effort to integrate values into his lessons, assignments, tests and examinations. In his lesson on the following morning he illustrated his first attempt of this integration into the lesson on circles. He used the idea of the circle being a cycle and used the life cycle of a butterfly to illustrate his point of what was meant by cycle. The learners were given time to discuss the notion of cycles in groups. The class picked up on the idea and issues of recycling and the cycle of life emerged.

One learner let us know that:

“... my mother and grandmother fell pregnant while at school. Both left school and became mothers. Sir, I’m going to break that cycle. Do I look like I’m going to get pregnant anytime soon?”

Mr Jacobs approached me on occasion to affirm that the value(s) he was suggesting was in fact inherent in the content or context. He also started making use of the incidental issues in the class to integrate values (either on an individual basis or with the entire class) into the lessons in Mathematical Literacy. For example, during a computer-based lesson on the straight line, a few of the learners were talking when Mr Jacobs was giving instructions. As a result this group was at a loss when asked to work on their own. Instead of reprimanding them or getting upset, he simply asked nearby learners who had been listening and were following the instructions to tell the group what was to be done. In so doing he was able to demonstrate to the miscreant learners the values of attention and focus while building self-confidence in the co-operative learners.

The time spent observing Mr Jacobs' class reaffirmed the influence an educator can have on values. It was evident that the learners in his class looked up to him as a role model. They saw him as someone who they could turn to when they needed direction in their lives.

Finally I look at the third classroom that I observed lessons in.

6.4. What goes on in Mrs Daniels' classroom?

Mrs Daniels, a coloured female, has practiced as an educator for 10 years. School C at which she teaches is located in a low income suburb in the Cape Flats. This five year old project school receives extra funding. The school comprises of both brick and mortar and prefabricated buildings set around a tarred quadrangle that serves as a netball court. The majority of the classrooms are housed in the prefabricated buildings. The school borders on a high traffic main road and is in close proximity to an informal settlement. The school grounds and the vicinity around the school are barren. The fencing with barbed wire rolls along the perimeter of the school suggests that security is vital in the area. Gaining access into the school grounds is also difficult, as on most of my visits the gates were locked. The lack of a system of communication between the gate and the administration building makes entry quite impossible at times. The school's telephone was also not working at the time of my visits. On two of my visits to the school I waited at the gate in the hope of someone coming out into the parking area and opening the gate before the start of the lesson I was going to observe. A third visit saw me leave the school gate without observing the lesson as nobody came into the

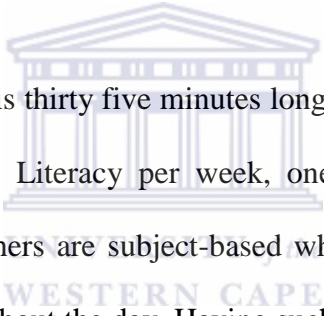
parking area and I could not contact the teacher. There are no proper sporting facilities at the school.

The fairly large ground floor classroom occupied by Mrs Daniels is housed in one of the prefabricated buildings. There are five windows, three of which are set high up on the wall, leaving the room rather dark and gloomy. All the windows looking onto the road are protected by burglar bars. Of the pair of strip lighting on the ceiling only one is functional. Like the previous two educators Mrs Daniels uses this as her home-cum-subject room. Fifty five learners in the grade 10 class use this room as their home room and for lessons in Mathematical Literacy. Groups of desks are arranged lengthwise in this overcrowded room, leaving little space for movement between them. The teacher's table and chair are wedged between the desks and chalkboard in the left front corner of the room with a tall cupboard for storage at the right front corner next to the door. The walls of the classroom are painted grey/cream with the door being olive green. Both are in need of a coat of paint. The floors have grey vinyl tiles. Both teacher and learners sit on plastic chairs. The walls are devoid of any display charts or notices.

Although the learner population at School C is 'black', it is still multilingual. While most of the learners who live in the surrounding low cost houses and nearby informal settlement walk to school, there are a few learners who live further afield and have to rely on public transport to get to school. These learners spend a considerable amount of time travelling to and from school each day. While each learner in the class is in possession of a copy of the

prescribed textbook and an exercise book in which to work through activities, the majority cannot afford other essential mathematical requirements, such as calculators and mathematical instruments. The teacher has sufficient calculators and mathematical instruments locked in her cupboard to distribute four to each group of learners to use in class when required.

Besides having completed an Advanced Certificate in Education (Mathematical Literacy) course, Mrs Daniels also has a diploma in teaching. Her level of involvement in sport at the school is minimal. Mrs Daniels had forgotten about the notebook/journal I had given her.



Each lesson at School C is thirty five minutes long. The grade 10 class has six lessons in Mathematical Literacy per week, one spreading over a double period after lunch. Teachers are subject-based which makes it necessary for learner movement throughout the day. Having such a large number of learners moving around the school campus every thirty five minutes creates a problem of control at times. In Mrs Daniels' class I relate the incidents that I observed and the manner in which she handled each of the situations.

On the first day of observation, Mrs Daniels was busy at her table as the learners streamed leisurely into her classroom at 10h50. The twenty three male and thirteen female learners sat at their desks and continued to talk amongst themselves. A male student was asked to hand out the calculators to the various groups of learners. Ten minutes into the lesson the teacher had the class settled and work commenced. The learners were reviewing their mid-

year examination scripts and the topic under discussion was: Simple and Compound Interest, for example:

Zandile takes out a bank loan of R13 500. The bank charges her 12% p.a. over two years. How much money must Zandile pay the bank?

The learners reworked the questions from the examination paper while the teacher walked around assisting individuals or groups of learners. The class became very noisy with learners assisting one another, predominantly through the medium of isiXhosa. A number of attempts by Mrs Daniels to quieten the class proved futile. At this point she resorted to screaming, “*Tomazaan! Tomazaan! Tomazana!!!*” and the class fell silent. In many of her later lessons Mrs Daniels also resorted to this method of getting her learners’ attention. At the end of the lesson the calculators were collected and counted by two students. They informed Mrs Daniels that there was a calculator short. The teacher asked the learners whether anyone still had a calculator in their possession. When she got no response she began screaming at them:

“Who has the calculator?! Someone has taken a calculator and not returned it! ... You are ungrateful! If I don’t get back that calculator ... no more calculators for you to use!”

However, despite all the screaming the calculator was still not found. The learners left for their next lesson with the teacher still fuming over the incident.

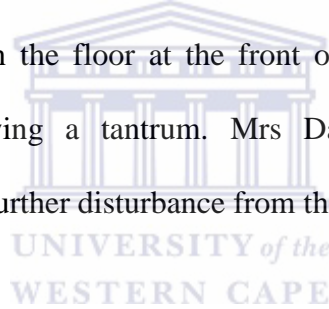
In a separate lesson on data handling, a few learners were asked to work out examples on the chalkboard. Mrs Daniels moved around the room marking the previous day’s exercise and commenting aloud “*very neat*” in response to some of the learners work. A learner at the back of the class sat singing rather audibly: “*very neat, very neat, very, very neat*”. I noticed a learner, with his

arm around another of his classmates (show of camaraderie), animatedly explaining the workings of an example on the board. The teacher finally moved to the board to discuss the following example to the class in general.

Nandi has completed all her portfolio activities for Mathematical Literacy. Her marks appear as follows. She has basically 10 portfolio activities completed. The scores are: 35, 27, 47, 16, 15, 20, 30, 18, 40, 34.

Calculate: a) median b) range c) mode d) mean.

She found that most of the learners continued talking amongst themselves and ignored her completely. When her attempts at quietening them down with “*Tomazaan! Tomazana!!!*” failed, she surprised me and silenced the learners by stamping her feet on the floor at the front of the room! It appeared as though she was throwing a tantrum. Mrs Daniels continued with the discussion without any further disturbance from the learners.



On two occasions I arrived at the school only to find that I was not going to get to observe any lessons. In the first instance, Mrs Daniels had forgotten to inform me that the learners were writing a test. On the second occasion I arrived at the school ten minutes before the start of the lesson at 13h10 and waited in the visitors’ area. When there was no siren to signal the change of period, I enquired from another member of staff as to what was going on. Mrs Daniels was sent for and emerged ten minutes later from the staff room only to inform me that there had been a change in the timetable. She was already finished with her lesson. She apologised saying

“... I started the lesson ... only later did I realise that you were scheduled in my class. I didn’t think to call you and let you

know about the change in times. I'm very sorry for the inconvenience”.

For the last observation session I arrived at Mrs Daniels' classroom at 9h50. As usual learners were streaming into the classroom at their own pace. Learners were given a follow up exercise on factorisation. The class appeared less noisy as they worked through the exercise. Mrs Daniels was walking around the room as usual marking the learners' exercise books and providing individual assistance to learners. Fifteen minutes into the lesson four boys arrived, picked up their bags and left the room without communicating with the teacher. Ten minutes later another male learner walked into the room, tugged at the teacher's sleeve and indicated for her to come outside. Mrs Daniels stepped out of the room for a few minutes and resumed the lesson as if there had been no interruptions. For a while there was a constant movement of different learners into and out of the room, causing much disruption to the learners. I was very confused about the above activities and when I spoke to Mrs Daniels after the lesson that was the first of my questions. She filled me on what was going on.

“... Before I got to my room this morning some of the boys were inside lighting pieces of paper ... now the Deputy Principal is investigating the matter.”

During the time I spent observing Mrs Daniels' lessons, she had many opportunities to integrate values into them. Even if she did not use the content and contexts of the activities in Mathematical Literacy given to learners, the incidents that occurred in her classroom as described above, presented ideal opportunities to include values in the lessons. For example, the missing

calculator offered her an opportunity to speak about honesty while the incident of the lighting of fires could have developed into a discussion on responsibility and respect for property.

Her classroom management style left me with a myriad of questions. I was confused by her contradictory responses to the learners' behaviour: she showed no reaction to learners walking into class late yet reacted in a rather dramatic manner when the learners became noisy in the class. Her justification was:

“I cannot wait for all the learners to get here ... it's up to them ... I will work with whoever wants to learn ... they will not listen even if I punish them ... But if they are in class ... they need to pay attention ...”

On questioning Mrs Daniels about integrating values into her lessons, I received the following comment:

“You saw the kind of stuff we have to deal with. Every day there's an issue with learners in this school ... they don't appreciate anything. I'm tired ... I'll teach the maths ... The principal and the parents can take care of discipline.”

The time spent in Mrs Daniels' classroom convinced me that her priority was to complete the syllabus with the learners that were interested enough to get to her class. Mrs Daniels was a confident and capable teacher but she appeared tired trying to sort out the problems of learners. For her, it was not just a matter of missed opportunities for the integration of moral values into her lessons, but rather the fear that with the myriad disciplinary issues in her class, this may result in more time being spent on the integration of values than on the subject content. Nonetheless a review of the assignments, tests and

examinations developed by Mrs Daniels, subsequent to my visits to her classroom, show that she has to a had attempted to integrate values into the Mathematical Literacy curriculum. An example is the use of the names: Pete, Gail, Zuko and Neshni and corresponding pictures of the individuals in an examination that she had set. It illustrates the values of equality and non-discrimination with regard to race and gender. For further examples see the examples of learner material in the Appendices.

6.5. Summary

In conclusion, my findings from the observation sessions suggest that both teacher and learner understanding of values are greatly influenced by the educational environment in which they are situated. However, one cannot discount the fact that both groups bring with them their own beliefs and life experiences that impact on values. Nevertheless, it is the teacher who ultimately determines the level to which values education is implemented in the classroom.

I noted mixed responses from the educators about the integration of values into their lessons. Teachers were not always prepared to take responsibility for values education in their Mathematical Literacy classroom especially if it meant dealing with negative behaviour. They viewed values as a means to an end; it basically helped them to maintain discipline in their classes. Both female educators were convinced that they were there to teach Mathematical Literacy and not values education.

CHAPTER SEVEN

Understanding and Identification of Values in the Classroom

Through the microscopes of learners

Open your arms to change, but don't give up your values. - Dalai Lama

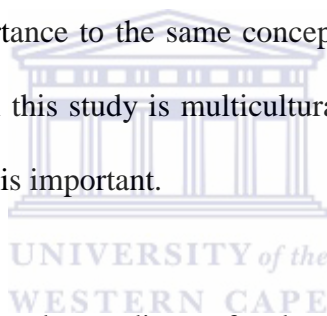
7.1. Introduction

The findings of my research on learners' understanding of values and the identification thereof in Mathematical Literacy classes are presented in this chapter. I was interested in establishing whether learners' stated understanding of values supported their behaviour and practice in the classroom. This understanding of values was crucial to the second tier of the focus group interviews, as I wanted to determine whether learners were able to identify, interpret and implement values embedded in the content and contexts in Mathematical Literacy lessons.

According to Okore (2007) the concept of understanding is both relative and contextual. As a relative concept, understanding is dependent on intent while carrying varying levels of meanings. At the simplest level it suggests an awareness of the existence of something, while at the second level it involves a deeper appreciation of the details of the idea under consideration. Level three draws on sympathetic awareness with the last level referring to practice. This bears a similarity to the multi-tiered model of classifying the perception of value issues to five affective levels of complexity as suggested by Bloom's Taxonomy for the affective domain. These levels include receiving (the mere awareness of values), responding, valuing, organizing and conceptualizing,

and characterizing by value or value concept (Kratwohl, Bloom & Masia, 1964). The fifth tier is the ability to distinguish implicit values through analysis. Despite the fact that Bloom had two sets of taxonomies for the cognitive and the affective domains, the two domains do not function separately but are co-dependent on one another. Seah's (2002) contention that "a high level of cognitive involvement is associated with values" illustrates this interrelatedness of the two domains.

Understanding as a contextual concept gets its meaning from a context-dependent knowledge base. As a result, different societies may assign different levels of importance to the same concept. Considering the fact that the learner population in this study is multicultural, the source of knowledge of learner understanding is important.



In this chapter, learner understandings of values and of factors that shape these understandings as reported from the focus group discussions are presented. Furthermore, the learners' ability (or lack thereof) to identify values in the classroom and to practice them is also given. The interviews were semi-structured to enable learners to freely express themselves about what they think values are. From the discussions I was also able to perceive the factors that play a crucial role in influencing their thinking on values.

7.2. Factors that influence values

As a prelude to the chapter I will give a synopsis of the factors I consider as having a substantial influence on values in South Africa. My study presumes

that amongst the numerous factors that have an influence on values and values education, there are four fundamental issues, namely: culture and ethnicity, religion, politics and international influences.

Culture and ethnicity wields a strong influence on values. South Africa has a culturally diverse population. During the apartheid era people lived in areas that were racially divided. Despite there being a shift to racially integrated areas in post-apartheid South Africa, there are still very many areas that are solely occupied by a single race or ethnic group. This determines the behaviour, norms and values evident in the given area. Though people move into areas that are more integrated, many retain their cultural/ethnic practices. Members of society become stereotyped according to ethnicity. Similarly learners and teachers bring with them into the classroom the norms and values associated with their culture. These may be alike or differ depending on the communities to which they belong.

Religion is a second issue that has a bearing on values. Besides being a multicultural people, South Africans also belong to different religious groups. For many families and communities, values and religion are synonymous. Religion may, in certain instances, determine people's decision of where to live or which school to send their children to. Learners, like teachers, assimilate the values, norms and practices depending on their religious affiliation.

The third level of influence stems from South African politics. Many South Africans are still rooted in the past, despite the rainbow nation being almost two decades old. Local politics is keenly associated with religion and culture. The dominant religious and cultural beliefs of the area impact on the political philosophy as well. For example, there are a greater number of Minority Front supporters in KwaZulu-Natal than the rest of the country as a result of the large Indian population in that province. Since many of the political parties have a youth wing, the philosophy of the mother party is invariably adopted by the learners.

Last but not least, value systems are also influenced by international trends and issues. Besides being exposed to global fashion and social issues such as children's rights and animal rights, South Africans are also exposed to international cultures. As a result new debates and discussions, such as on HIV/Aids and risky behaviour, are finding their way more often into the classroom.

