MATHEMATICS AND ITS APPLICATION IN THE PHYSICAL WORLD

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THIS STUDY IS DEDICATED TO MY

MUM AND LATE DAD

MY HUSBAND TERENCE, SON PAXTON AND DAUGHTER TEREEN

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ABSTRACT

The method used in the classroom is thought to have an effect on the learners learning the purpose/use of mathematics in their environment. Many see mathematics as a set of signs and symbols that are meaningless in their lives. The manner, in which mathematics is taught in the classroom, extends the thought of learners in believing that mathematics is a compulsory learning area that is required to be passed in order for them to proceed to the next grade. Meanwhile, the learners may be oblivious to the contribution mathematics can make in their lives.

One of the major contributory factors for this kind of thought is that mathematics is not taught in a way that helps learners understand its purpose/use in society. Thus, meaningless learning is perpetuated because of the approach in the classroom. If educators could alter their methodology in the classroom, then learners would be able to make sense of the subject and so apply the knowledge in their environment when the need arises. One of the ways to do this is to ensure that educators engage in meaningful and relative teaching.

The research for this study was based on the questionnaire and observation instruments. The target was primary school learners from grades five, six and seven, who were required to answer a closed questionnaire based on their understanding of the relevance of mathematics to their environment. The aim was to see how the educators' methodology affected the learners' understanding of mathematics. Educators were also given questions along the same lines, with their lessons observed and observations recorded, according to an observation protocol.

The conclusion that the researcher reached was that learners were not taught in a purposeful manner that might assist them in understanding and applying mathematics to their environment. Whatever they learnt or were taught in the classroom was in isolation, that is, there was minimal, if any, integration into other learning areas.

One possible solution to this problem can be that the educators need to change their teaching strategies. Some of the possible strategies that they could use are cooperative learning, problem solving, the constructivist approach to teaching or an amalgamation of more than one strategy to obtain the outcomes.

In effect, if learners are made to realize the relevance of mathematics consciously; their mindset towards learning it will be more welcoming and accepting of it. Understanding forms the foundation for application, and therefore if the problems in the classroom relate to the learners' experiences in their environment, then mathematics becomes meaningful to them and in turn becomes usable.

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CHAPTER 1

GENERAL ORIENTATION

1.1 INTRODUCTION

In the teaching of mathematics most educators would agree that there is more to the pedagogy of mathematics than just learning the content. According to Cangelosi (1996:28), learners find it difficult to form a link between classroom mathematics and mathematics that they are faced with in the real world. He says that teachers have failed to teach mathematics in a way that it can be used effectively in society. Reed (1999:29) claims that the content learnt with meaning is closely linked to "conceptual knowledge", and can be readily transferred to events in daily life. The approach to mathematics has become a stumbling block to the advancement of the subject. The belief is that teaching should take place at a level where learners can form the link between mathematics and its application or use in the real world.

According to Nkhase (2002: i) "Life in the world today calls for a mathematics educator that will enable pupils to grow as individuals, who can apply appropriate mathematical knowledge and skills to real life situations in the time of need." I shall argue that the methodology or approach in the learning area of mathematics is a complex domain. In order for educators to address this domain they need to have a clear understanding of the various methods or approaches that could form the link between mathematics in the classroom and its purpose/use in the environment. This understanding would result in educators having the skill to create the link in their day-to-day lessons. Learning the relevance brings in understanding and thus easy application for the learner in society.

Many children learn mathematics as a set of rules and procedures which they memorise or learn by rote and then apply with little understanding. According to Davis (Davis & Pettitt, 1994:2) information which is memorised is only "in the mind" and cannot be used or applied in daily life, since it is not understood. Skemp (Suggate, Davis & Goulding, 1998:4), claims that those who have an 'instrumental understanding' of the mathematics learning are unable to 'use or apply' it in their environment. At the outset learners have a notion of "I hate mathematics" or "why should I be forced to do it?" The only reason learners attempt the subject is because it is one of the curriculum requirements to moving on to the next grade. They see no purpose or reasoning behind some of the work that they are exposed to. Learners who are anxious and confused appear to be taking in very little. Educators lack the knowledge about improving the situation and thus the problem persists. According to Willoughby (1990:2), educators are not doing enough to help children learn and understand mathematics sufficiently well that they could lead productive and fulfilling lives in a modern society

Mathematics is seen as playing a major role in daily life. Simple concepts, such as being able to tell the time, counting money and reading speed limits can determine the level at which a person participates in society. According to Wain (Orton & Wain, 1994:26), for a person to get by in an industrial society, he or she requires skills such as recognizing numbers, using a calculator, working with measurements and capacity, and understanding geometric figures. For instance, baking a cake requires mathematical knowledge, in measuring the quantities of ingredients and timing the process. Having this ability to apply mathematical knowledge, and using it appropriately, will determine success. Gates (2001:24) claims that if one is excluded from the community of mathematics, one feels powerless to challenge certain problems. It therefore becomes imperative that the educator uses methodology that allows the learner to find the link between the content and its use in the world.

According to Nkase (2002:7), learners experience many problems when trying to make connections between the mathematics taught in the classroom and the social environment. She claims that "this suggests that there may be some serious constraints associated with the teachers' instructional approaches". The methodology used in the classroom may hinder the learners in making sense of mathematics, and thus reaching a level of understanding to use this knowledge effectively in society. I therefore feel that there is a need to examine the relationship between methodologies used in the classroom and the learners' understanding of its link or application. This examination may provide insight into the strengths and weaknesses concerning methodology and thus lead to possible suggestions about improving methods so that learners can form the link between mathematics and the external environment.

1.2 THE PROBLEM

According to the Revised National Curriculum Statements (2002:4), the purpose of mathematics is to ensure that it enables persons to contribute to and participate with confidence in society. The document sees an individual having access to mathematics as a human right. However, not all learners view it this way, with many seeing mathematics as being meaningless in their lives. For them it is a set of signs and symbols that are irrelevant, a perception certainly stemming from the culture of mathematics in the classroom that leads to the learners' ignorance about its purpose/use in the real world. This total misconception about mathematics results in fear, lack of curiosity or love for the subject, which then filters down to greater problems both for the educator and the learner. According to Martinez and Martinez (1996:2), those who do not understand numbers fear them, and this in turn leads to further misunderstandings that will ultimately lead to insecurities concerning application in society.

The problem gives rise to the following main research question:

- **What are the effects of the methodology that is used in the classroom on the learners understanding the purpose or use of mathematics in their social environment?**

The above question will lead to the following three sub questions:

- **Do learners understand the importance and use of mathematics in the real world?**
- **Do the educators' methodologies hinder the learners' understanding of the link or use of mathematics in everyday life?**
- **How can the methodology in the classroom be improved to foster the use of the subject in their environment?**

1.3 THE PURPOSE OF STUDY

The purpose of this study is to examine the educators' methodological approaches and to discover loopholes that lead to learners' lack of understanding in applying their mathematical skills and knowledge in society, when the need arises. It also aims to suggest ways in which the educator can alter his or her methodological approach to enable learners to understand the purpose of mathematics and how to apply it in their environment.

The aims and objectives

The aims of this research project will thus be as follows:

- **To find out what effects the methodologies used in the classroom have on the learners' understanding of its purpose and use in their social environment.**

- **To provide suggestions on how the methodology used in the classroom can be improved so that the skills and knowledge gained make sense to the learner and can be used in the real world.**

1.4 THE METHOD OF RESEARCH

The quantitative approach of study will be followed using the following techniques:

1.4.1 Administering written questionnaires.

The questionnaire for teachers will be along the following lines:

- Are educators using the appropriate methodology in the classroom that lends itself to learners acknowledging its purpose and applying it successfully in life situations?

The questionnaire for learners will incorporate the following:

- Do learners understand the purpose of studying mathematics and will it help them to solve problems relating to their daily life?

1.4.2 Observation

The observations will accord with the set criteria already prepared, with the focus on the methodology used in the classroom and the learners' responses to the activities. The aim is to find the link that the educator makes in relation to applying mathematical skills and knowledge to everyday situations.

1.5 PROGRAMME OF STUDY

Chapter one is intended to provide the general orientation of the research. A theoretical background of the problem, the purpose of study and the method of research are given.

Chapter two is a review of the literature on the nature of mathematics, the learning theories and the teaching strategies that would promote teaching the purpose/use of mathematics in our environment.

Chapter three brings into perspective the empirical nature of the research. The questionnaire and observation methods of data collection will be analyzed and interpret.

Chapter four presents guidelines and suggestions regarding how the methodology in the classroom can be improved to enhance the learners' understanding of the purpose/use of mathematics.

Chapter five is an overview of the study, drawing conclusions and making recommendations.

CHAPTER 2

THE TEACHING OF MATHEMATICS

2.1 INTRODUCTION

There are various views about what mathematics is, Suggate, Davis and Goulding (1998:1) claiming that there is no agreement on its nature. According to Orton (Orton & Wain, 1994:11), these views have changed in accordance with a changing world, and one's views of the nature of mathematics will affect one's aims in teaching it, therefore having various meanings to different people. The nature relates to what one believes mathematics to be, this very belief or view leading to one's aims in education and, inevitably, how the curriculum is drawn up and related to parents and learners. In this chapter the various views, aims, theories and strategies will be explored, with the intention of describing the purpose/use of mathematics in daily life.