The manner in which the above factors influence the learners is vital to the analysis of this study. I present my findings from the three focus group interview sessions next. Cognisance must be taken of the fact that this was the learners' first explicit experience with values education in the context and content of the Mathematical Literacy classroom. I have coded the responses as follows: FL1 represents female learner 1 and ML1 to represent male learner 1. To make the data more manageable, I present the responses of the learners of each school as a unit and not per lesson. Further, learners' responses to the

viewing of the video footage are presented thematically under the auspices of the schools. Learners were asked for the meaning that they ascribed to values, the responses to which are synthesised and presented as a group response per school. A presentation of my findings follows.

7.3. Learners qualify values

As a way of introduction to the focus group interview sessions, I attempted to establish the meaning that learners ascribed to values. This information enabled me to structure my questions for the learners in a suitable manner. The following provides some insights into the groups' understanding of values.



The learners at School A were of the opinion that:

“Values are things that are important ... from the time that we are young our parents and teachers teach us values. It makes us know what’s right and wrong.”

At School B the learners thought:

“Values are things that make us behave well ... they are what we believe in things that we think are important.”

Learners in the focus group at School C responded to my request about what values meant to them in the following manner:

“Values is like respect ... like when the teacher is teaching we must respect her ... listen to her. We learn values from when we are small. ... Values help us to do the right things.”

There is no definitive answer to this question. Nonetheless I recognised that learners in all three schools considered values to be a positive entity that was

associated with good behaviour. Having established a sense of learners' perceptions on values, I proceeded to interrogate their understanding of values in the classroom, building on the idea that in the Mathematical Literacy classroom values exist in contexts and in the mathematical content.

7.4. Learners' understanding of values

I recorded the following as understandings amongst the learners.

7.4.1. Learner understanding is based on personal gain

As these focus group interviews followed my observation sessions in the classrooms, the learners present were already familiar with the idea of values in the classroom. All of these learners had a copy of the 108 sub-values in their possession. I was interested in their views on integrating values into the Mathematical Literacy lessons. I was met with varying views on the subject from the learners at all three schools.

Some of the learners believed that the contexts that appeared in the exercises were difficult enough, without adding another dimension to complicate the understanding of the mathematical content. For example a male learner from School C claimed that:

“... The context only assists me in understanding the content. The only value I get out of the content is now I can calculate simple and compound interest ... which will help me to pass the exams ... it helps me to make decisions on investments.” (ML6)

Another learner felt that he had to

“... concentrate on getting the answers right. We need to make sure that we understand the maths. Maths Literacy is also

difficult. We do a lot of things that are difficult. You need to use everyday knowledge ... not values.” (ML7)

I established that learner understanding of values is based on the notion: of what benefit is it to me, the learner? The comments as those above demonstrated that for some learners the priority was to achieve academically. In accordance to the list of sub-values, the value demonstrated by these learners is the quest for knowledge (a sub-value of truth).

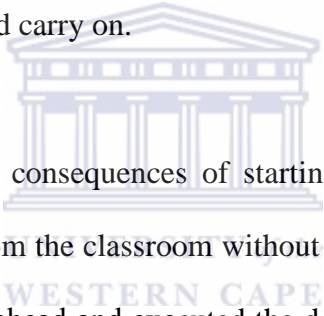
I noted that other learners had a different understanding of values. A learner from School A explained the need for respect in the classroom:

“ respect like ... like if we like participating in the class ... and each one puts up their hand ... we have to give everyone a chance to say what they want to say ... cause if we just gonna talk and go on ... and not give that person a chance to explain ... we can learn maybe learn from what they are saying.” (FL3).

The above comment reinforces the fact that showing respect for a peer was tantamount to learners benefitting academically. However, not all learners shared the same view. There were learners who were more open to the idea of integrating values into the Mathematical Literacy lessons. Even when seated in front of the computer screen viewing the recorded lessons these learners easily identified values inherent in the lesson. For example: In the video a learner found difficulty understanding the teacher and required repeated explanations. The other learners around him became silent allowing him to hear the teacher. The focus group labelled that as: consideration. It is evident that learners will follow a route of least resistance. For many of them their purpose in the Mathematical Literacy classroom is to learn the subject matter.

Anything over and above is not seen as essential and hence of not very meaningful use in accomplishing the goal of passing the subject.

Although the learners were fully conscious about values and moral issues, their choice of actions reflected self-interest. Possessing a value did not necessarily result in putting it into practice. For example, the learners in Mrs Lindt's class were of the opinion that it was not fair on the learners to be given time out for arriving at class late as they lost out on the lesson, but turned a blind eye to the situation because "... *if we say something we'll get into trouble with mam ... she'll get angry ...*"(FL2). The best strategy was to pretend to be ignorant and carry on.



In spite of knowing the consequences of starting a fire in a classroom or removing a calculator from the classroom without permission, learners in Mrs Daniels' class still went ahead and executed the deed. I concluded that values were not regarded as important by some learners; they needed to act in a manner that would ensure their survival. I observed that learners' understanding of values and their value judgments were resonant of their environment and circumstances.

7.4.2. Learner understanding of values has a socio-cultural-religious foundation

The interviews revealed that learner understanding of values is securely seated in their social, cultural and religious background and experiences. During our discussions it was evident that learners drew on these backgrounds to make

certain judgment calls. The community in which the learners live wields a great influence on their actions. Clearly culture has an impact on how learners make value judgments. In the interview with the learners from School B the issue about learners falling pregnant arose. A male learner commented about the culture.

ML3: *Pregnancy ... is a part of our culture. People fall pregnant after grade 10*

Researcher: *What do you mean by 'our culture'?*

ML3: *The 'coloured' community.*

The idea of culture surfaced again later in the discussion in the following comments:

Researcher: *What did you notice when the learners were all talking amongst themselves?*

Some Learners: *They understand each other. They were all part of one big family. They comfortable with each other*

ML3: *Topics allowed them to ... 'coloured' people are very vocal about their opinions.*

One gets the sense that the views of the community take precedence over that of the individual; one needs to get affirmation from the community before taking action. Traditionally in some communities the teacher is highly esteemed. Hence if learners are brought up in a community where one shows respect for an elder by not looking the elder in the face when being spoken to, they will demonstrate this in the classroom. This in turn may be construed by a teacher of a different culture as a sign of disrespect. This was evident in Mrs Daniels' class when on a few occasions she was heard saying "*Umfaan! Look at me when you speak!*"

Learners raised in a community where females are considered subordinate to males, will demonstrate gender biases in the classroom by their treatment of females. I was of the opinion that this was the situation with the mature male learner in Mrs Daniels' class who felt that the only value he could get out of the Mathematical Literacy content was the ability to *“calculate simple and compound interest which will help me to pass the exams ...”* (ML7). His attitude toward females and demeanour at the interviews also reflected this.

It was noted that many learners seem to associate moral values with religion. During the introductory segment of the interviews clarity was made about moral values not being a religious issue. Hence on the issue of values being integrated into the Mathematical Literacy lessons, some learners had the notion that the values should not be included. At the commencement of the interview session learners had been asked to write down a few things about themselves. As the discussions were centred on values, one student from School B wrote:

“I am a Christian and love going to church where my father is the pastor of our congregation. ... I believe that ... with the Lord on my side ...” (FL7)

Although the interview sessions showed that learners drew from differing social, religious and political experiences, the influence of community and religion were most frequently stated. This is apparent in the following conversation with a learner.

Researcher: *If someone in your community diagnosed with AIDS needed help, would you be willing to assist that person.*

FL10: *I don't know ... I'm not sure.*

Researcher: *What are you not sure about?*

FL10: *I'm not sure ... if I'm allowed to ... I will have to see what the other people where I stay say ... what the people from the church say.*

7.4.3. Teacher influence on learner values

I observed that learners' understanding of values and their value judgments were modelled around the actions of their teachers. Hence it is expected that teachers are expected to display impeccably high standards. A comment by a learner in School B that his classmates "*understand each other ... they were all part of one big family ... they comfortable with each other ...*" (ML3) prompted the following:

Researcher: *Do you think that the learners would have been the same if they had another teacher?*

ML3: *Obviously no ... I don't think so. Mr. Jacobs's a very understanding teacher ... and very honest. It's as though he's as one with his class. If he sees that you are ... you don't feel right ... he'll call you and ask if you are okay.*

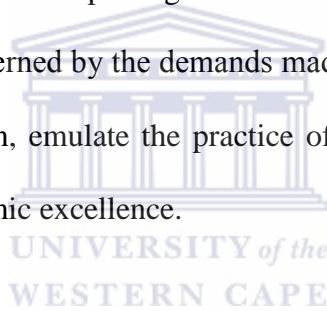
Learners in Mr. Jacobs' class viewed him as a role model. They considered him someone that they could trust.

A learner from School A, however, expressed concerns about her teacher's intentions in the Mathematical Literacy lessons. She commented:

"Sometimes the guys who do well in maths ... good ones learn the maths. Sometimes we will get angry at each other ... and with the teacher and the teacher will get angry with us ... she'll be in that lane and we'll be in that lane (using hand gestures to indicate two different places in the lesson) and we're like "Oh

mam, what are you talking about?” ... and we’ll ask her for help: “We don’t understand what miss is saying.” ... it’s like Greek to us. We’ll ask for help. You’ll tell her and she’ll get angry. She’ll say: “What is wrong with you guys? I just explained it to you”. Then she’ll get more angry and just go sit down ... and we’ll try & help each other ... then she’ll get even more angry cause the class is now noisy ... and she’ll scream. So it’s not always fine and dandy in the class ... we have our ups and downs. Not always. In general it’s okay. I think that all that mam wants from us is just to produce good Math Lit marks ... since we are the first Math Lit class” (FL2).

This suggests that schools are giving precedence to material values over moral values. Teachers and schools are judged on the pass rate of students and not on the character and moral standing of their learners in society. In the school system only academic and sporting achievements are rewarded. Hence teachers’ practice is governed by the demands made on them by the education system. Learners, in turn, emulate the practice of the teacher by tipping the scale in favour of academic excellence.



Emulating the teacher’s behaviour is further demonstrated by the learners in School A. For example, Mrs. Lindt chose to ignore the fact that some learners were not attentive in class and continued with her lesson. Learners in her class behaved in a similar manner with regard to their classmates who were barred from the lesson for arriving late.

Having established that the various factors impact on how learners make value judgments, I proceed to examine the learners’ ability to identify values in the Mathematical Literacy classroom.

7.5. Learners' identification of values in Mathematical Literacy

For the focus group interviews learners had positioned themselves around the table so as to get an unobstructed view of the video playing, in order to identify values in the lesson observed. The findings based on the viewing of the video are divided into three sections as follow: values in the generic classroom, values in the context and values in the mathematical content.

7.5.1. *Mathematical Literacy as a subject*

During the focus group interviews, consideration was first given to the values learners attributed to their experiences in the Mathematical Literacy classroom. I noted that learners showed great concern that, as a subject, Mathematical Literacy was looked down upon by both the educators at their school and the learners who did mathematics. A learner from School A expressed her sentiments over the subject being considered inferior:

“Some students say that Math Literacy is easier (than Mathematics). ... but it's not. Math Literacy is also difficult. We do a lot of things that are difficult. You need to use everyday knowledge ... lots of things we do about everyday life that they don't even know how to work it out. They can't use the x and y and z ... won't help further on” (FL5).

She was supported by a second learner in the group who defended the value that Mathematical Literacy had for her:

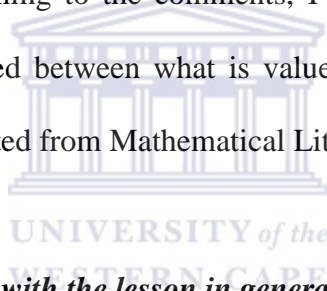
“Like we learn about tiling and geysers & finances ... it helps us girls ... And also there's a lot of reading. In Maths is easier ... the formula finished and kla ... in Math Lit we need to read and find the formula. They say that it's story sums ... but it's not story sums” (FL6).

Initially this negativity impacted on their performance in the subject but they claim that they were ‘*now more positive*’ about the value it added to their

lives. Nonetheless, the feeling of being discriminated against had been experienced by learners at School C as well, with a female learner commenting:

“... the other learners think that they are better because they do maths ... They think that we are stupid ... they make us feel stupid ... Can you (the researcher) make a poster to show that Math Lit is important? ... It helps us.” (FL9)

By their concerns the learners illustrated that they had found Mathematical Literacy useful. Their comments displayed a sense of honesty and a call for other learners and teachers to be considerate of their feelings. I waited for learners to mention these values in the interview discussions but they were not forthcoming. From listening to the comments, I became concerned that the learners may be confused between what is valued as opposed to the moral value that may be extracted from Mathematical Literacy as a subject.



7.5.2. Values associated with the lesson in general

To assist learners in understanding what was required of them (and clear any misconceptions) I gave the learners a list of values to assist with the identification of values. In a general discussion they attempted to identify values implicit in the classroom. Their ability to provide examples to support their choice of value convinced me that learners knew what was expected of them. An extract from the discussion at the start of the focus meeting with learners from School A (before the video footage was viewed) is given below:

ML4: As I was saying mam, there ... what was I saying?

Researcher: ... about patience?

ML4: Ja, patience, ja ... there's also patience because sometimes someone does not catch on very fast. So in

groups when we are working together and repeat it, ja, and we are helping each other, ja, because other people do not catch on very fast. Sometimes they are scared to just say to the teacher “we are not following”. So we are there, the students are there to help them.

Researcher: *So that’s then the value ‘helping’?*

ML4: *Ja.*

Researcher: *Okay, so you see what I mean.*

FL8: *Respect also...*

Researcher: *Yes?*

FL8: *Respect also, respect toward each other. Because you know it is not easy to respect one while we are the same age; not easy for me to respect you because I know we are the same age.*

Researcher: *Yes?*

FL8: *Sharing; sharing views...*



It was evident that by watching the video footage the focus group teams, in all three schools, were able to identify values pertaining to their fellow learners based on their behaviour and mannerisms in the classroom.

The learners’ understanding of values was reflected in the values that they identified from the video recordings. I found that the value that was consistently mentioned by learners was respect. It appeared that learners provided examples of positive traits more easily. A lack of positive values was also identified as a positive value. For example: when learners were not paying attention to the lesson, the respondents labelled the value ‘respect’ when they actually meant ‘lack of respect’. This suggests that learners were either uncertain as to how to identify values or to label them. They may have

also been confused about the relationship between negative behaviour and a lack of positive values.

A sample of the values, together with the supporting evidence, that members of the focus groups suggested that their peers had demonstrated appears in Table 7.1 below. Despite my presenting the value identification in a hierarchical format, it must be remembered that when the respondents in the focus groups viewed the footage of lessons, the values were cited in the sequence that they appeared in the lesson.



TABLE 7.1. Values identified about classmates by focus group from video footage

	Value	Evidence of value in the lesson
School A	Courage Respect Perseverance, self-discipline and attention Spirit of inquiry	Learner not afraid to ask questions to clarify any misconceptions. Learners spoke in class and did not pay attention to the lesson Learners working on practice exercises Learners focused on lesson & asking questions to learn more about the topic: Investment
School B	Co-operation, sharing teamwork & unity Respect Discipline	Learners working together – discussing questions Learners not paying attention to the lesson Learners worked quietly through the activities set by teacher
School C	Consideration Focus Good behaviour, respect/respect for property and responsibility Caring & helping Spirit of inquiry	Learner that was finding difficulty understanding and required repeated explanations Learners concentrating on lesson Learners in class had lit a fire in class Learner with arm around his peer's shoulders Learners focused on lesson & asking questions to learn more about the topic: Investment

The next tier of values that the members of the focus groups found relatively easy to identify were related to their respective teachers in Mathematical Literacy.

7.5.3. Values associated with the teacher

In general the teachers were described in terms of positive values by the learners. A learner at School C felt that her teacher was an epitome of values.

She considered her a dedicated teacher who came to school despite being ill. The other members of the group supported her comment by adding that she “*sacrificed her time to help her learners*” (FL9).

A learner from School A expressed praise for her teacher, Mrs Lindt, as follows:

“Like the way the class was set up ... and like we were there ... and the way we were paying attention ... that we wanted to learn ... she let us speak ... miss didn't tell us "no you can't say anything ... it's just my lesson ... I don't want your opinion" ... She like listened to us and even if we were wrong she like helped us get to the answer ... like indirectly trying to help us to get to the answer.” (FL4)

Learners in School A generally agreed that time-out was a common form of punishment for disobeying rules in their Mathematical Literacy class. They were of the opinion that it was unfair to the learners as they were deprived of learning. They felt that the teacher ought to use means to reprimand learners. Many learners were cautious when suggesting values about their teachers. I got the perception that many of them felt obliged to identify positive attributes about their educators. I also attributed this phenomenon to the social and cultural influences on learners' understanding of values.

A sample of the values, supported by evidence, which learners in the focus groups suggested their teachers had demonstrated, appears in Table 7.2 below.

TABLE 7.2 Values identified about the educator by focus group from video footage

	Value	Evidence of value in the lesson
School A	<p>Discrimination</p> <p>Helpful</p> <p>Honesty</p> <p>Proper use of time</p> <p>(Lack of) Patience, tolerance & understanding</p>	<p>Educator was not consistent with punishment when learners erred in class</p> <p>Walks around the class assisting learners; "...listened to us and even if we were wrong..." (FL4)</p> <p>Educator not sure about an answer & admitted to class: ".. I honestly don't know..."</p> <p>All lessons were fully utilized by teacher</p> <p>Educator becomes angry when learners do not understand & ask for help</p>
School B	<p>Caring, compassion, patient & understanding</p> <p>Helpfulness</p> <p>Honesty</p> <p>Leadership</p> <p>Proper use of time</p> <p>Resourceful</p>	<p>When learners have a problem the educator listens & assists.</p> <p>Walks around the class assisting learners</p> <p>Teacher's comment to class: "<i>I must be honest... I never really considered the values in my lessons...</i>"</p> <p>Teacher is able to control the class without losing his temper</p> <p>All lessons were fully utilized by teacher</p> <p>The teaching & learning aids that the teacher brought to class</p>
School C	<p>Dedicated & sacrifice</p> <p>(Lack of) Good manners self-respect</p> <p>Helpfulness</p>	<p>Teacher was at school when she was sick & had laryngitis</p> <p>Screams at learners or stamped foot on floor to get learners attention</p> <p>Walks around the class assisting learners</p>

Learners confirmed that they had some command of a moral vocabulary as they were able to provide evidence for choosing the value they had identified. However, it became apparent to me that the learners repeatedly chose the same values suggesting that they have a limited moral vocabulary. Furthermore, they used a host of moral names to describe the same apparent value. I realised that failure to distinguish between different categories was the reason for this practice.

I now proceed to discuss the values that learners attempted to identify in the contexts in which the mathematical content was embedded.

7.5.4. Values in the context of the activities in Mathematical Literacy

As mentioned in an earlier chapter, Mathematical Literacy requires a learner to either deal with one context or draw on a range of mathematical knowledge or a range of contexts to support the development of a particular mathematical content. The learner needs to read and understand the context before answering questions. Values within these contexts may be implicitly or explicitly presented.

As in the previous sections, I will first present a sample of the values that learners have identified (Table 7.3) followed by the challenges that learners experienced in attempting to accomplish the task. For each school I have only used one context to illustrate values identification. Focus group respondents from School B found the above exercise easier than the other two groups. I attribute this to the fact that their teacher had discussed values at the

commencement of the lesson. It may be the fact that they heard the values repeated in the video footage that they were able to identify them. Learners with the context on world poverty rates were also able to identify the values quite easily. However, the context on loans and investments did not prove as simple for learners to identify the value(s).

TABLE 7.3 Values identified in the contexts of the activities by focus group from video footage

	Value	Evidence in lesson
School A	Caring, compassion & concern for all life Reason	Context of Activity: World development World poverty rates – people living on less than \$1 per day Learners to provide factors that they consider important for ‘quality of life’
School B	Citizenship, responsibility & right action	Context of Activity: Making a dart board Teacher linked the circle to the cycle of life as a value – learners built on the idea with recycling.
School C	Right action Discrimination (against Zandile)	Context of Activity: Investments and Loans By investing his money Bongani was able to increase his bank balance Zandile had to pay more than was required for her medical operation (as compared with Bongani)

The results for the final area of analysis for value identification, namely mathematical content, follow.

7.5.5. Values in the Mathematical Literacy content

For learners to identify values embedded in the Mathematical Literacy content requires an understanding of the context, the content and the procedures required to answer the given question. Many learners face hurdles at the initial stage of unpacking the context. Hence, for the student, attempting to identify the inherent value is an issue of least concern.

I have deliberately retained the same lesson for each school for value identification in the context and content (see Tables 7.3 and 7.4). This makes differentiating between the two processes easier. For this exercise learners were asked to identify only one value evident in the content. Learners examined the processes required to answer a question in the activity set by the teacher. It is generally difficult for learners to identify values within the mathematical content. I therefore, gave them a value and asked them to identify the value within the content. Once again it took the learners in Schools A and B less time to identify the value due to the nature of the exercise. The values and evidence of values shown in the Table 7.4 are those that I considered as possibilities.

TABLE 7.4 Values identified in the mathematical content

	Value	Evidence in lesson
School A	Sharing	Context of Activity: World development Division by 1000 and 100 000
School B	Sharing	Context of Activity: Making a dart board Dividing the board into segments
School C	Equality which is a sub-value of truth	Context of Activity: Investments and Loans The correct use of the equal to sign, e.g. $P\left[1 + \frac{r}{100}\right]^n = 750\left[1 + \frac{9}{100}\right]^{12} = R2109,49$

7.6. Summary

The findings from the focus group sessions suggest that learner understanding of values is strongly influenced by their school environment and practical outcomes. Religious, social and cultural backgrounds continue to exert critical influence on values formation. These factors are so interwoven that on occasions it is difficult to credence impact to any one individual aspect. Many learners seemed to align values to religion which may be the contributing factor for learners giving values a positive angle.

The impact of the afore-mentioned factors is evident when learners undertook the value identification process. Learners' hesitancy in the use of non-positive terminology when identifying values bears testimony to the level of influence. Learners felt more comfortable with identifying values in the classroom environment, that is, their peers and teacher, than with the exercise involving

the content and contexts in Mathematical Literacy. This is supported by the fact that Tables 7.1 and 7.2 are more highly populated than Tables 7.3 and 7.4. I am of the opinion that if asked to identify the values in any other classroom, learners will produce a list very similar to those in Tables 7.1 and 7.2.

In the next chapter, I synthesise my findings and locate them amongst previous works. The contents in chapters 6 and 7 relate my observations and most of what educators and learners reported to me. In chapter 8, I tie this together with the information in chapter 5 where an analysis of documents was undertaken.



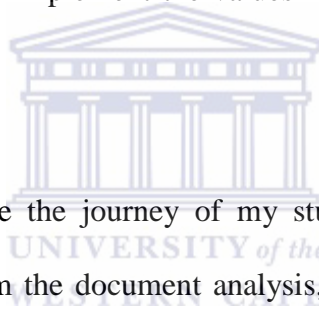
CHAPTER EIGHT

Analysis and discussion

Education is the most powerful weapon which you can use to change the world. - Nelson Mandela

8.1. Introduction

My study was an inquiry as to whether the integration of moral values into Mathematical Literacy lessons can contribute to social cohesion and aid transformation in the classroom. This study is guided by the question: How do learners in mathematical literacy classrooms in Cape Town, South Africa, understand, interpret and implement the values inherent in the Mathematical Literacy curriculum?



In this chapter, I retrace the journey of my study and combine the main findings ascertained from the document analysis, classroom visits and focus group discussions. In presenting my findings I am responding to three key research questions: (i) Values inherent in the Mathematical Literacy lessons, (ii) Teachers' integration of values into the Mathematical Literacy lessons and (iii) Learners' understanding, interpretation and implementation of values inherent in the Mathematical Literacy lesson. The chapter closes with recommendations that may enhance the integration of values into the curriculum for local schools and proposals for further research.

Before I launch into the journey I will present some of the conceptual and logistical limitations that presented themselves along the route.

8.2. Speed bumps along the journey

- The research questions

I found difficulty in framing the research questions because of the nature of the research process. I began with wanting to know the views on values of both teachers and learners in the mathematical literacy class. However, as I observed the lessons, listened to the learners, read the literature and spoke to other researchers in mathematics education, new questions and issues began to become apparent. As I began to better understand the research process it became necessary to revisit and revise the questions.

- The use of language

The issue of language can become problematic when researching values as it is sometimes imprecise. Janet Powney (1996) contends that it is difficult to make concerns and issues explicit in a field when the language is imprecise. Terminology can sometimes be broad hence it was sometimes difficult for me as the researcher to understand what the respondents meant and vice versa. Therefore, at times I found myself having to provide examples in the group interviews to ensure that the learners understood what was required of them.

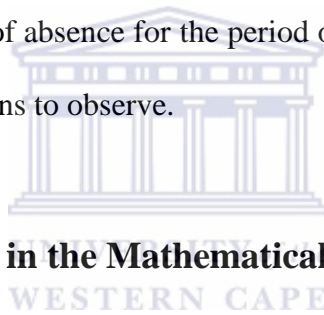
- Data collection

A well-devised data collection plan met its first test of bureaucracy when I was seeking permission to conduct my study in state schools in the Western Cape. Although I received a quick response to my request, the number and choice of schools that I had requested had been changed. This had an impact on the size and shape of my sample. As purposive sampling was used in

selecting the schools in the study and the criticism that may be levelled against it is that the findings cannot be generalised.

- Access to the classroom

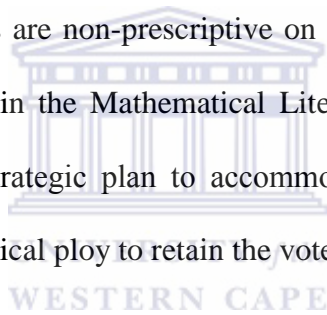
My patience became tested when I found myself at the mercy of the teachers and the schools. Although I was initially able to meet the teachers and secure the times for my classroom visits, I continuously had confirmed appointments postponed. I would arrive at a school only to find that I had missed the lesson as there were changes in the school times for the day. Despite having my contact details, the teacher(s) had not had the courtesy to inform me. One teacher had taken leave of absence for the period of my visit to her classroom, leaving me with no lessons to observe.



8.3. Values inherent in the Mathematical Literacy curriculum

The inclusion of values education in the curriculum was to aid moral regeneration of society and social transformation. Educational institutions were to be used as vehicles to securely entrench democracy in society. In an attempt to identify appropriate values for South African educational institutions several initiatives were undertaken. Issues associated with a high crime rate, drug abuse, poor discipline (within and outside school) amongst the youth, and a diversified society led to the identification of the gaps in the education system of the time and the need for values education. Discussions resulted in the birth of the Manifesto on Values Education and Democracy (DoE, 2001b), a document that played a vital role in (i) ensuring the inclusion of values in the curriculum and (ii) shaping the policies on values education.

An interrogation of the policy documents for Mathematical Literacy revealed that the key principles and values that underpin the curriculum are made explicit through the critical and developmental outcomes in the RNCS. These values are mentioned in less detail in the CAPS document (pages 5 and 6). There is no evidence of values being made explicit in the sequence of topics that follow in the CAPS document. The intention of values education is to nurture positive values and to use the negative values to foster positive outcomes. The Mathematical Literacy curriculum appears to have taken this into account by the inclusion of topics such as RDP housing, risk and gambling, and risky behaviour. Values are embedded in the content and contexts. The statements are non-prescriptive on the implementation and the interpretation of values in the Mathematical Literacy curriculum. This may have been the state's strategic plan to accommodate a multicultural South African society or a political ploy to retain the vote.



The authors of texts in Mathematical Literacy have continued to maintain the idea of both positive and negative values in keeping with curriculum requirements. However, the values are not made explicit to the user. One of the books introduces the learner to negative values with an opening statement: *“It is illegal to photocopy any pages from this book without the written permission of the copyright holder”*. The authors have included socio-economic issues relevant to the South African context with the intention of sensitising learners to social issues within their communities and the South African people in general. Nevertheless, the authors missed many opportunities to efficiently deal with the negative values in order to elicit

positive ones. I propose two reasons for these missed opportunities. The first may be due to the non-communication between the policymakers and materials developers/textbook writers, hence the latter being satisfied with the limited level of development in the materials. The second is that these developers/writers used the pattern evident in the policy statements as the benchmark for materials development. Clarkson et al (2000) cogently explains:

“... (values) seem to have a deep influence on how, why and what we learn. Hence, depending on the values learnt in mathematics classrooms, students may be helped in their lifelong learning, or may sadly learn values that inhibit their in-built creative potential.”

The ‘hidden curriculum’ and the values implicit in the curriculum have not been fully explored. The teacher’s task is to provide learners with opportunities for personal discovery through problem solving rather than indoctrination through societal norms (Piaget, 1932). Exposing the learner to the ‘hidden curriculum’ affords him or her opportunities. For example in Maths Literacy for all Grade 10, an activity on the critical analysis of data uses charts to illustrate the validity of crime statistics. Learners are asked to choose a graph to (i) *convince people that crime is not increasing* and (ii) *convince the government that crime is increasing*. Hidden in these questions are the issues of honesty and ethics which could have been explored. Twinned with the concept of the ‘hidden curriculum’, is that of familiar contexts. Working with familiar contexts will help facilitate the understanding of the content. Beginning with familiar contexts and the expansion to embrace new or unfamiliar contexts will create a sense of confidence within the learner. A

few of the activities in the textbooks examined convinced me that learners would encounter problems with the context. For example, the use of Table Mountain rather than Mount Kilimanjaro, in activities would have been more realistic to learners. Learners could have been introduced to the hiking and mountain climbing using Table Mountain and then extended to Mount Kilimanjaro.

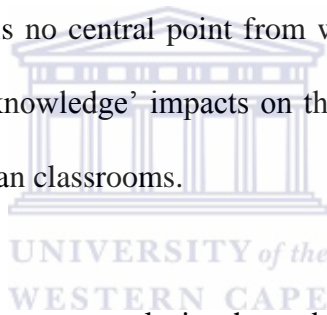
As I noted at the end of Chapter Five, a summary of the contexts and implicit values in the Mathematical Literacy curriculum point toward the promotion of social transformation and the preservation of human rights and social justice. However, the teacher needs to scaffold the process for the learner.

8.4. Teachers' integration of values into the Mathematical Literacy lessons

It appears that while the issue of the inclusion of values in the curriculum was debated, no clear consideration was given to implementation in the classroom. The policy documents reflect the values entrenched in the Constitution of South Africa and the Bill of Rights. The critical and developmental outcomes provide the basis for all teaching and learning. However, written policy does not necessarily determine implementation policy (McLaughlin, 1998). He adds that the implementers do not necessarily act as instructed but may respond in ways that seem unpredictable and resistant. In my study Mrs Daniels behaved in an unpredictable manner when *she began stamping her feet on the floor at the front of the room in an attempt to silence the learners*. Both female teachers in my study displayed resistance to the explicit

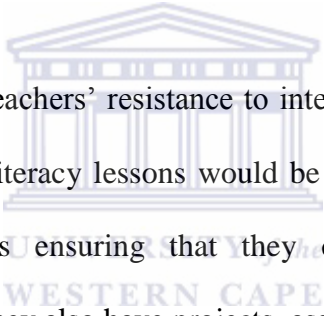
implementation of values in the classroom with comments such as *I'm tired ... I'll teach the maths ... The principal and the parents can take care of discipline.*” (Mrs Daniels) and *“I don't consciously think about values when I'm planning my lesson ...”* (Mrs Lindt).

Fink and Stoll (1998) and Hargreaves (1998) are of the opinion that there are 'soft' issues that may have an influence on the dynamics in the school environment. I attribute the 'soft' issues in the schools I visited to what Bauman (1992) terms as the lack of 'centre of knowledge' or what I term lack of a 'knowledge bank'. This implies that everyone can create their own knowledge hence there is no central point from which knowledge emanates. This lack of 'centre of knowledge' impacts on the implementation of values education in South African classrooms.



Evidence from the document analysis showed that there was a lack of communication between the architects of policy documents and the developers of materials for learners with regard to implementation of policy (Chapter Five). The policy documents, being learner-centred, placed emphasis on what learners should be able to do rather than providing direction on how to achieve the expected outcomes. Due to the fact that South Africa has a diverse, multi-cultural society, the curriculum developers themselves may have been uncertain about how to proceed. Hence the lack of a 'centre of knowledge' has a domino effect, leaving the interpretation of the documents to the materials developers/textbook writers.