2.2 THE SUBJECT MATHEMATICS

"Mathematics is cultural knowledge that derives from humans engaging in the six universal activities of counting, locating, measuring, designing, playing and explaining in a sustained and conscious manner" Bishop (Gates, 2001:281). Orton (Orton and Wain, 1994:11), claim that mathematics is "an organized body of knowledge, an abstract system of ideas, a useful tool, and a key to understanding the world, a way of thinking, a deductive system, an intellectual challenge, a language, the purest logic possible, an aesthetic experience, and a creation of the human mind…"

Gates (2001:285), questions the assumption that "mathematics is nothing but developing skills and is all about 'doing mathematics', consisting of working through the exercises in school math books to solve book problems, perform algorithms and procedures, and to compute solutions." Berger, Morris and Portman, (2000:5), claim it involves "applying knowledge, skills and understanding to solve problems in a variety of context."

There are different views on the subject mathematics, thus noting that the angle that it is looked at will depend on the way it is interpreted and filtered down to educators. They in turn come up with their interpretations and then facilitate the teaching of the subject through their understanding of mathematics. According to Orton (Orton & Wain, 1994:11), the educator's view of mathematics will have an effect on his or her aims of teaching it in the classroom. Lin and Cooney, (2001:35), concur by saying that educators need to change their thought about mathematics for their teaching to change.

If an educator has a certain conception about the subject, then s/he would manage it in a way that would fulfill his or her beliefs. For example, if an educator views mathematics as a humanistic activity then s/he would provide the right context for the humanistic approach to take place in the classroom. According to Gates (2001:279), many see mathematics as "cold, hard and inhuman", and as a male domain. Such a view would prevent teachers adopting a humanistic approach that relates mathematics to the real world.

Clarity on the nature of mathematics is important for the educators and their methods of teaching the subject. Their understanding will ultimately affect the way they interpret the outcomes in the mathematics learning area. The educators are designers of their own destiny in the subject matter, which in turn affects the context in which the learners acquire and use the material.

2.3 VIEWS ON MATHEMATICS

2.3.1 Traditional or reflective view of mathematics

There are two views in mathematics, namely the "traditional" and the "reflective" (Baroody, 1993:2). In the former, mathematics is viewed as being merely "a body of information", a collection of "numbers, facts, arithmetic rules, formulas, and computational procedures" with "gifted individuals" being those who can perform calculations with “exceptional proficiency.” According to the latter, reflective view, mathematics is more than “subject matter” but rather is a “method of inquiry”. Baroody writes that mathematics is a way of finding patterns, a requirement of which is “reasoning and communicating”. As the science and language of pattern, mathematics is seen as “solving problems, reasoning and communicating”. This reflective view of mathematics is more in keeping with developing skills in individuals than with extending into their social environment or using it well after leaving school. When learners are involved in mathematical activities, that include solving problems, reasoning or communicating, they acquire or strengthen their skills to solve problems in real life situations. According to Biggs and Shaw (1995:3), the learners must be given opportunities to “use and apply mathematics in practical tasks, in real-life problems and within mathematics itself.”

2.3.2 Absolutist or fallibilist view of mathematics

According to Gates (2001:278) there are two conceptions of mathematics, the ‘absolutist’ and the ‘fallibilist’. The absolutist perspective has dominated for some time, viewing mathematics “as an objective, absolute, certain and incorrigible body of knowledge which rests on the firm foundations of deductive logic” (Allen & Wilder, 2004:12). Gates (2001:278), holds a similar view, describing it “as an objective, absolute, certain and incorrigible body of knowledge”. Meanwhile, Burton (1990:70), believes that people often see mathematics as something “abstract, objective, logical, true, well defined and certain”, in what he calls this the ‘static image’ of mathematics.

The fallibilist view is more acceptable in society today and is more positive. With the changing nature of society, views and ultimately teaching in the classroom change. According to Ernest (1994:205), mathematical knowledge is fallible and is produced through social processes within a community of practice. He claims that to create the “absolute” truth in mathematics is illusory, rather “mathematical results can only be sanctioned by the mathematical community of the time on the basis of existing knowledge and evidence as well as agreed upon criteria.”

According to Von Glasersfeld (Allen & Wilder, 2004:14), the human side of mathematics is looked at "and is associated with constructivist and post-modernist thought in education." In this view mathematics is viewed as the outcome of social processes, where mathematics can be revised in terms of its proofs and its concepts. It rejects the notion that mathematics is unique, fixed and a permanently enduring structure. He sees a humanistic approach to the teaching of mathematics as advisable.

The fallibilist view allows one to approach mathematics in a way that encourages active participation by discussing and finding various ways to solve problems. It eliminates the notion that answers or methods of calculating are fixed. This flexibility allows the learners to become actively engaged for thorough understanding. The fallibilist approach encourages the humanistic approach to mathematics, allowing the educator to use problems from the environment that the learners are familiar with and can make a connection to, thus facilitating understanding. Looking at the OBE curriculum and the approaches or methodology used in the classroom, I see the fallibilist view of mathematics more in keeping with the changing nature of our curriculum and the era. According to Ernest (2004:13), "Mathematicians' views of mathematics should be considered irrelevant to school mathematics, which should be humanized for purely utilitarian and social reasons (i.e. to better mathematically educate the public) irrespective of any views of the so-called 'true nature' of mathematics."

2.4 AIMS OF TEACHING MATHEMATICS

Huckstep (Anghileri, 2000:15), believes that mathematics is taught so that it can provide 'a tool in everyday life' and 'a means of communication', but he also sees it as providing mental training and a means of empowering people. Orton (Orton & Wain, 1994:2), states that educators need to keep in mind the aims of mathematics because what takes place in the classroom is not always correct. Mathematics is taught to learners so that they can acquire the skills that are necessary for them to function effectively in everyday life. The knowledge and skills gained will guide learners to solve mathematical problems logically in daily life, when the need arises. According to Cangelosi (1996:28), mathematics in the world today is taught for purposes such as "everything from budgeting, to being a wise consumer, to holding down many jobs". He argues that fundamental mathematical tools are needed as basic survival tools for life. For him, the aim of teaching mathematics is for learners to be able to solve real-life problems in their environment.

According to Niss (Bishop, Clements, Keitel, Kilpatrick & Laborde, and 1996:13), the aims of mathematics education is to:

1. Make a contribution to society in the form of "technology and socio-economic development";
2. Contribute to "society's political, ideological and cultural maintenance";
3. Provide "individuals with prerequisites which may help them to cope with life in the various spheres in which they live: education or occupation; private life; life as a citizen".

Understanding the subject mathematics is an essential component in daily activities in the community. Mathematics is given a purpose or aim in the world, not just being an abstract component that cannot be reached by people. As a learning area it should be accessible to all individuals, ensuring participation in society through knowledge about the subject. According to Niss (Bishop et al., 1996:13), "mathematics education should enable students to master their everyday private life".

There is increasing pressure on learners of today to see the value of mathematics, in the past it having only been compulsory from grades one to nine. As part of the National Curriculum Statements for grades ten to twelve, mathematics has become compulsory in the form of learners choosing between Mathematical Literacy and

Mathematics, a sign that it is being viewed as important for the daily functioning of the adult or child in society.

2.4.1 Mathematics as a language

The role of language in mathematics depends on one's view of its nature. When mathematics is referred to as a language, it is talked about as a means of communicating or conveying ideas. Mathematics is viewed as symbolic in nature and thus not hindering its comprehension by second or third language speakers. Others argue that language does play a role in interpreting mathematical concepts, and only after learners have discussed and shared ideas with each other through language do they truly understand (Daniels & Anghileri, 1995:102).

According to Gates (2001:46), language in mathematics is an essential component to make it more "real" to learners, and this can be done through the context in which mathematics is taught. Students, through language, can think and talk mathematics and in this way the relevance and application of mathematics to real-life situations can be facilitated. Another important way that language is important in mathematics is through the use of word problems. "Without access to the appropriate aspects of the language of mathematics, pupils may be restricted to their use of strategies for thinking and for problem solving" (Daniel & Anghileri, 1995: 101).

Language is an extremely important tool in mathematics, especially with Curriculum 2005 and Outcomes Based Education (OBE). According to Jaworski, (1994:26) language should be used as a tool in guiding the students' responses. In books one may find the use of symbols but when one needs to share ideas and discuss or solve problems in groups, then the need arises for language. According to Durkin and Shire (1991:3), "By expressing ideas in principled operations and numbers, surely the mathematician transcends the vagaries and pitfalls of everyday discourse." This becomes important when forming links with the real world. He says learners start and continue mathematics education in a language, as mathematics "advances" and “stumbles” because of language, with its outcomes often being assessed in language. The learning of mathematics takes place through the medium of language, and as Cangelosi (1996:7) claims, educators of mathematics often neglect teaching ‘communication skills in the language of mathematics’. This is the major reason for misunderstanding concerning the subject.

When learners can talk mathematics and link it to a language not so different from the environment that they are living and communicating in, they will be able to form a connection with mathematics and the real world. Expressing their thoughts and ideas about mathematics in a language most people speak promotes understanding. Baroody (1993:2-99) states that “When instruction focuses on memorizing terms rather than communicating ideas, many find mathematics impenetrable”.

2.5 LEARNING THEORIES IN MATHEMATICS

To solve some of the problems in our classroom one needs to consider theories (Sierpinska & Kilpatrick, 1998:27). When these theories are studied and understood by educators, then they would use this knowledge as a basis to ensure meaningful learning takes place.

2.5.1 Vygotsky’s theories on cognitive development

2.5.1.1 Social interaction and the development of thought and language

Vygotsky (Huetinck & Munshin, 2000:51), wrote that thought and language are interrelated for the young child and that language is critical for his or her development. If a learner were among individuals who were competent, the internalization of these operations would be better, for example, if a child was brought up in a family that spoke very well, the language abilities would develop in that way. Von Glasersfeld (1995:191) concurs that “What we see others do, and what we hear them say, inevitably affects what we do and say ourselves.” He claims that these social interactions reflect upon how others think. Souviney (1994:43) also writes that, through interactions with others, the individual internalizes “public speech” and thus reorganizes it so as to make sense of it.

According to Secada, Fennema & Adajian (1995:308), “...education may be better thought of as a process of socialization.” Van Oers (Steffe, Nesher, Cobb, Golden & Greer, 1996:93) concurs by saying that the extent to which a person learns is “dependent on social interactions”. Education and socialization are not separate entities but are processes incorporating both. Davis (1996:201) argues that physical manipulation and vocalization are important parts of cognition. Vygotsky (Davis, 1996:201) writes that children are able to solve practical tasks by means of talking and using their eyes and hands.

If the educator acknowledges this theory, he or she would ensure that his or her methodology involves the active participation of the learner, who must be involved in talking and doing mathematics. The educator could guide the learner through the course of learning by associating classroom mathematics with the environment. If the classroom environment is viewed by the learner as an example of the environment he or she lives in, then the mathematics done in the classroom could be easily extended into the real world. Thus unity of all these produces internalization of what one sees, does and talks about. Vygotsky’s great emphasis on the “social and Linguistic” influences and the role of the teacher in the education process leads to another of his theories, which is the “Zone of Proximal Development” (ZPD).

2.5.1.2 Zone of proximal development

According to Vygotsky (Souviney, 1994:44), learning most effectively takes place when the child is engaged in activities with support and guidance from the educator. If a learner is working at a level where he or she already knows the work then no learning is taking place. However, if he or she is at a level slightly above what he or she can complete on his or her own, then effective learning takes place with the support/guidance of the other person. "… what children can first understand and do with assistance, they can comprehend and accomplish later without help" (Kennedy & Tipps, 2000:96).

Thus, when children work alone, they function at a certain level, but when they work with others the work is at a somewhat higher level, and this level they reach with the assistance of someone else is termed the ZPD (Shoenfeld, 1987:210). Through the ZPD, one can see the relationship that social interactions have on the cognitive development of the child. Souviney (1994:45) adds that the ZPD is the "metaphorical space" in which one studies the interaction between the teacher and learner.

Important developments occur in children when a competent other assists in completing tasks that they cannot do on their own. The educator is acting as a scaffold to enable the child to complete the tasks successfully (Huetinck & Munshin, 2000:50). It thus relates to the educator (or the peer) and the learner working together to increase or broaden their understanding of mathematics. According to Ferron, (1989:4) the educator forms a guide to the learners doing and in this process learning takes place because the learners learn for themselves while engaging.

Assistance between the educator and learner, or the learner and peers, leads to activity that takes place in the classroom. This activity that occurs in the classroom is important for educators and learners. The discussions and sharing of ideas develop skills that can be used later in life to solve problems in the real world. By the educator using questions and cues he or she could guide the learner towards calculating or solving problems that link up with examples from the real world. In this way the learner understands the relevance of completing such exercises and their place in the world.

2.5.1.3 Activity theory and its relationship to mathematics

Vygotsky emphasized "activity" throughout his writing, and from this the "Activity theory" was further developed by others like Leont'ev (Olsen, 1987:31). The activity theory embodies the individual and the society as a unit - as the individual acts in society he or she becomes "socialized" to it. This theory is important in the classroom because the activity theory is important for the educator as a "dialectical theory" (Olsen, 1987:33). It involves the learner being actively involved in his or her lessons. The mathematics in the classroom and the environment must not be seen as separate entities, but as forming a relationship that leads to one understanding the purpose of the subject matter and its importance in the environment.

Children need to actively engage with mathematics, solving problems, discussing mathematics and how it affects their lives in the environment that they live and the broader society (Ernest, 1991:208). Mathematics activities in the classroom cannot be removed from the real world; rather there must be a relationship and connection that the learner can identify with to make the link. When teaching, individuals must form this link with real life situations. The educators will have to focus on preparing lessons/activities that inform the learner of the link with the environment. Thus, activity theory considers the relationship between the content matter of a learning situation and its context, "as the latter is defined by the learner, and the dialectics between these two, that is, how they mutually develop and influence each other" (Olsen 1987:34). Activity theory influences the educator in linking the content of classroom mathematics with what is happening in the learners' environment.

2.5.2 Theory of constructivism and its implications for teaching

Constructivism is a popular theory in mathematics education, and came about as a result of Piaget's work. According to Smith (2001:16), ideas from Piaget, Vygotsky, Bruner and Diens have formed the basis for constructivism. He says that this theory "views the child as creating knowledge by acting on experience gained from the world and then finding meaning in it." The constructivist theory can change previous ideas about teaching and learning, and as Skemp notes (1991:203), it involves knowledge that cannot be communicated directly. Rather, knowledge has to be constructed anew by each learner in his or her mind: "Learning mathematics requires construction, not passive reception, and to know mathematics requires constructive work with mathematical objective in a mathematics community" (Davis Maher & Noddings, 1990 in Huetinck & Munshin 2000:50).

The above definition points to constructivism as not related to the traditional method of teaching but requiring more preparation on the part of the educator. According to Souviney (1994:36), educators need to know what their learners are thinking. This would help in the educator being a guide to the learner building on his or her previous knowledge. Thus he claims, it involves the learner "thinking aloud" when solving problems so that the educator is aware of what is going on in the learners mind. According to Orton (1994:67), every child does not know the same things or construct the same knowledge from the same experiences. He claims that, through interaction with the environment, every learner would construct his or her own knowledge, which may differ from that of the other learners. An environment with many possibilities can actually quicken the learning process so long as the learner is benefiting through his or her own constructive efforts. Thus, if the educator can form the link between the new knowledge taught and the learners' old experiences in the world, then learning will take place.

The central theme governing this theory is learner-centered teaching rather than teacher-centered teaching. The new OBE curriculum is very much in favour of this style of teaching and therefore knowledge of the constructivist theory will guide the educator in preparation and delivery of lessons. According to Brown (2001:10), the learner is an active participant in the lesson rather than receiving the material passively. Both educator and learner are both actively involved in creating or constructing new ideas, and as Brown affirms, knowledge is not "ready made" but constructed through all stakeholders involved in the learning-teaching situation.

Individuals use their pre-existing conceptual structures when perceiving new information. Thus the new information is reduced to already pre-existing structures. New ideas are associated the old ones. By accommodating the old knowledge, change occurs and learning takes place (Tanner & Jones, 2000:23). He also says that learning must seem important to learners for them to want to change.

The theory of constructivism is based on the view that people have to make sense of the world themselves and in their minds they will arrive at their own definitions and conclusions. This active construction is an activity that takes place in the learners' own mind, therefore the educators' task is to design stimulating projects, assignments and so on that the learner can relate to, from experiences in the world that guide or assist in the construction of knowledge. This stimulation of knowledge does not involve the educator starting off trying to instill knowledge in the learner, but merely helping make connections with personal experiences in the real world.

The constructivist theory and the ZPD show that theories can have many positive implications in the teaching-learning situation of mathematics. If educators are knowledgeable about these theories and apply them in their classrooms, they would see that mathematics cannot be separated from the environment. By educators adopting these theories, learners will be able to see that mathematics does have a place in this environment and is not taught in isolation to real world situations.

2.6 TEACHING STRATEGIES

Approaches to teaching have changed in the decade following the framing of the Constitution, largely because of the changing curriculum. As the emphasis has shifted from teacher-centered to learner-centered teaching, the educators are seen as facilitators of learning, responsible for developing teaching strategies according to what they want learners to achieve at the end of their teaching.

The focus in this chapter is to find ways to educate learners in mathematics so that skills and knowledge gained in the classroom can be used effectively in their environment when the need arises. One of the ways to ensure this is to strategize teaching. Educators can use teaching strategies that ensure the learners understand the subject matter by linking the content and knowledge to the environment they are living in. The belief is that the educator can use the following teaching strategies to ensure that he or she can connect classroom mathematics with the learners' environment, so as to clearly see its purpose or use in the real world.

2.6.1 Cooperative learning

Cooperative learning involves working in groups, although it does not necessarily mean group work. This extends far beyond merely working together in a group. According to Johnson (Killen, 2000:100), "most group work is not strictly speaking, cooperative learning." Two features that are distinguishable from general group work are "full participation and individual accountability" (Kenny & Tipps, 2000:101). All learners are engaged meaningfully in the activity and a commitment is made to all members as they ensure that group understanding is developed. The group is viewed as a "social unit", in which the whole group benefits (Kennedy & Tipps, 2000:101). By using this approach, I would show that the cooperative learning strategy can enhance the educator's approach of linking classroom mathematics with the environment.

Cooperative learning requires learners to tackle tasks both independently and in groups. They learn to become responsible to tackle tasks using certain methods or resolutions they can come up with. The skills they learn during these activities will extend into their adult lives when faced with such problems. When learners come up with different ways of solving problems, they discuss and decide on appropriate solutions. Through their various discussions they are talking and sharing mathematics and in so doing they can conclude that it is not so different from other subjects, and that it can be related to everyday activities.

When learners engage in this form of learning they usually discuss and share various ideas. They correct one another along the way and learn from each other's experiences. In this way they arrive at solutions to problems (Nkhase, 2002:63).

Working together allows them the opportunity to bring in their experiences from their environment. The problems that they are tackling are linked to their real world.

Backhouse, Haggarty, Pirie and Stratton (Nkhase, 2002:63) claim that, "Cooperative learning is an open way of learning in which people of different ideas, beliefs and values come together with a common goal". It is the educator's tasks to engage learners in meaningful cooperative learning tasks so that they can form the link with mathematics and their environment. Learning in this way teaches learners skills that will enable them to solve problems in their adult life.