Similarly, the teacher in the Mathematical Literacy classroom is left to his or her own devices. A severe challenge to education in South Africa is that the majority of the teachers who are required to implement this new values-based curriculum have not had prior training in values education. All three of the teachers in the study had initially trained as educators in Mathematics and/or Science. They trained further to teach Mathematical Literacy. Their own schooling has not exposed them to a similar form of education either. There is an underlying assumption that teachers would accept, make sense of and then implement the values inherent in the new curriculum in the Mathematics Literacy classrooms.



Another reason for the teachers' resistance to intentionally implement values into the Mathematical Literacy lessons would be the unrealistic demands of the curriculum. Besides ensuring that they complete the syllabus in Mathematical Literacy, they also have projects, assignments and tests to mark. Class sizes in Schools B and C make the monitoring and marking of learners' work a mammoth task. Teachers, to an extent, use values as a tool to ensure discipline in their classrooms. For example, Mrs Lindt sent the learners out of her class for arriving late. This was her non-verbal manner of getting a value across to her learners. The very fact that learners still arrived late demonstrated that the learners did not perceive this action as a lesson in values. Non-verbal means of sensitising learners to values was also demonstrated by Mr Jacobs by his handling of the group of non-compliant learners in the computer room. In my opinion the teachers' would have been more committed to the explicit implementation of values in the Mathematical

Literacy lessons had they felt a sense of ownership towards it. Bishop's (1999) comment that teachers are not always aware of the fact that they are teaching values in a mathematics classroom, although value-teaching does take place provides an explanation for Mrs Lindt's comment:

“Many of the learners already have a problem with the content. I need to make sure that they understand the concepts ... I don't consciously think about values when I'm planning my lesson ...”

or Mr Jacobs'

“I never really considered the values in my lessons ... I guess I'm so busy thinking of the content ...values was never on the agenda.”

In Chapter Seven, I pointed out that teachers and schools are judged on the pass rate of learners and not on the character and moral standing of their learners in society. In the school system only academic and sporting achievements are rewarded. Teachers and the principal are held accountable for poor pass rates. Schools are classified on the basis of their grade twelve results. Teachers do not find it imperative to participate in values education as they see no benefit for themselves. This is evident by the comments above made by the teachers.

Finally, the lack of implementation of values in the Mathematical Literacy class by teachers could be because they do not believe it is a part of their job description. For example the teacher at School C who felt that she will *“teach the maths ... The principal and the parents can take care of discipline”*. Nieuwenhuis (2007) may be responding to this very attitude of teachers when he suggests that the lack of discipline and moral decay in schools today,

together with the decline in the culture of teaching and learning, still leave policy-makers and educationists facing the values debate.

I have proposed reasons why the teachers at two of the schools were not very open to consciously implementing values into their lessons. This does not mean that all teachers share the same view as these two ladies. Mr. Jacobs, on the other hand, was prepared to implement values in his lessons. He was also prepared to ask for assistance when he felt uncertain.

In conclusion, I am convinced that until the policy makers and curriculum developers are more explicit about implementation of values into the Mathematical Literacy lessons/curriculum, implementation will remain a challenge. If we heed Nieuwenhuis' (2007) suggestion of regarding values as being an integral part of everything that is done at school, we will be able to approach values in education in a more integrated and holistic manner.

8.5. Learners' understanding, identification and implementation of values inherent in the Mathematical Literacy lesson

In Chapter Two I proposed that there exists a relationship between the values of mathematics and education and the social and moral values which becomes more meaningful to the learner, when he or she has understood the content and context of Mathematical Literacy. In order to develop this idea I will focus on two aspects of learners' understanding of values. These are societal

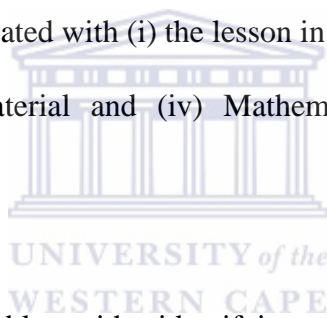
values and the learners' social, cultural and religious background and experiences.

My study established that learner understanding of values and their value judgments were influenced by the school environment in which they were situated. The behaviour of some the learners in Mrs Daniels' class may be attributed to the poverty that these learners are exposed to; for example the learner who took the mathematical set may have taken it to sell as a result of a dire need for money. The physical environment of School C which these learners attend is not conducive to learning. However, in general, the majority of the learners ensured that they followed the rules of the school. For many learners the teacher was seen as the role model whom they wanted to please. This is very evident from the comments by learners in Mr Jacobs' class: "*Mr. Jacobs's a very understanding teacher ... and very honest. It's as though he's as one with his class.*" The teacher is the figure of authority in the classroom hence learners will feel compelled to obey the rules set by the teacher. Besides the teacher was responsible for awarding the marks that sealed the learners' educational fate.

Learners' social, cultural and religious background and experiences also influenced learner understanding of values. The interviews revealed that learner drew on these backgrounds to make certain judgment calls. The community in which the learners live determine their behaviour and value judgments. This was evident when the male learner in School B made a number of references to his culture (Chapter 7). Learners can, at times, use the

banner of culture or religion as an excuse for socially unacceptable behaviour, for example, the male learner's explanation for a fellow student falling pregnant (Chapter 7).

Learner understanding of values was deemed necessary for them to progress to identifying, interpreting and implementing values inherent in their Mathematical Literacy lessons. The emphasis was on the identification and interpretation of values. Implementation was illustrated when learners provided explanations for their own (re)actions to a given situation. Five categories of values were identified. They were: Mathematical Literacy as a subject and values associated with (i) the lesson in general, (ii) the teacher (iii) context of learning material and (iv) Mathematical content of learning material.



Learners felt comfortable with identifying values in the classroom environment, that is, their peers and teacher, as well as values associated with Mathematical Literacy as a subject. The learners basically looked out for non-verbal behaviour (gestures or actions) or language that suggested a value. For example, the members of the focus group from School B associated the learners in the video footage working together, discussing questions to co-operation, sharing, teamwork and unity. However, the exercise of identifying values inherent in the content and contexts in Mathematical Literacy did not prove as simple. I offer the following reasons as to why learners experienced greater difficulty with the identification process. According to Bloom, Krathwohl & Masia the individual has a cognitive, affective and psychomotor

domain which results in a person responding as a whole being. They suggest that

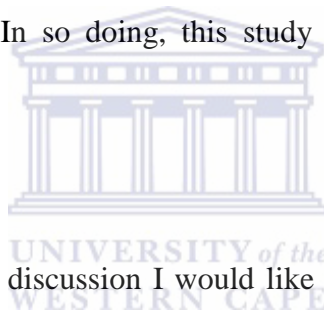
“... affective behaviors develop when appropriate learning experiences are provided for students much the same that cognitive behaviors develop from appropriate learning experiences.” (1964:20).

This was the learners' first encounter with the identification of values within a context of the mathematical content of a lesson. Learners will need to get more practice in this type of exercise to become more competent in identifying the values. For learners to identify values embedded in the Mathematical Literacy content requires a downward drilling into the various layers of the problem. An understanding of the context, the content and the mathematical procedures are necessary to answer the question. Many learners face hurdles at the initial stage of unpacking the context. Thus, the teacher's input is necessary to help scaffold the problem. The Mathematics educators from the Sathya Sai School for boys at Prashanti Nilayam, India and the Sathya Sai School, Chatsworth, Durban, had in the interviews indicated that their schools have as a theme for the week a given value. This implied that all the learners in the school were being exposed to the same value (truth, right action, peace, love or non-violence) in every subject area for a week. The sub-value(s) will be dependent on the content and context of individual lesson. Hence learners do not necessarily have to identify the value inherent in the lesson all on their own. Assistance from the teacher may also help minimise the confusion between a lack of positive values being identified as a positive value and result in an increased moral vocabulary. The teacher is seen as the

primary source of information on values (in the classroom) (Lickona, 1991 & Institute of Sathya Sai Education).

8.6. Bringing in the theory

While this study may have confirmed several findings from other studies, the key difference lies with the fact that the findings from this study reflect the learners' perceptions. An important point is that the study builds on other studies. Rather than merely identifying a range of factors that may impact on learner understanding of values, the study goes further to investigate learners' identification and interpretation of values with explicit reference to Mathematical Literacy. In so doing, this study adds another dimension to values education.



As a launch pad for my discussion I would like to re-iterate that Piaget and Kohlberg were the fore-runners with their theories on the stages of moral development in humans. According to Piaget (1932) the second stage of moral development, morality of co-operation, is exhibited by children older than 10 years. During this stage children follow their own moral rules. They begin to appreciate that rules are agreements between individuals and may be changed through mutual consensus (Sigelman & Rider, 2009). Piaget's theory suggests that the teacher is instrumental in the moral development of a learner.

Kohlberg held the view that an individual's ability to make moral judgements depended on the individual's capacity to reason. Hence, Kohlberg explained moral development through the stages associated with Piaget's theory of

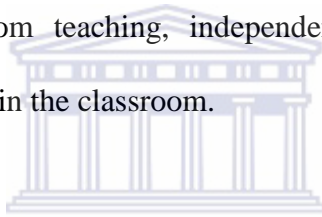
cognitive development. This learner-centred approach allows learners to take control of their own learning. Does this also afford learners the freedom to construct their own values? Solomons (2009) contends that despite criticisms levelled against Kohlberg's theory, it

“... does illuminate the fact that moral development is a process and that learners are able to respond to moral issues if provided with relevant thinking tools and opportunities to use them.”

Vygotsky (1978) was of the view that in order to understand the human development of an individual a study of the individual and the external social world associated with him needs to be undertaken. A crucial element in this theory of learning and development is internalization and stresses the role of language. Tying in with Vygotsky's intimation that it is the collective responsibility of society to mediate moral issues to learners is the cognitive apprenticeship theory. Furthermore, Mathematical Literacy is able to provide learners with the relevant thinking tools to analyse and opportunities to use them in their social environment. Knowledge as a product of situated learning requires learners to work in groups to engage with one another and the learning materials. This affords learners the opportunity to share and deepen understandings, and create knowledge from collective learning opportunities in the classroom (Orgill, 2007; Macklin, 2007 & Wenger, 1998). I argue that the cognitive apprenticeship theory challenges the teacher to situate learning and teaching activities in contexts that are familiar and make sense to the learner. Hence the educator will need to use the prescribed textbook more innovatively or develop activities in contexts that are not only familiar and make sense to the learner but also incorporate values education. However, to

enable the teacher to achieve this goal, he or she would have to have a clear understanding of the contents of the curriculum statements.

Results of other recent studies that support my findings include Haydon (1997) and Falkenberg (2006). Haydon (1997) maintains that the character and climate of the school influence the determination of values education. The level of understanding and use of the hidden curriculum impacts on the strategies employed in the classroom. The study by Falkenberg (2006) claims that classroom teaching carries with it a moral dimension, irrespective of whether it is acknowledged or not. The study by Jackson, et al (1993) has recognised that classroom teaching, independent of the subject content, influences the moral life in the classroom.



I did not find any evidence in the literature that suggests a fail-safe theoretical approach to success in values education. I am of the opinion that for any measure of success in values education, a combination of these theories of learning and moral development has to be employed. These will be dependent on the ethos and climate of the school. However, the recipe for success requires more than transforming theory into practice; there is a need for all role players to make a concerted effort to ensure that they are all playing for the same team.

Information regarding the functioning of the school that I derived from my conversation with the principal and the Mathematics teacher from the Sathya Sai School for boys at Prashanti Nilayam, India supports my view about

success in values education being a team effort. The school, although located in a very poor area in India produces excellent results. The principal is very visible and his approach is very hands-on. The school climate was conducive for teaching and learning. The principal informed me that:

“... all the policy documents are drawn up by the Sathya Sai Institute of Education in India. Swami (Sathya Sai Baba) ... He makes certain that the documents reflect the values. All the teachers need to be trained in EHV (Education in Human Values) ... So that they know what to do in the classroom ...”
(Interview with principal: July 2007, India).

In a separate interview the Mathematics educator confirmed the above. This meant that all the stakeholders had a good sense of what was required by the policy documents. The teacher informed me that the textbooks used at the school also went through a similar process. The teacher’s dedication to his work and students was cemented by his comment:

“... I stay here at the hostel ... I only go home when the boys go home for the holiday. My work is here with Swami ... you only get to teach in this school if Swami wills it ... Now I must make certain that I do the best for my students ... they are Swami’s students ...”
(Interview with teacher: July 2007).

Through the entire conversation the teacher illustrated his enthusiasm for his work. He illustrated how values were infused into every Mathematics lesson.

The principal at the Sathya Sai School in Durban supported the comments made by the principal at Prashanti Niliyam with regard to policy documents and informed me that the same policy documents are used at all Sathya Sai Schools around the world. He added that:

“... Our school follows the DoE syllabi ... therefore these documents are used in collaboration with the policy documents from the DoE (South Africa) ... All our teachers are trained in EHV ... they are required to complete a course in EHV once

they start working at our school.” (Interview with principal: January 2010, Durban).

Bloom, Krathwohl & Masia sum up my thoughts on values education with:

“If affective objectives and goals are to be realized, they must be defined clearly; learning experiences to help the student develop in the desired direction must be provided ...” (1964: 23).

8.7. Future research

The findings of this study showed that teachers were hesitant to explicitly and overtly integrate values into the Mathematical Literacy lessons. Their priority was the teaching of Mathematical Literacy lessons. Further research therefore needs to be conducted to establish whether new programmes can be developed or existing programmes by tertiary institutions for pre- and in-service teachers improved, to equip them with the skills necessary to identify and interpret the values inherent in the curriculum and policy documents.

During the research it was evident that the issue of values education was less valued than the content of the Mathematical Literacy lesson. As I pointed out in an earlier chapter, schools, educators and learners are only rewarded for academic and sporting excellence. As a result, for both sets of individuals, academic and sporting achievement will take precedence over values education. By establishing the details of an effective tool to assess values in the classroom, research to test this hypothesis may be conducted. This need not be an independent test but may be incorporated into the Mathematical Literacy tests.

As an educator of Quantitative Literacy at tertiary level, I would like to assess my own practice. The materials in the courses I teach are developed by a team teaching on the courses. Research may be conducted to establish the extent to which the materials reflect the values inherent in the policy documents developed by the institution and the Constitution of South Africa.

8.8. Conclusion

Over a decade ago state schools in South Africa adopted the Outcomes-based education policy. Twinned with this was Curriculum 2005 which carried the values education policy. Over the years the curriculum documents have had cosmetic and name changes resulting in the present day Curriculum and Assessment Policy Statement (CAPS). Despite the changes, the policy on values education has remained steadfast.

This study set out to investigate the integration of moral values into Mathematical Literacy lessons in classrooms in South Africa. While the findings show strong support for the identification and implementation of moral values by learners, these are the general values found in any lesson. The values specifically related to the Mathematical Literacy curriculum itself appeared to be less evident to the learners. The learners need more exposure to this type of exercise. There is also evidence of social cohesion though it was difficult to assess the transformation element. This is not to say that there is no transformation per se but rather the instrument required to measure it would be difficult to establish. It would also require data about learners' behaviour over a period of time.

Another observation emanating from this study is the influence teachers have on their learners. Teachers need to take cognisance of this fact and alter their nonchalant attitude towards the integration of values education into Mathematical Literacy lessons. The apathy on the part of the teacher in this regard may be attributed to the rewarding of academic excellence at the expense of values education. Schools need to strike a balance between these two variables by changing the institutional climate.

The lack of moral vocabulary amongst learners may be ascribed to the absence of deliberate integration of values education by the teacher. For the teacher to be effective in the classroom, policy needs to unambiguously state its goals and plans for implementation of the integration of values education in Mathematical Literacy lessons. In so doing, a 'knowledge bank' for values education and moral vocabulary will be created. In addition, measures need to be instituted to train and provide support to the teacher.