2.6.1.1 Values of cooperative learning

According to Kennedy and Tipps (2000:121) the following are the values of cooperative learning:

1. To increase student participation.
2. The greater the student participation is, the greater the likelihood of them doing mathematics in meaningful ways.
3. It accommodates all the different ability groups of learners.
4. It extends the learners' understanding as they teach their peers.
5. Learning with learners that are knowledgeable helps those who are lagging behind.
6. It encourages understanding in cross-cultural and ethnic backgrounds.
7. It helps those learners who are second language speakers to clarify and understand better.
8. It can accommodate multiple intelligences in the classroom.

What is learnt in the classroom is not learnt for the moment but should be carried through into other situations. Therefore, selecting this method can be beneficial to the educator and learner in many ways. According to Stahl (Killen, 2000:100), "cooperative learning must allow each group to focus on maximizing the long-term academic success of each learner, so that information can be retained, recalled and applied well beyond the end of the group meetings". In this statement he is reinforcing the point of learners being able to use what is learnt in school in the real world. Work is not learnt in this way for purposes of passing a particular grade, but to apply this knowledge in the environment when the need arises. Thus, learning through this approach accommodates learning mathematics for the purpose of using it long after the individual finishes school.

2.6.1.2 Some selected cooperative learning methods

Huetinck and Munshin (2000:22) suggested the following learning methods:

1. Think-pair-share

Think-pair-share involves non-routine problem solving in open-ended situations. Learners apply their knowledge and use various mathematical tools to solve problems. Although they are seated in groups, the emphasis is on "one-on-one" interaction. This kind of learning results in maximum participation from all learners, because they have the opportunity to be both listeners and problem solvers. A question is posed by the educators and each individual thinks about or writes the answer down quietly on his or her own. Then, in their groups, they discuss the answer for one or two minutes with another member of the group (working in pairs). Then they can share with the rest of the group or the entire class. An advantage of this method is individual accountability, as learners share their individual ways of solving problems.

2. Team learning

Team learning involves three to five members in a group. They can be randomly selected or any other method can be used. Each member in the group is given a different task that will lead to the successful completion of an assignment.

Assessment is focused on group self assessment and the contribution of each member towards solving the problem.

3. Random selection

The method of random selection is specifically used to master specific skills. Learners are randomly selected to work in groups of four, and any can be called up to work out or hand in the solved problem. The whole group would then receive an assessment on this learner's individual answer. Thus, the group must ensure that all learners in the group must understand how to work out the problem, because their assessment is dependent on it.

4. Collaborative learning

In collaborative learning, learners work in small groups on a common task, for example, completing corrections and helping the weaker learners. For the educator, this process can help them while busy completing other work. However, it can be a disadvantage to weaker learners, who only copy down the correct answers from the strong learners.

2.6.2 Problem solving

According to Huetinct and Munshin (2000:232), "To become an efficient problem solver is a skill valuable in many aspects of living". On the other hand, Killen (2000:128), states that "Because problem solving can engage learners in seeking knowledge, processing information and applying knowledge to real world situations, it has the potential to motivate learners and show them practical reasons for learning." He sees problem solving as a process of applying one's old knowledge to situations that are new to the learner, in order for the learner to be able to learn new knowledge through this process.

It is important to learn problem solving techniques, not just for the purposes of the classroom but to continue to apply them in daily life, well after one leaves school. According to Henderson and Pingry (Huetinck and Munshin, 2000:232), “throughout their lives students will need the ability to “formulate and solve problems involving quantitative thinking”. Huetinck and Munshin (2000:232), sees problem solving as an important skill in many parts of everyday life. According to Fosnot and Dolk, (2001:18), word problems allows teaching to take place in a particular real-life context where learners are given opportunities to “generate and explore mathematical ideas”.

According to Cangelosi (1996:29), “Students need experiments in discovering and inventing mathematics and utilizing mathematics to solve real life problems.” He claims that life today is changing so dramatically that children need to learn problem solving skills to tackle the world of tomorrow. He argues that people turn to problem solving when they have questions “unanswered”. Therefore, if educators want to plan lessons, they need to focus on the problems that learners would be facing in their current world, or even as adults.

According to Henderson and Pingry (Huetinck and Munshin, 2000:232), one can use the following framework for solving problems:

1. The learner approaches the problem in such a way that he or she makes the problem his or her own and then develops a deep seated need to solve it.
2. The learner then uses his or her previous knowledge and experiments to try to arrive at a possible answer.
3. Test the hypothesis by deducing implications or by making predictions and checking the results.

With problem solving being so complex, educators need to assist by questioning learners and providing further assistance to guide them.

According to Killen (2000:130), "Problem solving will be most successful when the problem is realistic and reasonably complex." He sees no purpose in learners solving problems with a set procedure. If this does occur, learners will not be able to acquire the necessary skills in problem solving to use in the real world. There can be various ways and means to solve a problem and learners should be allowed the freedom to figure out and arrive at their answers. In this way, they would conclude that in real life there are various avenues to solving problems and decisions have to be made concerning the most appropriate ways to do so.

2.6.2.1 Encouraging learners to use problem solving techniques

According to Souviney (1994:87), an educator needs to plan carefully in order to use the problem solving strategy effectively. He suggested the following for effective implementation. The educator should:

- enable an environment that allows the learner to take intellectual risks and explore untested alternatives;
- see all answers as useful to the learners;
- encourage learners in their efforts and the different answers they come up with;
- accept group work as part of the problem-solving strategy;
- motivate learners to work out problems at home with family members;
- raise questions to assist learners in solving the problems;
- introduce a systematic problem-solving plan;
- establish a systematic schedule for integrating problem solving sessions into each strand of the mathematics curriculum.

2.6.2.2 Planning problems that link to real world situations

When the educator plans for problems he or she needs to raise examples that are real to the learner. According to Eason and Green (Killen, 2000:144), "Real problems for children are those that have immediate, practical effects on their lives, and in which the children themselves can effect some improvement to the situation." They suggest the following for the planning of problems in mathematics that are related to real life problems. Problems should relate to what is of concern to learners and impact on their lives. They should be "actionable" in a way that learners can make a "change" and there should not be clear cut correct answers. Learners are to come up with ways of solving problems and they should be at a "complex" level that requires considerable effort and activity.

By working through these problems they would realize that there is no set solution to a problem, just as it is in real life situations. According to Kummerow (Killen, 2000:145), learners need to progress from solving "routine problems" to solving "non-routine problems" to solving "open-ended problems". Thus, it is the educator's job to help learners develop problem solving skills rather than using set ways to solve problems. In this way it will develop their ability to solve real life problems.

Learners must be offered opportunities to apply classroom mathematics in "real life problems" for them to develop these skills (Comer, 1996:26). However, developing these skills is not easy. Learners need to know the reason for studying mathematics in order for them to learn at an effective and practical level. This can be done by educators using real life examples in the mathematics classroom. Using the problem-solving technique is an easy way to accomplish this.

2.6.3 Constructivist approach to teaching

The constructivist approach is a popular approach in mathematics. According to this theory knowledge is not transferred from, example: the educator to a learner, rather the knowledge is constructed by the individual himself. Von Glasersfeld (Souviney, 1994:36) claims that this theory is based on the notion that human beings have this unique ability to "recognize patterns, organize knowledge, and purposively plan future actions". Piaget (Hughes, Desforges & Mitchell with Carre, 2000:12) claims that human beings have the ability to "invent or construct general theories about their experiences".

Piaget and Vygotsky (Souviney, 1994:36) believe that individuals develop certain cognitive structures to organize knowledge from the outside in their minds to make it meaningful. This understanding does not necessarily mean that the learner has internalized it correctly. He or she can continuously get the sum wrong, using the sense of understanding that has been attained (Souviney, 1994:36). According to Middelton and Geopfert (1996:22), no two people have the same interpretations of things because of their different backgrounds and experiences. However through discussions that arise from the various viewpoints, this leads to higher levels of understanding amongst learners.

According to Brandt (Killen, 2000: xxii):

- A person will learn what makes sense.
- A person will achieve a greater learner experience if he or she accepts tasks that are "challenging" but have "achievable" goals.
- "Learning is developmental", the new learner will approach learning tasks differently from those learners that know more about the tasks.
- Every individual learns in his or her own way, "but in general people construct new knowledge by building on their current knowledge".
- The heart of learning is through interacting socially.
- Individuals must get useful feedback to learn.
- The use of workable learning strategies should be learnt by individuals.
- Educators must focus on the physical, social and psychological aspects of the environment for effective learning to occur.

The basic understanding here is that if a learner does not internalize or make sense of the information in his or her mind, then learning does not take place. The only way that the learner can make sense of this information is by making a link with prior knowledge from past experiences. According to Gates (2001:126), the educator serves as a guide and as a teaching aid. He or she would scaffold the learner through various aspects of learning, and the learner must construct meaning for himself or herself.

To stimulate students to reason “inductively” one can use a four stage lesson plan (Cangelosi, 1996:86), which allows or accommodates the constructivist theory:

Stage one: Sorting or Categorizing
Learners are presented with a task to sort and categorize. The educator merely facilitates, allowing learners to complete the task on their own.

Stage two: Reflecting and Explaining
In this stage learners give an explanation/reason for the way they sorted and categorized the information. The educator would “raise leading questions, stimulate thought and clarify students’ expressions”.

Stage three: Generalizing and Articulating
A description of the concepts is completed by learners. They may also develop a definition of the concepts.

Stage four: Verifying and refining
These descriptions and definitions are tested with examples that they already know would fit and with examples that they predict would not fit. Thus, the outcome of the tests would allow learners to change certain things about the descriptions and definitions, and the previous stages can be revisited.