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APPENDIX 1

Research Permission Request

Mathematical Literacy learners at _____ High School

I, Sheena Rughubar-Reddy, am a lecturer in Quantitative Literacy at the University of Cape Town. I have lectured to in-service teachers on the Mathematical Literacy ACE course. I am currently registered for a PhD in Education at the University of the Western Cape. My area of interest is Mathematical Literacy. My study is a part of a project to build a better society in the Western Cape. The Western Cape Education Department has granted me permission to conduct research in selected schools in the Western Cape, one of which is your child's school. The principal has also conceded to my request. I will be observing lessons in Mathematical Literacy for four weeks at the school. A selected group of learners will be interviewed by me about the Mathematical Literacy lessons. I will use information acquired from these classroom observations to write up my PhD thesis which is titled: *Crouching Learners, Hidden Values: Values in School Mathematical Literacy lessons*. I hope that such educational research will contribute positively to the educational needs of South African (and other) teachers and learners.

Naturally, an important part of my work will arise from observations I make about the learners' reactions in the classroom and reflections in their journals. I am therefore requesting your permission to use this kind of information in my writing. In no case will any observation, reflection or quote will ever be identified with any individual, and I will not identify the student cohort either.

I therefore ask you to sign the permission slip below:

<p>I, _____, parent of _____ agree that Sheena Rughubar-Reddy may use my child's responses and any other material that is handed in for legitimate, constructive research purposes, on condition that my child's identity will remain anonymous. I also agree to my child being interviewed by her.</p>	
Signed: Parent: _____	Learner: _____
Date: _____	

APPENDIX 2

P.O. Box 34046

Rhodes Gift

7707

16 March 2006

The Principal

_____High School

Sir

Request to Conduct Research

I am a lecturer in Quantitative Literacy at the University of Cape Town (after having taught secondary school mathematics for 20 years). I have also lectured to in-service teachers on the Mathematical Literacy ACE course and shorter courses in Mathematical Literacy. I am currently registered for a Phd in Education at the University of the Western Cape. My area of interest is Mathematics and Mathematical Literacy. My study is a part of a project to build a better society in the Western Cape. The Western Cape Education Department has granted me permission to conduct research in selected schools in the Western Cape, one of which is your school. I hereby request your permission to observe lessons in Mathematical Literacy for four weeks of this year at your school. I will only be at the school for the duration of the lesson. I will also like to interview approximately five (5) learners from the class I observe.

I have spoken to Mr 'Jacobs' with regard to observing lessons in his Mathematical Literacy classroom. He is willing to work with me. I in turn am willing to assist him with his subject.

Attached is a copy of the letter of approval from the Education Department (Western Cape). I promise to adhere to the requirements as set down by the Education Department.

I look forward to a positive response from you.

Yours in education

Sheena Rughubar-Reddy

Tel. (work): 021 650 5730 (cell): 072 317 5007

e-mail address: sreddy@maths.uct.ac.za

APPENDIX 3

BASIC HUMAN VALUES AND SUBVALUES AS USED BY THE SRI SATHYA SAI SCHOOLS				
TRUTH	RIGHT CONDUCT	PEACE	LOVE	NON-VIOLENCE
Consciousness	Cleanliness	Attention	Bliss	Psychological: Ceiling on desires
Creativity	Contentment	Calm	Caring	Compassion
Curiosity	Courage	Concentration	Compassion	Concern for all life
Discrimination	Dependability	Contentment	Dedication	Consideration
Equality	Duty	Dignity	Devotion	Co-operation
<i>Honesty</i>	Ethics	Discipline	Empathy	Forgiveness
Integrity	Gratitude	Endurance	Friendship	Good manners
Intuition	Goals	Focus	Forgiveness	Loyalty
Natural environment	Good behaviour	Happiness	Generosity	Universal love
Optimism	Healthy living	<i>Honesty</i>	Helping	Unwillingness to hurt
Quest for knowledge	Helpfulness	Humility	Human dignity	Social: Appreciation of other cultures and religions
Reason	Initiative	Inner silence	Inner happiness	Brotherhood
Self-analysis	Leadership	Optimism	Joy	Citizenship
Self-knowledge	Perseverance	Patience	Kindness	Equality
Self-worth	Proper use of time	Reflection	Patience	Global awareness
Sense control	Resourcefulness	Satisfaction	Purity	Inclusiveness
Spirit of Inquiry	Respect	Self-acceptance	Sharing	National awareness
Synthesis	Responsibility	Self-confidence	Sincerity	Respect for Property
Truthfulness	Sacrifice	Self-control	Sympathy	Recycling
Unity in thought word and deed	Self-confidence	Self-discipline	Tolerance	Service to others
Unity in diversity	Self-sufficiency	Self-respect	Wisdom	Social justice
	Simplicity	Understanding		Sustainable growth
				Unity

- Sub-values may be found under more than one value. For example: The values of Truth and Peace both have '*Honesty*' as a sub-value.

APPENDIX 4

Table 5. 1: Content categories in Mathematical Literacy & specific learning objectives

Content	Specific learning objectives
Compound Growth & Finance	Banking loans; break-even analysis; budgets; cost & selling price; exchange rates; income & expenditure; inflation; interest; profit & loss and tariff systems.
Measurement	Calculation of area, perimeter & volume; conversions; measuring length, weight & volume; temperature and time.
Numbers & calculations	Fractions; number formats & conventions; operations using numbers; percentages; proportions; rates; ratios and rounding
Patterns, relationships & representations	Patterns & relationships; representation of relationships in tables, charts & equations.
Statistical data Representations	Inflation rates; interest rate and compound interests; actuals and real earnings; time value of money; annuities.

APPENDIX 5

Table 5. 2: Expected Mathematical Literacy competencies

Competencies	Core descriptors of the competency
Comparing numbers	Conversions of numbers from one form to another
Critical thinking skills	Asks questions about the content & contexts; checks the appropriateness of the solutions; examines evidence.
Data representation methods	Familiarisation of with data representation methods (tables & graphs); analysing & interpreting data presented in various data representation methods
Procedural competencies	Routine calculations; relationships between quantities; substitution and manipulation of formulae
Reading from graphs, tables & texts	Making meaning of numbers in charts, tables & texts; comparing data in graphs, tables and texts
Writing skills	Communicating information effectively; clarifying thinking; explaining understandings of concepts and ideas; applying acquired knowledge to new unfamiliar situations

APPENDIX 6: Samples of Worksheets & Assignments

Grade 10 Mathematical Literacy: LO1 Numbers Date:..... Learner:

Worksheet on order of operations, mental mathematics, associative properties, distributive law, commutative properties.

1. Don't work out the answer to the expression, but identify the expressions listed below, which have the same answer as:

$$367 + 68 \times 214 \times 1966 + 814 \times 45$$

1.1. $214 \times 68 \times 1966 + 367 + 814 \times 45$

1.2. $45 \times 814 + 367 + 214 \times 68 \times 1966$

1.3. $68 + 367 \times 214 \times 1966 + 814 \times 45$

1.4. $1966 \times 214 \times 68 + 45 \times 814 + 367$

1.5. $367 + 68 \times 214 \times 814 + 1966 \times 45$

2. What numbers would you combine first to evaluate mentally?

2.1. $5 \cdot 79 \cdot 20$

2.2. $3 + 7 + 67$

2.3. $10 \cdot 37 \cdot 10$

2.4. $730 + 693 + 270$

2.5. $5 \cdot 50 \cdot 20 \cdot 2$

3. Evaluate mentally (do not use a calculator!)

3.1. $35 + 15 + 8$

3.2. $25 \cdot 4 \cdot 8$

3.3. $42 + 17 - 2 + 3$

3.4. $125 + 18 + 75 + 162$

3.5. $4 \cdot 6 \cdot 25 \cdot 50 \cdot 2$



Factorisation

Exercise

- List all the pairs of factors that could be multiplied to give $8p^2$.
- What is multiplied by $3x$ to give $6x^3$?

Here is a collection of terms: $8x^2$; $12x$; $5y$; 12 ; $15xy$; $10y$; $\frac{7x}{2}$; $4x^3$.

- Which of the terms have 6 as a factor?
 - Which of the terms have x as a factor?
 - Which of the terms have $3x$ as a factor?
 - Which of the terms have $5y$ as a factor?
 - Which of the terms have x^2 as a factor?
- Find the highest common factor of each pair of terms:
- $5x$ and $5y$
 - $6d$ and $6d^2$
 - $3g$ and $12gh$
 - $18w^2$ and $10wz$
 - $8r$ and $7r$
 - $10p$ and $10pq$
 - $15p^2$ and $5pk$
 - $15r^2$ and $10r^2$
 - $3a^2$ and $5a$
 - $8t$ and $4t^2$
 - $6v^2$ and $6v^4$
 - $9a^3$ and $16a^2b$

Complete:

- $3x + 6 = 3(\dots + 2)$
- $12p - 8 = 4(\dots - \dots)$
- $7t + 7 = 7(\dots + \dots)$
- $10a - 15 = 5(\dots - \dots)$
- $4x + 8y = 4(\dots + \dots)$
- $12r - 15f = 3(\dots - \dots)$
- $a^2 + 5a = a(\dots + \dots)$
- $3x - xy = x(\dots - \dots)$
- $cd - cg = c(\dots - \dots)$
- $ab + bc = b(\dots)$
- $6x + 3x^2 = 3x(\dots)$
- $2vw - 4vz = 2v(\dots)$

Factorise, then check by expanding:

- $2x + 4$
- $145t - 10$
- $153p + 12$
- $1620 + 4d$
- $18g + 6$
- $1821 - 7r$
- $1920 + 15a$
- $2012x - 8$
- $16b + 10$
- $229k - 15$
- $2324 - 20w$
- $244 + 6x^2$
- $8x + 8y$
- $2610p - 5q$
- $276a - 8b$
- $2815t - 10q$
- $p^2 - 5p$
- $30x^2 + 6x$
- $3a - a^2$
- $32c + 2c^2$

Factorise these expressions, then check your answers by expanding. (Make sure you choose the highest common factor, that is, the terms left in the brackets should have no common factors.)

- $3xy + 6x$
 - $45rt - 10t$
 - $3510gh + 20g$
 - $364a - 12ab$
 - $8x^2 + 12x$
 - $386p^2 - 9pq$
 - $398fg + 10g^2$
 - $406xy - 8y^2$
- Factorise by taking out the negative common factor:
- $-5x - 15$
 - $-3p - 12$
 - $43 - 12y - 18$
 - $-8g + 16$

Substitution

Exercise

Given $a = 6$, evaluate:

- $4a$
- $a + 8$
- $\frac{a}{3}$

- $3a - 7$
- $5\frac{2a}{4}$

Given $x = 4$ and $y = -3$, calculate:

- $x + y$
- $x - 4y$
- $x^2 + y^2$
- $\frac{2x + 2y}{4}$
- $x - y$
- $3(2x - y)$
- $2x(y - 2)$
- $\frac{5x}{3y - 1}$
- $2x + 3y$
- $5xy$
- $\frac{x + 5}{y}$
- $\frac{3 + 2xy}{y}$

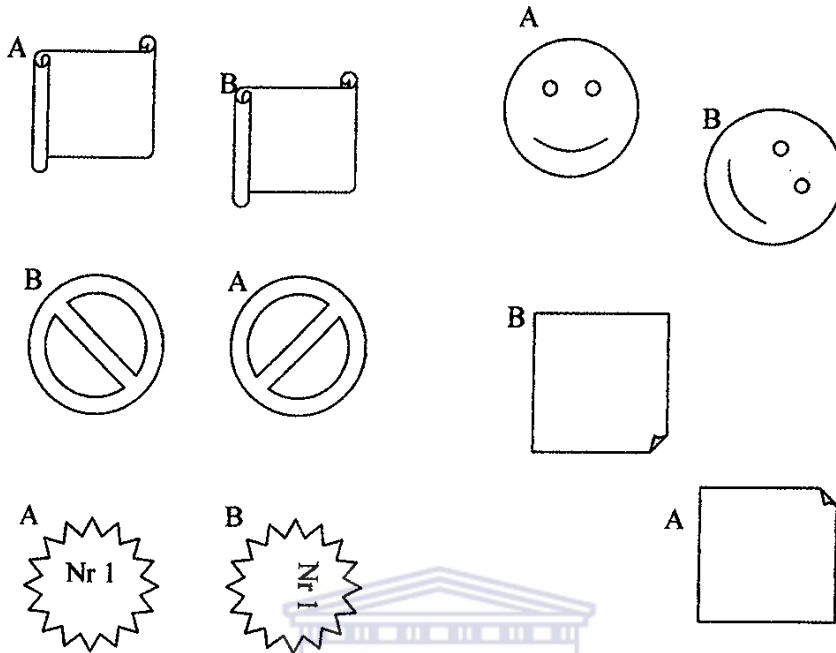
Given $a = 3$, $b = -2$ and $c = 0$, find the value of:

- $a + b + c$
- $a(b + 2c)$
- $\frac{c}{a} + 3b$
- $\frac{2a + b^2}{2}$
- $\frac{ac + 7}{b}$
- $a + bc$
- $\frac{2a + b^2}{2}$
- $\frac{ac - 6b}{a}$
- $\frac{ab - 4}{a + b}$

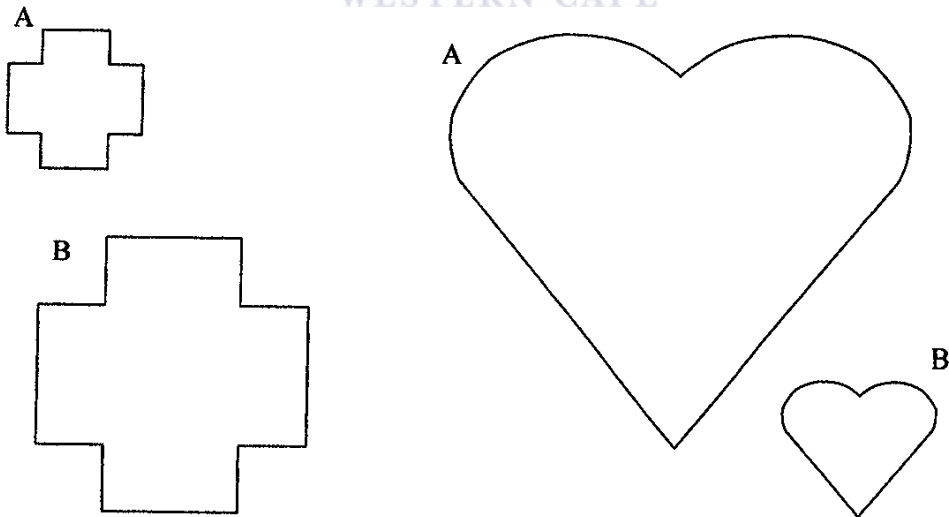


Grade 10 Mathematical Literacy – TRANSFORMATIONS
 One unit on the page is 0,5 cm

1. Identify the following (combinations of) transformations from figure A to figure B:



2. Work out the scale for figures A to B for the following:



Learning Outcome 1: Number in context

**Instructions: Use one page per section and show your method for calculations!
Clearly label all answers correctly and leave an empty line between questions.**

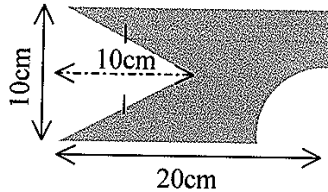
SECTION 1

- 1.1. At the inter-house swimming gala 172 swimmers took part in the races for their respective teams. The total learner population for the school is 1250, 30 learners were involved with the MFC shop and 8 learners were absent. Calculate the percentage of the learners that was cheering?
- 1.2. Eugene won the 100m freestyle race in 1 minute 4 seconds and 56 hundredths of a second. Calculate the speed at which he won the race in m/s.
(round off to two decimal figures)
- 1.3. The swimming pool at The University of the North High School needs approximately 502 400 litres of water to fill it up. How many ml is this?
- 1.4. A drop of water is 2 ml, calculate the approximate number of drops of water needed to fill the pool and write your answer in scientific notation.
(based on your previous answer)
- 1.5. The MFC purchased 12 crates of cokes, 5 crates of fanta grape, 6 crates of cream soda and 4 crates of fanta orange. Write an expression to indicate how many cooldrink cans were purchased in total?
(make use of only the numbers given to you – no calculations to be done)
- 1.6. A total of 144 Savoury pies were purchased at R180 per case (36 in a case) and sold at R7 a piece.
- 1.6.1. Write an expression (with the numbers given to you) to show the maximum profit that could be made on the pies.
- 1.6.2. Calculate the % mark-up price for a pie.
- 1.7. In total 468 cooldrinks were sold. The Eco-society recovered approximately 115 of the empty cans for re-cycling.
- 1.7.1. a) Round of the numbers to the nearest one hundred and write these numbers as a fraction to illustrate what part of empty cans were recycled.
b) Re-write this fraction in its simplest form
c) Represent this fraction as a percentage
- 1.7.2. Now use your calculator and calculate accurately the % of empty cans that was recycled to the nearest %.
- 1.7.3. Comment on the level of recycling achieved at this event.

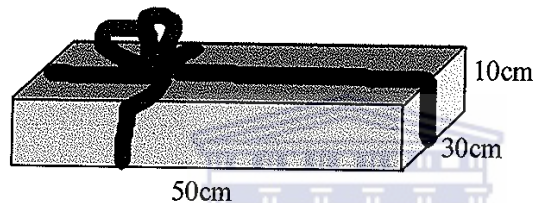
One crate =
24 cooldrinks

SECTION 2

- 2.1. On a city map with scale 1 : 20 000, you measure the length and breadth of a city block as 15mm and 9 mm.
- 2.1.1. What are the length and breadth of the block in reality (express your answers in meters)
- 2.1.2. What is the area of the block in m^2 (first make a sketch with the real measurements, before you calculate)
- 2.2. Calculate the perimeter and area of the shaded shape shown below.



- 2.3. Calculate how much ribbon would be required to tie the ribbon as shown in the diagram and 20cm is needed to tie the bow.



SECTION 3

- 3.1. I invest R1 000 at 8% p.a. for 3 years, but at the end of each year I take the interest it earned and use it. (In other words I do not re-invest the interest.) How much interest will I have earned in total?
- 3.2. I invest R500 at 9% p.a. compounded yearly, for 10 years. What is the value of the investment at the end of the 10 years.
- 3.3. How much interest will you earn if you invest R3 500 at 5% p.a. compounded monthly, for $4\frac{1}{2}$ years.
- 3.4. A shop advertises this Sony DVD Micro Hifi
- 3.4.1. The price used to be R1599 but is reduced to R1199. What is the percentage change of the cash price for this item?
- 3.4.2. Calculate what is the total amount the customer has to pay if he/she buys the Micro Hifi on Hire Purchase.
- 3.4.3. How much interest must the customer pay?
- 3.4.4. What is the amount the customer borrows from the shop?
- 3.4.5. Calculate the annual interest rate.



GRADE 10 MATHEMATICAL LITERACY
RESEARCH TASK
CONTEXT: SOLID WASTE (MANAGEMENT)
Learning Outcomes 1, 2, 3 & 4

Learner: Set: Group:

Area of domicile: Mathematical Literacy Educator:

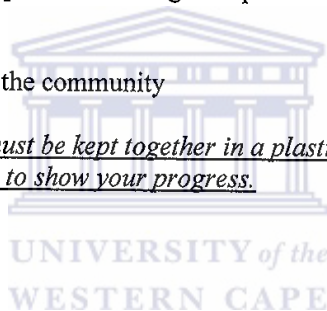
For this Research Task, the learner will gather information over a period of one week at home and find other information in the community regarding solid waste and its management; as well as perform mathematical processes such as measuring, estimating, calculating and representing data.

This is an individual task, although at times group co-operation and exchange of information is required. All calculations must be rounded off to two decimal figures.

Your task will be assessed according to the following criteria:

- Sticking to the deadlines set by the teacher to help you complete the task.
- Group co-operation
- Calculations
- Clear explanations of methods where problem solving is required
- Graphical representation
- Completeness and accuracy
- Informative and functional poster for the community

All completed and incomplete tasks must be kept together in a plastic sleeve designated for this task only, which must be brought to each lesson to show your progress.



TASK 1

The day on which my household rubbish is being collected is:

Collect and separate the following recyclable solid waste products and keep a daily record of your collection in the table provided below as shown in the example.

This collection must start on the day of municipal collection.

Where possible items should be pressed (compacted) before storage.

Name: Set: Group:

Number of people in the household: adults, teenagers and small children.

Recyclable solid waste produced from/...../..... to/...../..... (dd/mm/yy)

	Organic	Glass	Paper	Cardboard	Cans/tins
<i>Example</i> <i>Day 1</i> <i>Monday</i>	<i>1 banana peel</i> <i>a tea bag</i>	<i>1 jam jar</i> <i>1 large mayo jar</i>	<i>1 newspaper</i> <i>A telephone book</i>	<i>1 large cereal box</i> <i>An A4 sheet</i>	<i>3 beer cans</i> <i>2 tins</i>
Day 1					
Day 2					
Day 3					
Day 4					
Day 5					
Day 6					
Day 7					

TASK 2

Determining the volume of the recyclable solid waste produced

Name: Set: Date:

2.1. Find a way to measure/calculate/estimate as accurately as possible, the approximate volumes of all the categories of recyclable waste as collected in Task 1, in m³.

Explain your method of how you went about each category and complete the table below:

Quantity of recyclable solid waste produced in my household during one week, per category in m³

Category	Volume (in m ³)	Method of measurement / estimation / calculation
Organic		
Glass		
Paper		
Cardboard		
Cans/tins		
TOTAL		

2.2. Find out, calculate or estimate the total volume of your municipal bin in m³.
 Explain you method/show all calculations.

2.3. At the end of your week of separating selected materials, express as a fraction (estimate), how full your municipal bin is with any other waste (non-recyclable or other recyclable materials which we did not separate), and calculate the volume of the waste in the municipal bin in m³. (show your calculations)



2.4. Complete the table below:

**Total amount of waste produced by my household from/...../..... to/...../.....
 (dd/mm/yy)**

	Recyclable solid waste	Other solid waste	Total solid waste
Volume in m³	(2.2.)	(2.3.)	
% of total waste			

TASK 3

Name: Set: Group: Date:

3.1. Complete this table with all the information of each member of your group:

Solid waste collected per household per category for the duration of one week, in m³.

Waste category Household	Organic	Glass	Paper	Cardboard	Cans/tins	Other	TOTAL
1							
2							
3							
4							
5							
TOTAL							
Mean per household							

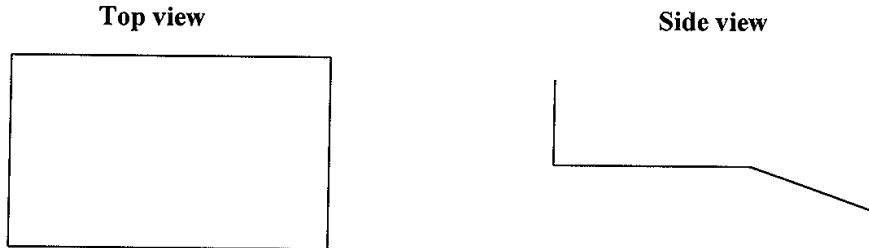
3.2. In the space below, produce an appropriate graph to show the mean waste produced per household per week in the various categories from your table above. (Remember to include all the required information for the readers – and attach a sheet with any calculations that were necessary to do the graph).

TASK 4

Name: Set: Group: Date:

Below are two diagrams to represent the school's swimming pool.

4.1. Add the necessary measurements on the diagrams that you need to calculate the volume of the pool.



4.2. Calculate the volume of the swimming pool in m^3 . (show all your working out)

4.3. Based on your estimate calculations of the mean amount of solid waste produced by one household, Write an equation to show the amount of solid waste produced (w) in terms of nr of weeks (t) and complete the table for each so you can draw the straight line graph of each of these equations.

4.3.1. In the case that no solid waste is recycled. Equation: =

t (nr of weeks)	0	5	10	15
w (solid waste produced in m^3)				

4.3.2. In the case that the same materials we have separated in Task 1 are being recycled by all the households. Equation: =

t (nr of weeks)	0	5	10	15
w (solid waste produced in m^3)				

4.4. Graph both functions on the same grid (make sure to indicate how to differentiate between the two) and attach it to this page. Read off from your graph approximately how long it would take to fill up the whole pool. (Show your method on your graph)

4.4.1. In the case that no solid waste is recycled.

4.4.2. In the case that the same materials we have separated in Task are being recycled by all the households.

4.5. Compare the two readings and comment on them.

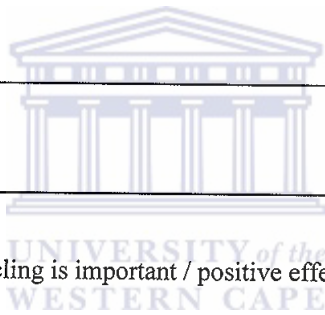
TASK 5

Name: Set: Date:

Find for as many possible solid waste materials the nearest recycling point to your home and complete the table below as much as possible. (Give a location – an address for each)

Closest recycling point to (your neighbourhood) per category.

Material	Location (address)
Glass	
Paper	
Cardboard	
Cans/tins	
Plastic	



TASK 6

6.1. Write down 3 - reasons why recycling is important / positive effects from recycling:

-
-
-

6.2. Write down 3 possible difficulties people have to overcome to start with recycling:

-
-
-

TASK 7

Design a poster A3 format (soft paper), which can be posted at your local grocery store to **encourage** people to recycle, and to **inform** them of the location of the nearest recycling points.

APPENDIX 7: Samples of Tests & Examination Papers

MARCH MINI-EXAM 2006 GRADE 10 MATHEMATICAL LITERACY

LO 1 and LO 3
Assessment Standards: 10.1.1., 10.1.2., 10.3.1., 10.3.2.

1 Hour
60 Marks

Instructions

- Draw a ruler line 2,5 cm from the right edge of your page for the marker.
- Show all your steps of working out unless otherwise stated in the question.
- Use your scientific calculator unless otherwise stated.
- Label your answers clearly and correctly.
- Leave an open line between questions.

Question 1

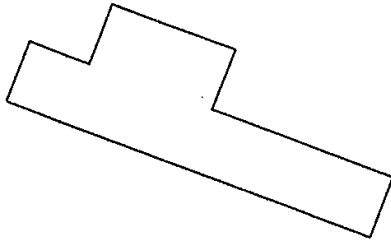
- 1.1. Use BODMAS to simplify the following expression step by step (*without the use of your calculator*) until you have obtained the value of the expression: (3)
$$[(3 + 7) \times 5 + 14] \div 8$$
- 1.2. Round-off the following numbers according to the instruction given by each of them: (2)
- 1.2.1. Ayanda earns a gross salary of R3548 per month. (*nearest 100*)
- 1.2.2. The piece of wood measured 0,2183 metre (*nearest 100th*)
- 1.3. Write the following numbers in scientific notation (4)
- 1.3.1. 0,000 000 000 000 026
- 1.3.2. 12 450 000.
- 1.3.3. Health problems cost South Africa R 4 billion per year.
- 1.4. Convert the following fractions to (a) decimal figures (*round off to 3 decimals*) and (b) to percentages (*round off to 1 decimal*) (4)
- 1.4.1. $\frac{2}{111}$ 1.4.2. $\frac{20}{3}$
- 1.5. Use your calculator to do the following calculations - *only write the answers.* (3)
- 1.5.1. $(433 - 20) \times (400 + 28)$
- 1.5.2. $1,2 \times 10^{-3} \times 2,457 \times 10^3$ (*write your answer as an ordinary number*)
- 1.5.3. $125 \times \frac{256 + 24}{8}$
- 1.6. **Show** how you can make use of the distributive and associative properties to make mental arithmetic of these expressions easier – *no need to do the calculations* (5)
- 1.6.1. $485 + 46 + 15 - 16$
- 1.6.2. $25 \times 23 \times 4$
- 1.6.3. 48×7
- 1.7. Write the following ratios in their simplest format (3)
- 1.7.1. 312 : 468
- 1.7.2. 8 mm : 1 km

[24]

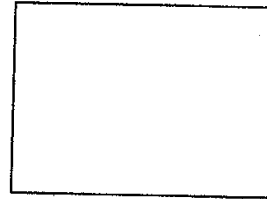
Question 4

Measure the sides to the nearest cm and determine the Area and the Perimeter of the following shapes. [4]

4.1.



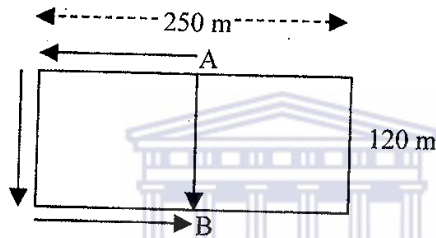
4.2.



Question 5

Over relative short distances John is able to run 12km/h and swim at 5km/h.

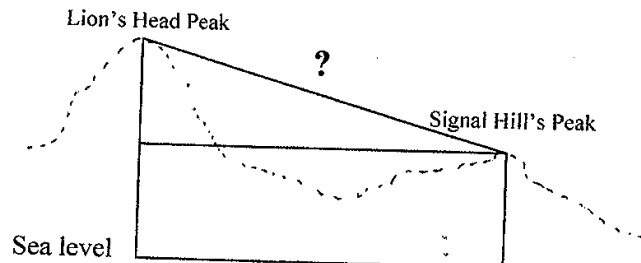
- 5.1. His running speed converts to 200m/min. Convert his swimming speed to metres per minute (3)
- 5.2. What would be faster: swimming across this dam or running around it? (to get from point A to B; Point A is halfway of the length of the dam). (4)
 Show all calculations on which your answer is based.



[7]

Question 6 – Refer to the map of Cape Town on the last page.

- 6.1.1. Accurately measure (to the nearest mm) the scale of the map of Cape, and write it as a ratio. (remember to mention the units) (2)
- 6.1.2. Simplify this ratio to the format 1 : (2)
- 6.1.3. Accurately measure the horizontal distance between the peaks of Lion's Head and Signal Hill on the map, to the nearest mm; and use your answer in 6.1.2. to calculate the real horizontal distance in metres. (2)
- 6.1.4. Copy and complete the side view diagram of the two peaks; add all the necessary measurements (some to be found on the map + some from calculations), and use the Pythagoras Theorem to find the direct distance of the two peaks in metres. (round off to the nearest metre) (6)



[12]

TOTAL [60]

JUNE EXAM 2006
GRADE 10 MATHEMATICAL LITERACY

LO 1, LO 3 and LO4

2 Hours
100 Marks

Instructions

- Draw a 2,5 cm margin on the right-hand side of the page.
- Show all calculations used in determining your answers.
- Use your scientific calculator unless otherwise stated.
- Label your answers clearly and correctly.
- Leave a space between questions.