The use of these four stages is in keeping with constructing knowledge from a person’s old experience. The children learn from the known to the unknown, with the help and guidance of the educator. They are given an opportunity to complete the task on their own. The educator raises leading questions, providing an opportunity for the educator to form a link with the learners' environment through these leading questions. The learner is tested according to information that he already knows. The educator has ample opportunity to use this strategy to enable learners to learn meaningfully when associating classroom mathematics with their daily lives.

2.7 CONCLUSION

In this chapter, the researcher attempted to clarify the nature of mathematics, the theories that could be effectively used and teaching strategies that could facilitate teaching the purpose or use of it in daily life. If the educator is knowledgeable about the nature, theories and strategies in mathematics, it would make it easier for him or her to plan, prepare and facilitate lessons in a way that allows for him or her to teach in the environment. Drawing from the literature study in this chapter, the researcher concludes that a combination of the problem solving, cooperative and the constructivist approach, as well as combining the theories of learning, would facilitate learning the purpose/use of mathematics in the environment.

CHAPTER 3

RESEARCH DESIGN

3.1 INTRODUCTION

"Research design can be defined as a process of creating an empirical test to support or refute a knowledge claim" (Mertens & McLaughlin, 1995:20). According to Henning, Gravett and Van Rensburg (2002: x) "Research aims to reorient our thinking, to make us question what we think we do know, and to focus on new aspects of our complex reality." We all interpret the world differently and therefore research findings may vary because of the differences in the way people view the world. Nkhase (2002:i) writes that: "Life in the world today calls for a mathematics educator that will enable pupils to grow as individuals, who can apply appropriate mathematical knowledge and skills to real life situations in the time of need." The researcher aims to find out whether the educator's methodology does help to extend the learners' knowledge and skills beyond the classroom so that he or she can apply them in real life situations when the need arises. Thus, in this chapter the researcher will explain how she plans to go about conducting her research.

3.2 DATA COLLECTION TECHNIQUES

The researcher chose to do a small-scale study using two different data collection techniques. The use of two questionnaires, that is, one for the educator and the other for the student (Annexure A and Annexure B), and the observation protocol (Annexure C) was used. The researcher felt that using both these techniques would effectively elicit information pertaining to the research.

The researcher found that the use of questionnaires for the students was suitable as it appeared in a structured format. Since the learners were literate, they would be able to read and understand the questions, and the fact that they were primary school learners made this kind of questionnaire easy for them to answer. The closed format also facilitated the process, with them answering by merely ticking in a block. The questionnaire was not taxing to them and they were therefore willing to participate. The questionnaire permitted anonymity and they were at liberty to give true and honest answers.

The researcher foresaw that without a research assistant she could effectively carry out such a research successfully on her own, with maximum supervision. This kind of research also involved minimum time spent by the participant. All questions were prepared in advance and therefore the researcher was not at liberty to change the questions to suit her findings. This eliminated bias on the part of the researcher, while the closed type of questions also allowed the researcher to record, analyze and interpret the data quickly and easily.

The educators' questionnaire were also in the format of the learners' questionnaire, however the educators were given an opportunity to write in detail about the methodology that they used in the classroom. In this way they were not restricted to choose a method with which they were not familiar.

The researcher found that the use of the observation technique was essential to compliment the information provided from the questionnaire. More than one strategy in data collection is very important and it is the combination of techniques which provide the necessary checks and balances in research. The use of the observation helped to crosscheck whether what was answered in the questionnaire was a true reflection of what occurred in the classroom.

The researcher felt that through the observation technique she could get first hand information about what was taking place in the classroom situation. According to Brown and Dowling (Nkhase, 2002:85) "…it is always necessary to collect first hand data through the researchers own direct experiences from the learning environment being explored".

3.3 POPULATION AND SAMPLE OF STUDY

The investigation took place using grades 5, 6 and 7 mathematics educators, and learners from one school only. The population of the learners per grade and the educators teaching them were as follows:

Grades	No. of learners	No. of educators
5	87	1
6	74	1
7	86	1

There were only three educators teaching these grades, so the researcher decided to use the entire population of educators as a sample. However, the learners' population was 249, such a large number that the researcher decided to work with thirty learners only. The systematic sampling technique was used to draw out learners to participate in the research. According to Mertens and McLaughlin (1995:77), to eliminate bias in systematic sampling, names on the list of the "defined population" must not be in a particular order.

Thus the sample was as follows:

Grade 5	7
Grade 6	11
Grade 7	12

Total number of learners: 30

Total number of educators: 3

3.4 METHODOLOGY

3.4.1 Permission to conduct the research

The research process took place over two days only. Before this stage the researcher sought permission to conduct the research from the following entities:

1. The Principal Secretary of Education (GDE)
2. The Principal/ Heads of Department/ Mathematics educators

These were hand-delivered and written permission to conduct the research was received from the Principal Secretary of Education to conduct the research. The researcher then met with the participating educators and set time and date schedules for the lesson observations. The researcher also reached consensus on the day and time to conduct the questionnaire with educators and learners.

3.4.2 Data collection

According to the agreed upon time with the educators, the researcher observed their lesson with his/her learners and recorded them according to the observation protocol. This observation took place during normal teaching time and answering the questionnaires for the learners were carried out during their break time. All participants were gathered in one classroom and the questionnaire was completed by them together.

The researcher was present during this process. The written instructions were explained to the learners orally, and they were free to ask questions so as to clarify any doubts that they might have and avoid misinterpretation. As soon as the learners were finished, the questionnaires were collected to avoid learners' answers being influenced by their peers. The same procedure was followed for the educators' questionnaire. The researcher then used a tally table especially for the students' questionnaires, appropriate since there were thirty participants. The answers were classified under similar headings so as to facilitate the process.

3.4 DATA ANALYSIS AND INTERPRETATION

The researcher decided to do a quantitative research, which is good for this study since it tends to be more field focused (Denzin and Lincoln, 1994:2). According to Mouton (2001:108), "Numeric data (statistics, numbers and quantitative measurements) are usually well structured and easy to capture…" a view shared by Schumacher and McMillan (1993:40), who wrote that in the quantitative technique one uses numbers and measurements. The information will be presented in the form of tables and will be followed by a discussion analysis. The tables would represent percentages according to the structured responses.

3.5.1 Learners' response (Annexure A)

The following were the responses to the learners' questionnaire:

1. Response on which grade the learners are in:

Option	Frequency	% Frequency
Grade 5	7	23
Grade 6	11	37
Grade 7	12	40

2. Response on whether the learners use mathematics in other subjects at school:

Option	Frequency	% Frequency
Very often	3	10
Rarely	17	57
Never	10	33

3. Response to whether the learners use mathematics in their daily activities:

Option	Frequency	% Frequency
Very often	4	13
Rarely	15	50
Never	11	33

4. Response to whether the learners think mathematics will be useful to them in their daily lives:

Option	Frequency	% Frequency
Definitely	14	47
Not sure	14	47
Never	2	6

5. Response to whether the learners think they will use mathematics when they start work:

Option	Frequency	% Frequency
Definitely	8	27
Not sure	20	67
Never	2	6

6. Response to whether the learners think they will use mathematics in their adult life:

Option	Frequency	% Frequency
Definitely	7	23
Not sure	21	71
Never	2	6

7. Response to whether the learners think mathematics is important for them to find a job:

Option	Frequency	% Frequency
Definitely	14	47
Not sure	13	43
Never	3	10

8. Response to whether the learners look forward to their mathematics lessons:

Option	Frequency	% Frequency
Very often	16	54
Rarely	13	43
Never	1	3

9. Response to whether mathematics is interesting and fun to the learners:

Option	Frequency	% Frequency
Very often	3	10
Rarely	14	47
Never	13	43

10. Response to whether the learners do mathematics word problems in class:

Option	Frequency	% Frequency
Very often	5	17
Rarely	18	60
Never	7	23

11. Response to whether the learners enjoy solving word problems in class:

Option	Frequency	% Frequency
Very often	6	20
Rarely	19	63
Never	5	17

12. Response to whether the word problems are related to activities in the learners' environment:

Option	Frequency	% Frequency
Very often	10	33
Rarely	15	50
Never	5	17

13. Response to whether mathematics helps the learners to think, reason and make good decisions:

Option	Frequency	% Frequency
Very often	4	13
Rarely	23	77
Never	3	10

14. Response to whether they think mathematics can help the learners solve problems in their day to day lives:

Option	Frequency	% Frequency
Definitely	5	17
Not sure	17	57
Never	8	26

15. Response to whether the learners participate actively in their mathematics lessons:

Option	Frequency	% Frequency
Very often	10	33
Rarely	17	57
Never	3	10

16. Response to whether the learners work in groups when solving mathematics word problems:

Option	Frequency	% Frequency
Very often	1	3
Rarely	7	23
Never	22	74

17. Response to whether group work helps the learners solve problems better:

Option	Frequency	% Frequency
Very often	4	14
Rarely	13	43
Never	13	43

18. Response to whether the learners solve mathematics problems quicker when they work with their peers:

Option	Frequency	% Frequency
Yes	11	37
NO	19	63

19. Response to whether each member in the group is individually accountable for his/her own answers or do they respond as a group:

Option	Frequency	% Frequency
Individually accountable	0	0
Respond as a group	30	100

20. Response to whether the learners think that working in a group and discussing ideas will help them to remember work better and use it in their environment?