Question 1

Carefully read the newspaper article and answer the following questions:

Hillary inspires duo to beat their own Everest in form of Great Wall of China by ANDY SHLENSKY Cape Times Thu 4 May, 2006	
<p>A DOCUMENTARY on Sir Edmund Hillary, first man to summit the world's highest peak, inspired Capetonian David Grier to meet the challenge that everyone should conquer their own Everest.</p> <p>Grier and friend Braam Malherbe have found theirs in the form of the Great Wall of China. They hope to become the first people to run along the wall from end to end.</p> <p>The two will attempt to run 45km each day for five months beginning in August to complete the 6700km trek from Jiayuguan, in the Gobi desert, to Shanhaiguan where the wall meets the Yellow Sea.</p> <p>"When I finish, that's going to be my Everest" said Grier.</p> <p>The run, entitled the "Great Wall Challenge for our Children", will</p>	<p>benefit Operation Smile South Africa, a branch of the global non-profit volunteer medical service organization that provides reconstructive facial surgery to children with facial deformities.</p> <p>"With Smile, the money will really make a difference," Grier said. "It changes their lives completely."</p> <p>Operation Smile executive director Natalie Miller is overjoyed to have their support.</p> <p>"What they are doing is amazing" said Miller. The duo aim to raise at least \$120 000 for the cause. The two face sandstorms, heat, hills and cold. At times they will carry all their gear.</p> <p>"We wanted to find some challenge that has never been done before," Malherbe said. "And nothing could top this."</p>

- 1.1. What do you think Sir Edmund Hillary meant by his statement that "Everyone should conquer their own Everest"? (2)
 - 1.2. Who are the two Capetonians inspired by the documentary on Edmund Hillary? (2)
 - 1.3. Who will benefit from their endeavor? (2)
 - 1.4. They are aiming at raising at least \$120 000 for the cause, if 1\$ = R6,0340 how much money are they aiming to raise in Rands? (1)
 - 1.5. a) How long is the Great Wall of China? b) Convert your answer to metres and write in scientific notation. (4)
 - 1.6. If they will be running 45km per day on average, how many days will they be running? (2)
 - 1.7. If they run on average 8 minutes for every kilometer, how many hours will they be running per day? (3)
- [16]

Question 2

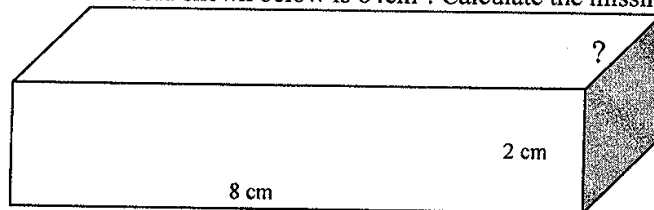
The municipal bill a house owner got at the end of April read the following amounts payable to the City of Cape Town:

- property rates: R186,33
- Water: R21,88 *
- Refuse: R53,56 *
- Sewerage: 37,25 *
- + 14% VAT on the amounts marked with * above

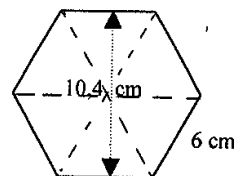
- 2.1. Calculate the total owed to the city for this month. (4)
- 2.2. "How your rates will rise in July. (Tygertalk 27/4/2006)
The City of Cape Town is set to increase all tariffs at the beginning of July below projected inflation figures.
Tariffs for electricity, sanitation and solid waste are all expected to increase by about 5%, while water tariffs are expected to increase by 7%."
- 2.2.1 Calculate this person's new Monthly Rates Account for July, based on his April statement and the projected increases published in the newspaper. (property rates stay the same) (5)
- 2.2.2. Calculate the %-increase of property rates if the amount is increased from R186,33 to R199,37. (3)
[12]

Question 3

- 3.1. Our school's swimming pool (top view) measures 21,1m by 25m.
- 3.1.1. Draw an accurate diagram on a scale 1 : 500 (+ show your working out) (4)
- 3.1.2. Calculate the length of the diagonal of the pool to 2 decimal places. (4)
- 3.2. A square carpet covers an area of $1,44\text{m}^2$. Calculate the length of its sides? (2)
- 3.3. The volume of the cuboid shown below is 64cm^3 . Calculate the missing length. (3)



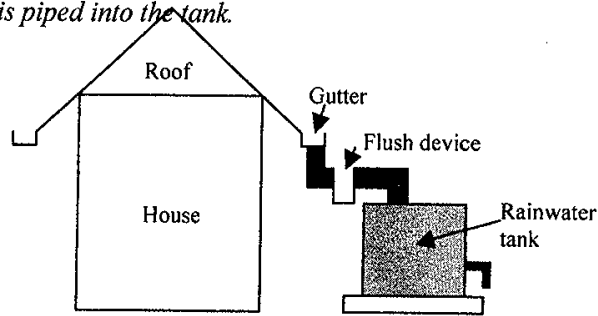
- 3.4. Calculate the area of the following regular hexagon: (4)



[17]

Question 4

A cylinder shaped rainwater tank is used to catch and store rainwater. The water can be used for washing, watering the garden and if properly filtered drinking. From the sketch you can see that when it rains, the water runs off the roof into the gutter. From the gutter it is piped into the tank.



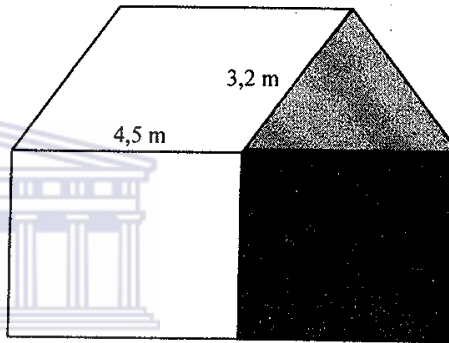
- 4.1. Which measurements would you have to know in order to calculate the volume of rainwater that will be collected in the rainwater tank in the picture? (5)

The sketch aside shows the dimensions of the roof.

- 4.2. What shape is the part of the roof from which the water will be collected? (1)

- 4.3. Calculate the area from which the water will be collected. (2)

- 4.4. Calculate the volume of rainwater collected if 20 mm of rain fell. (3)



The sketch aside shows the dimensions of the cylinder shaped rainwater tank.

- 4.5. Calculate the volume of water the tank can hold. Correct to three decimal figures. (3)

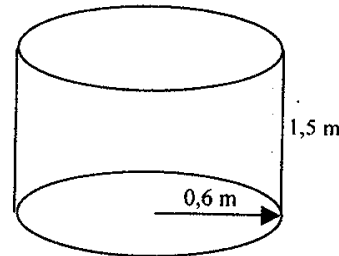
- 4.6. If 1 litre = 1000cm³, show all the steps to work out how many litres there are in a m³. (5)

- 4.7. How many litres of rainwater can the tank store? (1)

- 4.8. If 20mm of rainfall has occurred,
a) express as a fraction, what portion of the tank has been filled with rainwater. (3)

- b) simplify the fraction
c) complete the sentence: The tank will be approximately 1/....th filled with water.

[23]



Question 5

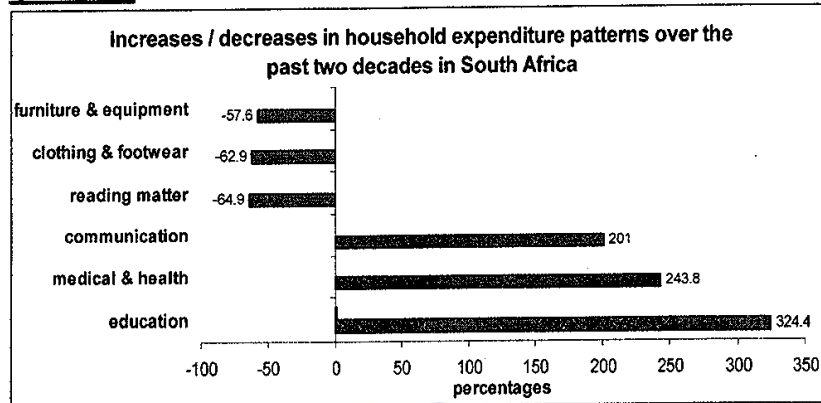
The following figures were publicized in the Cape Times "Save Electricity" special edition on 25/4/2006 regarding the sources from which electricity is generated in South Africa:

- ❖ 93% of power is generated from coal
- ❖ 5 % nuclear, and
- ❖ 2 % other – mainly hydro and pumped storage

Draw a pie chart to represent this data.

[10]

Question 6



- 6.1. How long is two decades? (1)
- 6.2. Why do some of the bars go left and some of the bars go right? Explain their meaning. (2)
- 6.3. What is represented on the horizontal axis of this chart? (3)

Answer all the following questions with complete sentences as if they were part of an official report!

- 6.4. What was the %-increase for expenditure on education for South African households over the last two decades? (2)
 - 6.5. On which category do South African households spend 3 times as much now than they did 20 years ago? (2)
 - 6.6. Write a sentence to describe the trend depicted in this graph. (3)
- [13]

Question 7

The annual salaries of eight employees working on a large fruit farm are as follows: R12 000; R12 000; R15 500; R15 700; R18 300; 65 000; R89 700 and R145 000.

- 7.1. Calculate the Mean of their salaries. (2)
- 7.2. Find the Mode of their salaries. (1)
- 7.3. Find the Median of their salaries. (2)
- 7.4. Which measure of central tendency is not a good indication of their average salary? Explain why. (2)
- 7.5. What is the range of their salaries? (2)

[9]

TOTAL MARKS: 100

Grade 10 Mathematical Literacy
August 2006

Jenni and Roscoe have been dating each other for 3 years, and have decided to get married to start a family. Jenni's parents will pay for the wedding party. Family and friends have been invited.

Question 1

They found a suitable venue for the wedding which will cost them R4000

The DJ is charging R400 per hour, and will be used for 2 hours

The live band costs R5 000 for the evening

The hire of equipment and decorations (table, chairs, table cloths, plates, plants, drapes, etc...) is R10 250.

The catering costs R 45 per person. (this includes the food and the waiters)

A professional video camera man will take a video of the wedding party for R1000.

1.1. Classify each of the costs as fixed or variable costs (6)

1.2. Find the total for the fixed costs. (2)

1.3. Show the calculation how to obtain the cost if 50 people attend the party. (2)

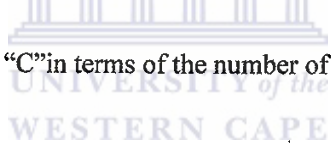
1.4. Show the necessary calculations and copy and complete the table below: (6)

Number of people attending the wedding party	50		150
Cost for the wedding party (Rands)	22900	23350	

23300 23750

1.5. Draw a graph to represent the cost for the party, on the grid provided behind the title page of this exam paper. (8)

1.6. Write a formula for the total cost "C" in terms of the number of people attending the wedding "n". (2) [27]



Question 2

The couple sent 200 invitations to friends and family and 135 have responded that they will be attending the wedding party.

2.1. Write down the ratio of number of people attending to the number of people that were invited. (1)

2.2. Use your calculator to simplify this ratio as much as possible. (1)

2.3. What percentage of the invited guests are attending? (3)

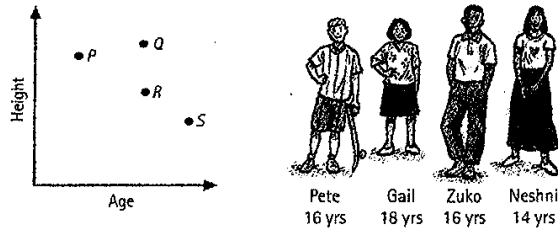
2.4. A month before the wedding the total number of guests that will be attending the wedding went up to 147. Calculate the %-increase. (4) [9]

Question 3

Compound Interest calculation: $V = P \times (1 + r)^n$

3.1. Jenni's Parents invested money 20 years ago so they would be able to give Jenni a nice wedding party. They invested R5000 at the bank in an account that gave them 8% p.a. compound interest, compounded annually. What is the value of the investment now? (3)

6.5. Who is who in the graph below? (Write the letters in alphabetical order and the corresponding names next to each) (4)

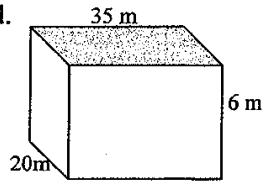


[27]

Question 7

Area of rectangle = $l \times b$
 Volume cuboid or cylinder = $\text{area base} \times h$
 Area circle = $r^2 \times \pi$

7.1. Below is a diagram of the hall where the party will be held. The hall is a cuboid shape.



- 7.1.1. Calculate the floor area to the nearest m^2 . (2)
- 7.1.2. Calculate the volume of the hall in m^3 . (2)
- 7.1.3. A decoration ribbon is going to be placed along the walls right around the hall. How long must this ribbon be? (2)
- 7.1.4. For the special lighting a cable needs to be taken from one corner of the ceiling to the opposite corner (diagonal). Use the theorem of Pythagoras to determine how long that cable must be? (4)

7.2. If a coke can (cylinder) holds 340 ml and is 11,7 cm high, what is its diameter to the nearest cm if $1\text{ml} = 1\text{cm}^3$? (6)



[16]

Question 8

At the party a lucky draw is done and there are 3 prizes to be won. Everybody received a numbered ticket as they entered. In total 147 tickets were handed out, numbered 1 to 147.

- 8.1. What is the probability that John will win any of the 3 prizes to be won, expressed as a fraction? (1)
- 8.2. What is the probability that Jenni or Roscoe will win one of the 3 prizes, expressed as a percentage? (2)
- 8.3. The first prize ticket has been drawn, what is the probability that it was a number ending in a "5", expressed as a decimal? (2)

[5]

Total marks 120



- Instructions:
1. Show ALL YOUR WORKING OUT, unless otherwise stated
 2. WRITE IN PEN – Only sketches may be done in pencil.
 3. All calculations must be to two decimal places unless stated otherwise
 4. Only hand in your answer sheets.

Question 1

The Arrive Alive campaign was started in order to reduce the number of road deaths on South African roads. The campaign was implemented in two phases. The table below shows the number of fines issued for certain offences during the two phases.

OFFENCE	PHASE 1	PHASE 2
Speed	400 000	250 000
Alcohol	40 000	15 000
Seatbelts	150 000	40 000

- 1.1 Draw a multiple bar graph to illustrate the above information. (7)
- 1.2 Based on this information, do you think that the Arrive Alive campaign is working? Motivate your answer. (2)
[9]

Question 2

In 2005 there were 9 600 deaths due to road accidents.

- 2.1 If 3 800 of them were pedestrians, what percentage is this of the total number of road deaths? (1)
- 2.2 Arrive Alive aims to decrease the total number of road fatalities by 5%. If they are successful, how many lives will be saved? (1)
- 2.3 60% of all road accidents are alcohol related. Express this value as a:
a) decimal fraction
b) a common fraction (2)
[4]

Question 3

The table shows the Budget for the Phase 1 of the Arrive Alive campaign.

	Amount in Rand
Equipment	25 200 000
Overtime	8 300 000
Communication	6 600 000
Training and information	9 900 000

- 3.1 Draw a pie chart to represent the above information. (show all your calculations in a table) (7)
- 3.2 The budget for Phase 2 of the campaign is R15 million. This is to be spent on equipment, overtime, communication and training/information in the ratio 3 : 6 : 4 : 2. Determine the amount that will be spent on each item. (5)
- 3.3 Calculate the %-change of the amount of money spent on communication in Phase 2 compared to the amount that was spent on the same in Phase 1. (2)
[14]

Question 4

- 4.1. The Arrive Alive campaign receives a donation of R1 500 000. It is decided to invest the money for 4 years. They have two options:
- Option A: 13% p.a. compounded annually
 - Option B: 12% p.a. compounded monthly
- Calculate which option will be the best for them. (8)
- 4.2. Michael buys a second-hand motor car for R40 000. He borrows R25 000 from his Parents.
- 4.2.1 a) If his parents charge him 5% p.a. simple interest over 3 years, what is the total amount he must pay his parents? (4)
- b) Write your answer in scientific notation. (2)
- 4.2.2 Calculate his monthly payments to his parents. (2)
- [16]

Question 5

On National roads the speed limit is 120km/h. Drivers who travel over the speed limit are fined. The table below shows how much a driver is fined depending on how fast they were Travelling.

Speed (km/h)	120	135	150	165	180	195
Fine (Rand)	0	150	360	600	885	1260

- 5.1 5.1.1 Name the dependent variable (1)
- 5.1.2 Name the independent variable (1)
- 5.2 Use the table to draw a point-by-point graph on the grid provided in addendum 1 (8)
- 5.3 Calculate the rate of change (gradient) between:
- 5.3.1 120 km/h and 135 km/h (2)
- 5.3.2 150 km/h and 165 km/h (1)
- 5.3.3 Is the rate of change constant? Elaborate. (2)
- 5.3.4 Calculate the average slope between 120 km/h and 195 km/h (3)
- [18]

Question 6

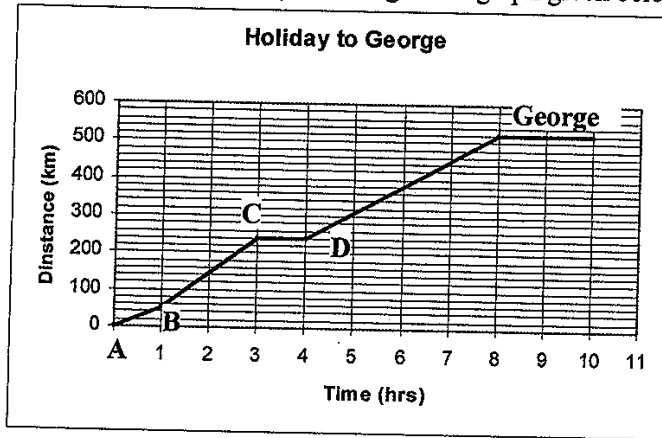
The table below gives the number of motorists who were fined for speeding in the Cape Town area during 2005 per month.

January	February	March	April	May	June
250	220	110	235	105	95
July	August	September	October	November	December
110	90	85	65	115	275

- 6.1 Calculate the mean, median and mode of the number of fines per month. (5)
- 6.2 Calculate the range of the number of fines per month. (2)
- 6.3 Which three months have the highest number of fines? Give a possible explanation. (4)
- 6.4 Organize the numbers of fines in a frequency table with 5 class-intervals. (5)
- [16]

Question 7

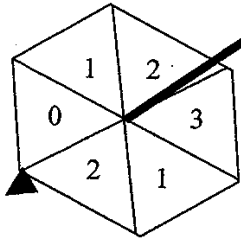
A family goes on holiday to George. The graph given below describes their trip.



- 7.1 Describe what is happening between points A and B. (1)
 - 7.2 Describe what is happening between points B and C. Use the graph to motivate your answer. (2)
 - 7.3 During their journey they stop at the Engen One-Stop. Where is this shown on the graph? (1)
 - 7.4 How long did they stop at the Engen One-Stop? (1)
 - 7.5 How far was the Engen One-Stop from home? (1)
 - 7.6 The petrol costs R9,88 a litre and they buy 45 litres, how much did it cost? (1)
 - 7.7 How long did it take them to reach their destination? (1)
 - 7.8 The car uses an average of 7 litres per 100km. If the tank holds 50 litres of petrol, how many kilometers can they travel before filling up again. (3)
- [11]

UNIVERSITY of the
WESTERN CAPE

Question 8

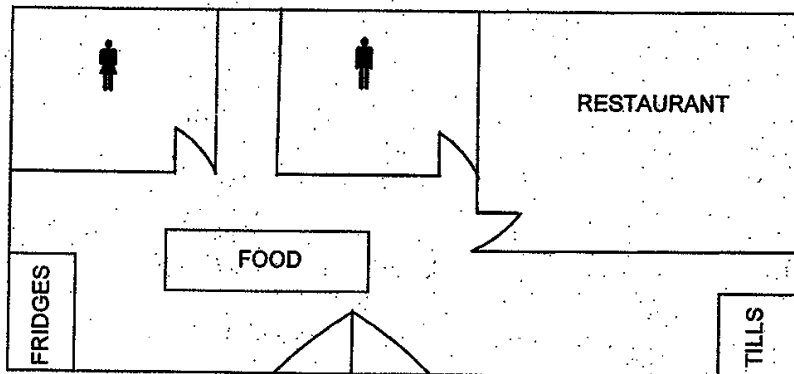


Event	Consequence
Spinner lands on 0	Gambler loses his money
Spinner lands on 1	Gambler does not win nor lose
Spinner lands on 2	Gambler gets 2 × the amount he bet back
Spinner lands on 3	Gambler gets 3 × the amount he bet back

- 8.1 What is the probability that the spinner lands on “0”? (2)
 - 8.2 What is the probability that the gambler will make a profit? (2)
 - 8.3 What will happen if a gambler bets R20 and the spinner lands on “1”? (2)
- [6]

Question 9

Below is a plan of the Engen One-Stop at Laingsburg. The scale used is 1 : 150. A ruler must be used for any necessary measurements. (Accuracy to the mm)



- 9.1 Describe what the scale used in this plan means in words. (2)
- 9.2 Calculate the actual length and the breadth of the restaurant in metres. (5)
- 9.3 Calculate the area of the restaurant in m^2 . (2)
- 9.4 The owner has decided to tile the restaurant. The size of a single tile is $20\text{cm} \times 25\text{cm}$. Calculate how many tiles will be needed to tile the area of the restaurant. Draw a sketch to show how many rows and how many columns of tiles he will need for the restaurant so that he won't have to waste any. (4)
- 9.5 The tiles come in boxes of 16. How many boxes will the owner need to buy? (3)
- [16]

INSTRUCTIONS

- Prepare each answer sheet with a 3cm margin on the right side. You will leave this right margin blank for the marker.
- Label your questions correctly according to the question paper.
- Write neatly – **all answers in pen**
- You may use a calculator but, **SHOW ALL YOUR METHODS OF CALCULATIONS, round off to 2 decimal figures unless otherwise stated in the question!**
- Use Pi on your scientific calculator.
- Good Luck! Keep an eye on your time.

Question 1

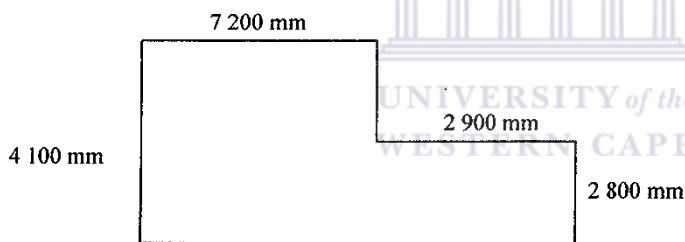
A certain amount was invested at 8% per annum simple interest. After 10 years, the investor withdrew his money to find that the value of his investment is R12 600. What was the amount that he initially invested?

[7]

Value of investment = $P \times i \times n + P$

Question 2

Calculate the area of this floor in m^2 and the volume in m^3 for concrete required for a slab 100mm thick.



[7]

Question 3

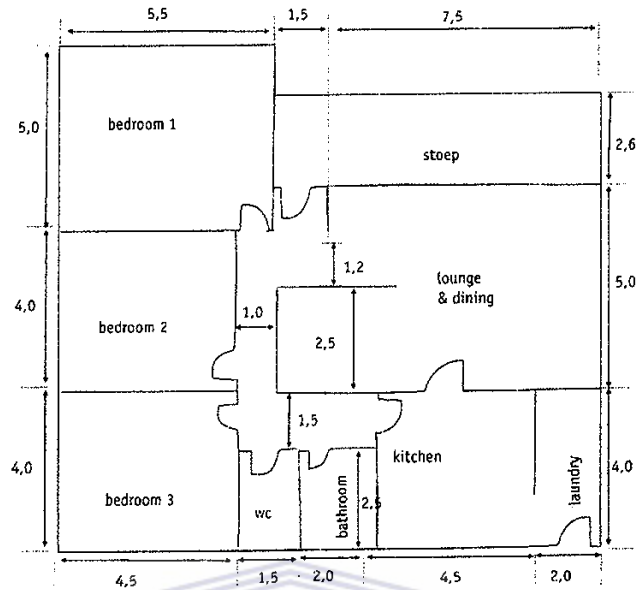
Bank PIN numbers are made up of several numbers that can be repeated.

- 3.1. List all the possible numbers per digit for the PIN code. (1)
- 3.2. How many possible combinations are there for a 2-digit PIN number? (2)
- 3.3. How many possible combinations exist for a 4-digit PIN number? (2)

[5]

Question 6

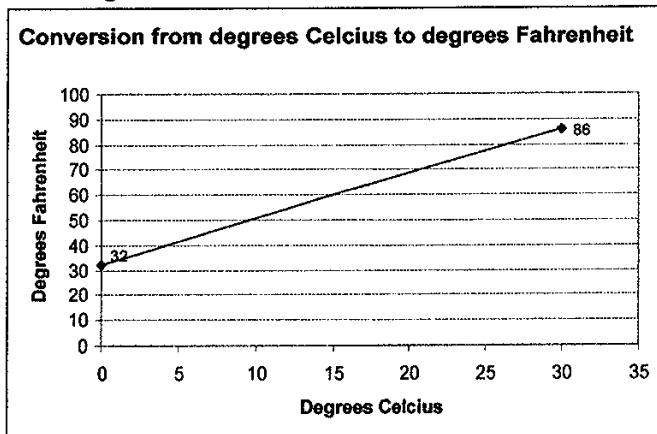
Below is a rough drawing of a floor plan of a house, the measurements indicated are in meters.



- 6.1. Draw an accurate scale drawing of the stoep, to a scale of 1 : 50 (5)
- 6.2. The stoep will be tiled with tiles that are 50cm sides. Draw the tiles in on the scale drawing. (2)
- 6.3. The tiles are sold in boxes of 3m² for R135 per box. (11)
How much will you have to pay if you add 5% to the number of tiles required to cover for breakages and accidents while cutting. [18]

Question 7

- 7.1. Use the graph to copy and complete the conversion table from degrees Celsius to degrees Fahrenheit. (2)



Temp in °C	0	30	x
Temp in °F			y

JUNE EXAMINATION 2006

MATHEMATICAL LITERACY

GRADE : 10

MARKS : 100

DURATION : 2 HOURS

INSTRUCTIONS TO CANDIDATES

- 1. ANSWER ALL THE QUESTIONS!**
- 2. DO ALL CALCULATIONS NEATLY!**

SECTION A

QUESTION 1

Calculate the following without the use of a calculator:

1.1 $30 - (16 + 1)$ (1)

1.2 $\frac{23 + 17}{5}$ (1)

1.3 $\frac{4^3}{2(18 - 14)}$ (1)



Given that $a=6$; $b=12$ and $c=2$, calculate the value of P:

1.4 $P = a + b + c$ (2)

1.5 $P = \frac{b}{c} + c$ (2)

1.6 $P = \frac{b + ac}{6}$ (2)

Round the following numbers to the nearest 1000:

1.7 6499 1.8 7555 1.9 19999 (3)

Convert the following percentage to decimal figures:

1.10 a. 28,2% 1.10 b 116% 1.10 c 20% (3)

**Convert the following fractions to decimals, and then to percentages
(with the help of your calculator)**

1.11 (a.) $\frac{3}{8}$ 1.11 (b) $\frac{214}{45}$ (4)

/19/

QUESTION 3

Read carefully & show all your calculations when answering the following!

- 3.1 Siphso does casual work delivering pizzas. His rate of pay is R14,85 per hour Monday to Friday, and R16,26 per hour on the weekends. Calculate his total Earnings for working from 17:30 to 22:00 on Friday, and from 18:15 to 21:00 On Saturday. (5)
- 3.2 Zandile takes out a bank loan of R13 500 to pay for an urgent medical Operation. The bank terms are 12% p.a. over two years, compounded Annually. How much money must Zandile repay the bank? (2)
- 3.3 Bonga invests his first Christmas bonus of R750,00 in a bank that offers Interest rates of 9 % p.a. compounded yearly. How much interest will Bonga have earned after 12 years? (2)
- 3.4 A bank charges 11% interest p.a. on loans over 4 years. Olwethu borrows R12 000. Calculate:
- 3.4.a. The amount of interest due: (1)
- 3.4.b The total amount to be repaid: (1)
- 3.4.c. The monthly repayments needed: (2)

/13/

**SECTION B
QUESTION 4
COMPLETE:**

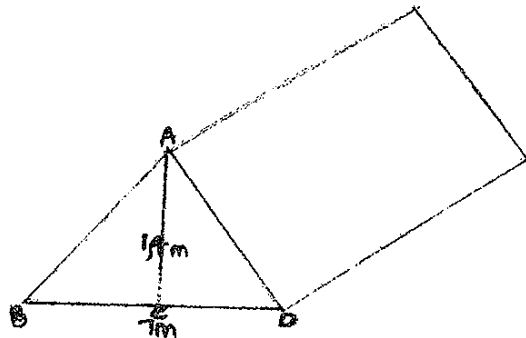
- 4.1 1km.= _____m
- 4.2 1km=_____mm.
- 4.3 25km.= _____cm
- 4.4 250ml = _____l
- 4.5 0,25kg = _____g (5)

Show all your calculations when answering the following!

- 4.6 The length and breadth of a monitor of a computer is in the ratio 4:4 Calculate the perimeter of the monitor. (2)
- 4.5A swimming pool is 40 m long and 15m wide.
- (a) calculate the perimeter of the pool. (2)
- (b) Calculate the area of material needed for a cover for the pool. (2)

4.6 Calculate the amount of facing board needed for the following Gable roof!(correct to 1 decimal place) (3)

(a)

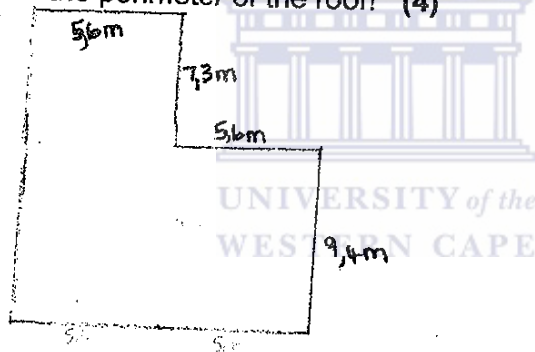


- (b) Using the Theorem of Pythagoras to calculate the side AD. (3)
 (c) What is the perimeter of the front face of the gable roof?) (3)

QUESTION 5

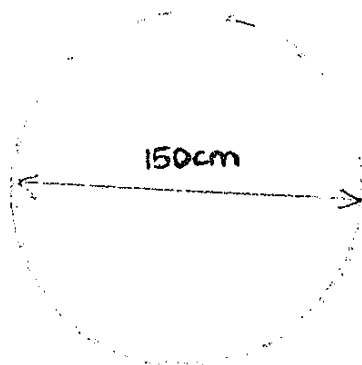
5.1 (a) The following shape represent a roof of a building! Builders need an amount of tiles to cover the roof. Calculate the area of the roof in order to establish the amount of tiles needed for the roof. (4)

(b) Calculate the perimeter of the roof! (4)

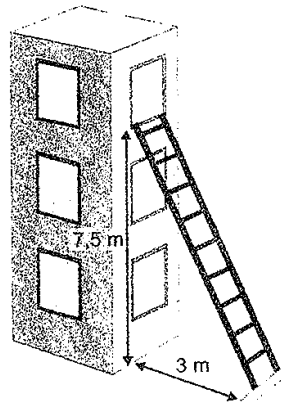


5.2 The following shape represent an umbrella! Calculate the:

- (a) area (2)
 (b) perimeter (2)

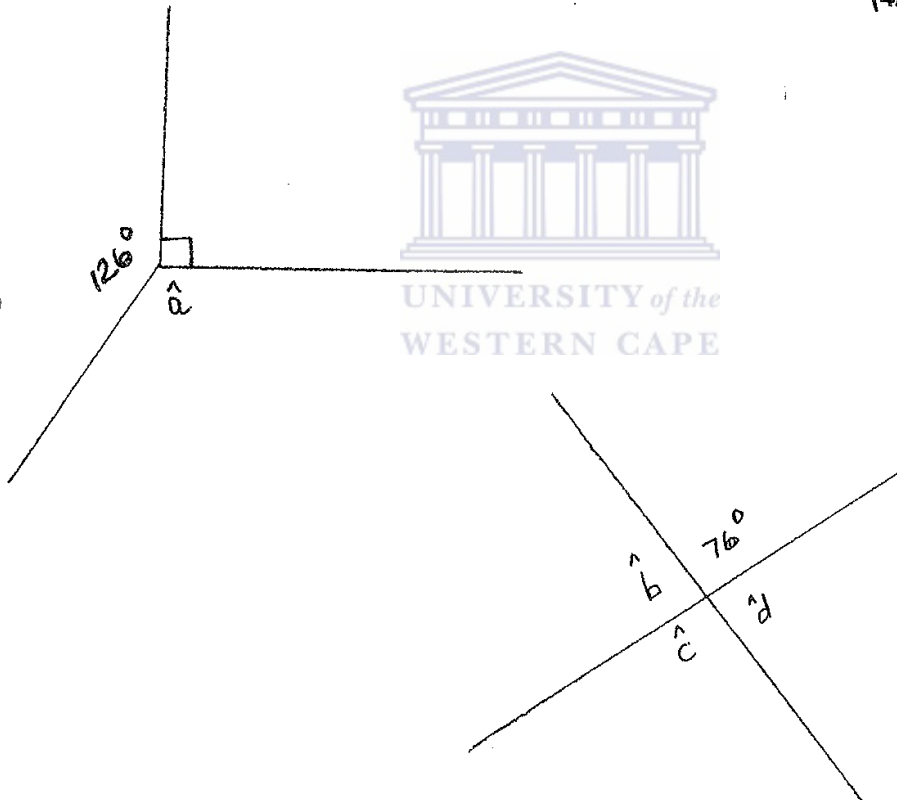


5.3 A window cleaner uses a ladder to reach the windows of a three-storey building in a narrow lane. Look at the measurements of the building in the diagram below and calculate the maximum length his ladder needs to be! (2)



QUESTION 6

6.1 Calculate the size of the angles marked (a) –(d), and give reasons for your answers! (4x2=8)



6.2 Find the value of x in each of the following drawings: (4×2=8)