Option	Frequency	% frequency
Very often	14	47
Rarely	13	43
Never	3	10

21. Response to whether the learners see mathematics as being meaningful in their daily lives:

Option	Frequency	% Frequency
Very often	11	37
Rarely	17	57
Never	2	6

22. Response to whether the learners see mathematics as a set of signs and symbols that are difficult:

Option	Frequency	% Frequency
Very often	13	43
Rarely	16	53
Never	1	6

23. Response to whether the learners study mathematics because it is useful, important and relevant in their daily lives:

Option	Frequency	% Frequency
Yes	25	83
NO	5	17

22. Response to whether the learners think their teachers teaching helps them to solve real life problems:

Option	Frequency	% Frequency
Very often	3	10
Rarely	22	73
Never	5	17

23. Response to whether the learners' teacher relates the content of mathematics to problems in real life.

Option	Frequency	% Frequency
Very often	6	20
Rarely	18	60
Never	6	20

24. Response to whether the learners enjoy mathematics:

Option	Frequency	% Frequency
Very often	10	33
Rarely	18	60
Never	2	7

25. Response to which teaching method do the learners think they can use to help them learn the purpose/use of mathematics in their daily lives:

Option	Frequency	% Frequency
Educator showing	21	70
Group work	0	0
Reading and working alone	9	30

3.5.2 Educators' response (Annexure B)

The following were the responses to the educators' questionnaire:

1. Response to which teaching methods do educators most frequently use in the teaching of mathematics:

Option	Frequency	% Frequency
Group work/discussion	1	34
Discovery	0	0
Problem solving	2	66
Lecturing/telling	0	0
Other	0	0

2. Response to which of the following do the teachers use to determine the teaching method per lesson:

Option	Frequency	% Frequency
Contents and examinations	0	0
Knowledge, skills, values with long term goals.	3	100

3. Response on how the teachers address students most of the time:

Option	Frequency	% Frequency
Individually	0	0
Small groups	0	0
Whole class presentations	3	100
Other	0	0

4. Response to when the teachers do group work is learners individually accountable for their work or do they focus on their effort as a group:

Option	Frequency	% Frequency
Individually accountable	1	34
Group effort	2	66

5. Response on what the teachers' major source of information is when preparing questions:

Option	Frequency	% Frequency
Textbooks	3	100
Original questions designed to link mathematics with learner's environment.	0	0

6. Response to whether the teachers provide learners with activities that encourage them to apply mathematics to real life situations that really matter:

Option	Frequency	% Frequency
Very often	1	34
Rarely	2	66
Never	0	0

7. Response to whether the teachers provide the learners with instructional approaches that would be of interest to learners and impact on their daily lives:

Option	Frequency	% Frequency
Often enough	1	34
Rarely	2	66
Hardly ever	0	0

8. Response to whether the teachers work with educators of other subjects to ensure integration of mathematics:

Option	Frequency	% Frequency
Often enough	0	0
Rarely	1	34
Hardly ever	2	66

9. Response to whether the teachers work with educators of other subjects with an intention to teach the purpose/use of mathematics in all the other subjects:

Option	Frequency	% Frequency
Often enough	1	34
Rarely	0	0
Hardly ever	2	66

10. Response to whether the teachers relate abstract mathematics concepts to everyday life:

Option	Frequency	% Frequency
Often enough	1	34
Rarely	2	66
Hardly ever	0	0

11. Response to whether the teachers think it is possible to teach the content of each lesson according to its purpose/use in real life:

Option	Frequency	% Frequency
Often enough	2	66
Rarely	1	34
Hardly ever	0	0

12. Response to whether the teachers ensure that the learners fully understand the purpose/use of mathematics to everyday life:

Option	Frequency	% Frequency
Often enough	2	66
Rarely	1	34
Hardly ever	0	0

13. Response to which of the following does the teachers' teaching mostly encourage:

Option	Frequency	% Frequency
Factual recall	1	34
Critical and creative thinking and application.	2	66

14. Response to whether the teachers assess according to the learners understanding the purpose/use of mathematics in their day to day lives:

Option	Frequency	% Frequency
Often enough	0	0
Rarely	2	66
Hardly ever	1	34

15. Response to whether the teachers' assessment questions involve assessing logic, creativity, reasoning and problem solving techniques.

Option	Frequency	% Frequency
Often enough	2	66
Rarely	1	34
Hardly ever	0	0

16. Response to whether the teachers encourage and allow learners to suggest their own projects, problems and questions to solve.

Option	Frequency	% Frequency
Often enough		
Rarely		
Hardly ever		

17. Response on whether the teachers involve learners in activities that encourage them to use mathematics and support their thinking and reasoning:

Option	Frequency	% Frequency
Often enough	2	66
Rarely	1	34
Hardly ever	0	0

18. Response on whether the teachers provide opportunities for learners to debate and argue issues based on solving mathematical sums:

Option	Frequency	% Frequency
Often enough	1	34
Rarely	2	66
Hardly ever	0	0

19. Response on whether the teachers think it is possible to link the learning outcomes to teaching the purpose/use of mathematics in everyday life:

Option	Frequency	% Frequency
Very possible	3	100
Fairly possible	0	0
Impossible	0	0

20. Response to whether the teachers think their teaching allows learners to form the link between mathematics and the real world:

Option	Frequency	% Frequency
Often enough	2	66
Rarely	1	34
Hardly ever	0	0

21. Response to whether the teachers think there is a relationship between the educator's methodological approaches and the learners learning the purpose/use of mathematics on everyday life:

Option	Frequency	% Frequency
Definitely	2	66
Not sure	1	34
Never	0	0

3.5.3 THE OBSERVATION PROTOCOL

Reflected in the tables below is the interpreted information of the observations.

Part one: Observation on whether the educators:

1. Link the content to real life situations:

Option	Frequency	% Frequency
Not at all	3	100
Only trying	0	0
Achieving	0	0

2. Link the content to other subjects:

Option	Frequency	% Frequency
Not at all	3	100
Only trying	0	0
Achieving	0	0

3. Draw on the learners' life experiences and situations:

Option	Frequency	% Frequency
Not at all	3	100
Only trying	0	0
Achieving	0	0

4. Use teaching resources that can aid learning the purpose / use of mathematics in the environment:

Option	Frequency	% Frequency
Not at all	3	100
Only trying	0	0
Achieving	0	0

5. Use teaching resources that can aid in learning the purpose / use of mathematics in human life.

Option	Frequency	% Frequency
Not at all	3	100
Only trying	0	0
Achieving	0	0

6. Set homework that encourages use of the environment to solve problems:

Option	Frequency	% Frequency
Not at all	3	100
Only trying	0	0
Achieving	0	0

Part two: Observation on:

7. What learners are involved in the lesson through:

Option	Frequency	% Frequency
Exercises from textbooks	1	33.3
Answering educator's questions	1	33.3
Practical application		
Repeating educator's facts	1	33.3

8. What the lesson seems to be concentrating more on:

Option	Frequency	% Frequency
Factual learning and recall	3	100
Practice of skills	0	0
Problem solving application	0	0

9. What the methodological approach applied in the classroom is through:

Option	Frequency	% Frequency
Socio-constructivism approach	0	0
Direct approach	3	100

10. What the learners' activities involve:

Option	Frequency	%Frequency
Individual work	2	66
Small group discussions		
Questioning and answering	1	34

11. Whether the content is related to the subjects and/or learners' lives outside the classroom:

Option	Frequency	% Frequency
Yes	0	0
No	3	100

3.5 FINDINGS AND IMPLICATIONS

The educators' and learners' questionnaires and the observations conducted on educators in their classrooms will be analysed to reveal the findings of the research and their implications. According to whether learners think that they will use mathematics in their daily lives, 47% of the learners responded definitely. However, the other 47% were not sure and the balance indicated 'never'. To the response on whether mathematics would help them in their adult lives, 71% of the learners were not sure. From these responses, the researcher would infer that most of the learners did not know the purpose/use of mathematics in their environment, and therefore were not sure whether they would ever use it after school. One can also conclude from this that learners did not see the link to the environment because the work done in the classroom did not promote linking the class work with everyday activities.

When relating to mathematic word problems, 60% of the learners claimed that they rarely did mathematics word problems, while 17% responded ‘very often’ and 23% claimed ‘never’. Only 20% of these learners enjoyed solving word problems, while 63% of the learners say that they rarely enjoyed solving problems. 50% of the learners claimed that word problems rarely related to activities in the environment. From all these varying figures, it seems that word problems were not done very frequently in the classroom, and if they were attempted, seldom did the problems relate to real life situations. The majority of the learners rarely enjoyed completing these sums. Although using word problems is an opportune time to link mathematics to the real world, this is rarely and at times not at all done in the classroom.

17% of the learners felt that mathematics helps them to solve problems in their day to day lives, while 57% were not sure and 26% said ‘never’. In response to whether mathematics helped them to think reason and make good decisions, 77% thought rarely and 10% answered ‘never’. A large number of learners were not sure whether mathematics did help them solve problems in their day-to-day lives. The reasons for this could be that the methodology/approach in the classroom did not allow for the extention of class work into the real world. The learners did not know any better because they were not exposed to the content of mathematics being linked with the real world. Learners were therefore unsure of the purpose / use of mathematics in their lives.

74% of the learners claimed that they never worked in groups when solving problems. In response to which teaching method they used in the classroom, 70% answered ‘educator showing’ and 30% responded ‘reading and working alone’, while 0% ticked group work. It seems as though group work was not done at all, or very rarely in some classes. According to the learners, the direct teaching approach seemed to dominate, something the researcher’s observation seemed to confirm. The educator showing and the learners listening passively seemed to dominate. Learners were actively involved through question and answer technique, and completing answers from textbooks with relation to the environment.

The learners' thoughts on issues or their own methods to calculate sums were not entertained. No form of critical thinking or problem-solving techniques, nor the constructivist and cooperative learning strategies were used. 70% of the learners were of the opinion that the teacher showing could actually add to them learning the purpose/use of mathematics in their daily lives. The answers that were reflected on the teacher's questionnaire and the findings in the observation seem to differ a little. 66% of the educators claimed to use the problem-solving method, while 34% claimed to be doing group work/discussions. However, these methods or approaches were not revealed during the class visit. The teaching focus on factual learning and recall seem to dominate, with minimum emphasis on knowledge, skills and values with long-term goals.

The educators' questionnaire revealed that a 100% focused on knowledge, skills, and values with long term goals. However, through the observation it was discovered that the central emphasis was on contents and examinations. There was no relation to class work/ homework being linked to real life situations in any way. 100% of the educators indicated on the questionnaire that most of the time learners were addressed through whole class presentations. 100% of the educators also agreed that they used the textbook as their major source when preparing questions, rather than designing original questions to link mathematics with the learners' environment.

66% of educators agreed that they rarely provided learners with activities that encouraged them to apply mathematics to situations that really matter to them. 66% of educators answered in their questionnaire that they very often prepared content and used instructional approaches that would be of interest to learners and impact on their daily lives. However, this was not revealed in the observation. As already stated above, the questions were merely taken out of textbooks. Work was not designed around the learners' interest to impact on their daily lives.

On the question of whether educators worked with educators of other subjects to teach the purpose/use of mathematics in other subjects, 66% answered 'hardly enough'. Learners responded that 57% rarely used mathematics in other subjects, while 33% of learners claimed never. Mathematics was seen as a learning area on its own and therefore there was no integration with the other subjects. Lack of communication with other educators reduces the likelihood of integrating mathematics in the other learning areas, thus the subject was marginalized to the learning area of Mathematics only.

In response as to whether learners were individually responsible when doing group work, 66% of the educators responded 'no'. The learners' response to this question was that 70% replied in the negative. Learners were usually given a group mark and this did not make them accountable for their own learning. Thus, the strategy of cooperative learning is neglected. This kind of learning strengthens the skill of working cooperatively with each other while at the same time acknowledging that all are individually accountable, and the same is expected in real life situations.

In the educator's questionnaire on whether they taught the content of each lesson according to its purpose/use in real life, 100% answered 'often enough'. 66% of educators claimed that their learners fully understood the purpose/use of mathematics in everyday life. However, the learners' responses did not show this and the observation protocol indicated that the content was not at all linked to real life situations. The educators could probably be trying to do this, but were not getting through to their learners because they did not know how to. Thus, teaching strategies in line with helping them teach the purpose/use of mathematics in real life may be useful to get this concept across to learners.

During the observation, it was noticed that 0% teaching resources were used to aid in teaching the purpose/use of mathematics in the environment. However, in the questionnaire, 34% answered that they often enough related abstract mathematical concepts to everyday life. Using resources would be an ideal way to relate the abstract mathematical concepts to everyday life.

In the questionnaire, educators were 100% sure that it was possible to link the learning outcomes to teaching the purpose/use of mathematics in everyday life. They also agreed 100% that there was a relationship between the educators' methodological approaches and the learners' learning the purpose/use of mathematics in everyday life.

3.7 CONCLUSION

The researcher found in this research study that not much, if anything, is being done by the educators to link mathematics with the physical world. There is no conscious effort on the part of the educator to plan accordingly. Many learners are ignorant of the fact that one learns mathematics so that it can be applied in day to day life. Rather, they see it as a learning area on its own, divided from the other learning areas or the world.

The use of the cooperative learning strategy is non-existent in the educators' dictionaries. Group work is carried out in some classes, but with minimum impact on the learner gaining any skills that he or she can use in the outside world. The activities are not meaningful, interesting or enjoyable to the learners, who do not feel individually accountable when working in a group.

The direct teaching approach seems to dominate in all the classes where learners are addressed almost all of the time in whole class presentations. Learners are actively involved through textbook exercises which relate to factual learning and recall. The above procedures minimize, if not cancel out, the learners' learning the purpose/use of mathematics in their environment.

The researcher thus feels that it is imperative that the educator changes his or her approach so that the learners learn in a way that assures them that mathematics is important and relevant beyond the walls of the classroom. Learners need to be aware of the reasons for studying mathematics and how it can help them in their daily and adult lives. The proposed way to do this is for the educator to facilitate his or her lesson in a way that promotes learning the purpose/use of mathematics in the learners' daily lives, and so be able to apply it when the need arises.

CHAPTER FOUR

GUIDELINES FOR TEACHING THE PURPOSE/USE OF MATHEMATICS

4.1 INTRODUCTION

The literature review and the empirical study in the previous chapters have given a background as to how to teach the purpose/use of mathematics in the physical world. In this chapter, the guidelines for teaching the relevance of mathematics in the environment will be proposed. The proposal will be as follows: to integrate mathematics with the other subjects; to use the questioning technique as a means to teach the use of mathematics in their environment; and to combine strategies for educators to reach their goal of teaching mathematics in a meaningful way that facilitates understanding.

4.2 INTEGRATION OF MATHEMATICS WITH OTHER SUBJECTS

One of the suggested ways to facilitate teaching the relevance of mathematics in the curriculum is through integrating mathematics into the other learning areas, and/or integrating the other learning areas into mathematics. According to Kellough (1996: v), to become an effective teacher one must integrate the learning of mathematics into the other learning areas to make it meaningful in the learners' lives, instead of teaching them in isolation to the other subjects. There are various activities that the educator can administer with the learners to ensure that integration does take place, an example being through such activities as projects and investigations.

4.2.1 Projects as an activity for integrating subjects

According to Bishop (Kennedy and Tipps, 2000:72), one way to integrate topics from other learning areas is through projects.

He views the following as beneficial when using projects:

1. The learner becomes personally involved in whatever he/she is doing.
2. The learner is encouraged to use different resources "that stimulate thinking about the importance of the mathematical approach to interpreting and explaining reality".
3. The activity that the project involves reaches a stage where the learner starts to critically analyse the value that mathematics offers to society (accomplished through the educator's guidance).

Thus, relationships and patterns are formed while working on the projects, and these can be generalized for use in other situations or subjects. The learner becomes involved in making decisions about materials and so can use them appropriately, with skills being developed that can be used in real life situations. Examples of this are decisions concerning the type of materials to be used being guided by the Technology teacher. When the project is complete, both the Technology educator and the Mathematics educator can give the learner an assessment according to their own rubrics. Thus integration is facilitated. Because of the hands-on approach, and the personal involvement of the learner, he or she is personally accountable for his or her work. Projects do encourage cooperative learning, as well as personal accountability of the learners.

4.2.2 Investigations as an activity for integrating subjects

Another activity that can encourage integration of subjects is through investigations: "Mathematics investigations are mathematical activities which, although structured, are also open-ended" (Fraser & Honeyford, 2000:69). These authors write that these can be different from normal classroom mathematics in the sense that they take "the form of challenges or problems". Through this method, skills are developed that can be used in daily life.

Investigations can be easily carried out in a cooperative learning situation. According to Kennedy and Tipps (2000:129), educators usually have a goal in mind and through guidance the learner determines the outcome. The ZPD comes into play at this point. The ZPD stresses the learner reaching his full potential through the guidance of the competent other. Kennedy and Tipps also note that "investigations are more flexible than teacher directed lessons", and that investigations can form a link to other "fields and ideas", because of the in-depth involvement.

According to Fraser and Honeyford (2000:69-70), the following opportunities are afforded to the learner through investigations:

- Problems can be posed as real life situations.
- Investigations can improve "logical thought processes".
- They encourage learners to work in teams.
- The learner is encouraged to use and apply numbers.
- They develop problem-solving skills.
- They help to take the competent beyond their level and support those that are struggling.
- They make mathematics enjoyable and meaningful.

As is done to plan projects, educators can plan investigations together to link up other learning areas. From one investigation activity, learners can be assessed in another learning area besides Mathematics, thus showing learners that mathematics can be integrated into other fields. If planned strategically by educators, the integration of subjects can be easily facilitated.

4.2.3 Other suggestions on how to integrate other subjects with Mathematics

1. The educators should plan their lessons together and try to focus on a similar context for a period of time. For example, when the Human and Social Science

educator is teaching with weather maps, the Mathematics educator can teach along similar lines, thus reinforcing the reading of units of measurement for temperature.

2. When discussing in the classroom, the educator ensures that he or she links that particular knowledge, skill or value with other subjects or situations.

3. When preparing projects or investigation activities, educators can get together and come up with a single project or investigation activity that learners could complete. They then receive an assessment for other subjects as well, according to set criteria. Learners are given different rubrics for the different learning areas in advance, so they know what to concentrate on for assessment. Thus, integration of subjects is accommodated.

4. Educators can ensure at the beginning of the year that the learning programmes and work schedules allow for integration from the outset. The year and term planning allows in advance for integration of learning to take place.

4.3 QUESTIONING AS A MEANS TO TEACH THE RELEVANCE OF MATHEMATICS

One of the ways to ensure that learning takes place through real-life situations can be based on the way educators question learners in the classroom. If the educator deliberately led the questions towards learners answering, using real-life situations then the learners will think in the context of everyday life when working with problems. Thus, if the educator provides leading questions, the learner will eventually be addressing the problem of finding connections to other subjects and relating the context to real-life situations. In this way the role of mathematics in the modern world can also be addressed. The class work will therefore be driven by life-related applications of mathematics.

4.3.1 Types of questions

There are various types of questions that the educator can use to encourage learning through real life contexts.

According to Kellough (2000:87), the following types of questions could be used in the classroom:

1. Clarifying questions: This type of question helps the educator to extract more information from the educator, so that he or she can get a deeper understanding of what the learner is saying.
2. Convergent thinking questions: Another name for these questions are “narrow” questions, a type that requires single answers only and involves “lower-order thinking”.
3. Cueing questions: If questions are asked and learners do not respond, or they give an “inadequate” response, then a question can be asked that cues the desired response.
4. Divergent thinking questions: Opposite to convergent thinking questions. It requires “higher-order” thinking. These questions are open-ended and therefore require learners to think “creatively”. Learners are taken along the path of the unknown.
5. Focus thinking questions: Entails focusing the learners’ thinking to, for example: particular events.
6. Probing questions: Have the characteristics of clarifying questions. Learners are required “to go beyond superficial first-answer or single-word responses”.

4.3.2 Suggestions on how to ask questions effectively

The educator needs to strategise on how to ask questions effectively to attain the desired response. The following are but a few suggestions:

1. Prepare likely questions in advance so that the educator does not fumble around but knows exactly where he or she is driving the learner to. The educator does not have to necessarily stick to these questions, but merely use them as guidelines, because probing questions may expect the educator to think on his or her feet.

2. Ensure questions are distributed evenly amongst all learners. When questioning, do not direct the questions to one learner only, but to the entire class, so that everybody thinks about the answer.

3. Allow learners adequate time to deliberate on their answer before responding.

4. Always show respect towards the learners' answers. If one ridicules their answers, then the learner develops a feeling of fear and inadequacy which will ultimately make them afraid to answer in real life situations for fear of being incorrect or ridiculed.

5. Ensure questions are clear and explicit and do not come across ambiguously to the learners.

6. Make questions entertain all the different ability groups of the learners. Educators should direct questions appropriately to the different abilities of the learners. If the questions are beyond the learners, they will lose confidence in answering or even attempting to answer.

4.4 COMBINING STRATEGIES

In the literature reviews, three strategies to teaching learners the purpose/use of mathematics was mentioned, that is, cooperative learning, problem-solving and the constructivist approach. However, when in the classroom the educator can plan to employ a particular strategy to achieve his or her outcomes, but this is not always the way it turns out. According to Kennedy and Tipps (2000:62) there are problems that may lend themselves to being solved in one way, however more complex problems may require more than one way to solve them. In the same light, educators may need to approach a particular lesson using more than one strategy.

The same may be the case when approaching a problem in a Mathematics classroom. The educator may decide to approach his or her lesson using the problem-solving strategy, however, when learners are working, more than one strategy may come into play. For example, the cooperative method can be used while trying to solve problems. At the same time the educator is questioning the learners to guide them towards achieving their goals, so the questioning strategy is now in play. The educator therefore needs to prepare thoroughly, using all the options available.

4.4.1 Cooperative learning

4.4.1.1 Planning for cooperative learning

It is imperative that the educator plans carefully for cooperative learning. According to Reed (2000:107), the educator needs to ensure that the learners “work as a team, exchange ideas, thinks critically and help one another to learn”. All of this requires careful planning. Reed adds that the educator should plan accordingly:

1. Both the “academic and social outcomes” must be specified with emphasis on group goals.
2. The entire cooperative learning session should be explained to learners so that they know what they are up against. Explain your expectations to them, including how you will help learners and how you are going to assess them.
3. Prepare materials in advance that learners will need.
4. The topic that is chosen should be relevant and interesting to all learners.
5. Some thought should also go into how the groups will be formed. For example, males and females can be mixed, high flyers and slow learners put together and so on.

6. Develop a system for recognizing and rewarding the learning of individual learners, as well as for the achievement of the groups.
7. It must be made clear to learners that all of them are required to achieve the outcomes. The educators should prepare her “assessment instruments” in advance to give educators an idea of what she is assessing.
8. Educators should develop a system to keep records of individual and group achievement, while ensuring she makes the group achievement known to all.
9. Assign some time to learners for reflection after they have completed their task and recovered feedback.

4.4.1.2 Effectively implementing cooperative learning strategies

The following are guidelines on how to effectively implement cooperative learning strategies:

1. Before instructions are given, assign learners to groups.
2. Explain the outcomes clearly at the outset.
3. Explain how learners are going to be assessed.
4. Explain the expectations to learners in respect of helping one another learn and the goals relating to cooperative learning.
5. Provide learners with the necessary resources.
6. Give learners time frames.
7. Monitor group discussions without interfering in small problems. Give them an opportunity to sort it out on their own.
8. Lessons should be brought to a reasonable end.
9. Evaluation should take place. Learners should also evaluate how they have worked with one another.

4.4.1.3 Using cooperative learning to form the link with real-life situations

The educator can use cooperative learning to form a link with everyday situations by coming up with tasks for the learners that involve solving problems from real life. The educator should base his or her tasks on situations with which learners are familiar in their environment. Thus, through these efforts, the cooperative learning group would be involved in problem-solving relating to their physical environment. Cangelosi (1996:53) claims that "…some teachers incorporate concrete mathematical models or problem-solving tasks into every teaching unit". Through interactions and discussions with one another, communication skills are developed that are important for functioning effectively in society.

4.4.2 Organizing for problem solving

According to Souviney (1994:87), the educators need to plan carefully for problem-solving. He suggests the following:

- Provide a non-threatening environment.
- All answers should be seen as useful.
- Learners should be encouraged and praised for the work put in.
- Educators should evaluate the learner's problem-solving efforts.

Cangelosi states that students should "analyse real-life situations instead of contrived problems". Therefore, through trying to solve real life problems, the educator bases his or her learning on the learners past experiences and thus uses this as a median to build on the new knowledge learnt. The constructivist approach would therefore come into play as well through solving problems. While problem-solving, learners build on their previously learnt information that they have gained through experience.

4.4.3 Constructivist approach

Canfrey (Souviney, 1994:37) suggests the following that the educator can use to carry out effective constructivist teaching.

1. "Promote intellectual autonomy and commitment in students by valuing student theories and inventions."
2. "Develop students' reflective processes by using learning logs."
3. The educators should use "portfolios or informal observation logs" in order to develop a "case history" on the learner.
4. The different ways to solve problems should be discussed with learners by asking them to write or give a verbal report.
5. After learners have arrived at solutions, revisit their "solution path" by discussing the various solutions to find similarities and differences in the way learners have answered.
6. Make a deliberate effort to prevent outside interruptions and ensure that learners stay focused on the lesson.

4.5 CONCLUSION

Through the guidelines outlined in this chapter about integrating Mathematics into other learning areas, and using the various teaching strategies effectively outlined in this paper, the aim of teaching learners the purpose/use of mathematics in their environment can be accomplished. The educator is the designer of the lessons, and mainly through his or her expertise in these areas will the learners be able to apply classroom mathematics in their daily lives.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY

The purpose/use of mathematics in our daily lives is fundamental for individuals to function with confidence within the society that they live in. In order for learners to carry this out effectively they need to be able to understand mathematics. This understanding stems from their learning in a meaningful way, for which educators need to facilitate the learning of mathematics in a way that allows learners to apply it in their real world.

The aim of this study was to find out what effects the methodology used in the classroom have on the learners' understanding of its purpose/use in their social environment. Also, it aimed to provide suggestions on how the methodology used in the classroom can be improved so that the skills and knowledge gained make sense to the learners and can be used in the real world.

The literature review focused on the claims of academics, many agreeing with the reflective and fallibilist view of mathematics. The teaching strategies reflected in this review can help to improve the way mathematics is taught in the classroom. The cooperative, problem-solving and constructivist approach helps to form the link between classroom mathematics and application in the real world. The intention of learning theories in mathematics also helps to throw some light on learning mathematics with understanding and being able to adapt this knowledge and skills learnt to one's environment.

Through the use of the observation and questionnaire on both the learners and the educators, the researcher concluded that the methodology used in the classroom is having an effect on the learners learning the purpose/use of mathematics in their environment. The researcher suspects that if the various methodologies mentioned are implemented effectively, according to the guidelines, then the educator would easily facilitate meaningful learning.

Integrating mathematics with other subjects is one of the OBE requirements. Through careful planning with all educators concerned, the integration of mathematics into other subjects allows learners to view its content as relevant to their daily lives, and not as an isolated compulsory subject to pass through to the next grade. The educators must also be aware that strategies cannot be compartmentalised, and they can use more than one given strategy at any time, thus careful study and application of these guidelines can extend mathematics beyond the boundaries of the classroom and make its application possible in the physical world.

5.2 CONCLUSIONS

The researcher arrived at the following conclusion after research was conducted in a school at District 11 in Lenasia, Gauteng Province. It was found that the lecturing/telling method was dominating the methodology used in the classroom through whole class presentations. The textbook formed the major source of information, thus eliminating or minimizing the use of original questions to link mathematics to the learners' environment.

Very rarely were learners provided with activities that encouraged them to apply mathematics to situations that really mattered to them. Most of the work related to content-based teaching, thus ignoring the development of knowledge, skills, values and attitudes in learners that could be used beyond the confines of the classroom.

Learners were unsure whether they would use mathematics in their lives after they left school. Their past experiences were not being used as a foundation to build on new knowledge learnt. Cooperative or problem-solving strategies were rarely if at all administered, and therefore learners were not learning in an environment that promoted learning the purpose/use of mathematics in their daily lives. It was therefore concluded that the educators were not teaching in a way that ensured the learners fully understood the role of mathematics in the real world.

Thus, it is clearly evident that the educators need to change their methodology in the classroom so that learners understand the subject mathematics and find it meaningful in their lives. The educator should move away from teacher-centered to a learner-centered approach. Use of the cooperative, problem-solving and constructivist strategies would help to reinforce the learner-centered curriculum.

The researcher concluded that an integrated approach to teaching mathematics must be implemented in all mathematics classrooms. Using the various strategies mentioned in this paper, together with the integrated approach, would allow learners to see the value of mathematics in society, and be able to use and apply these knowledge, skills, values and attitudes, learnt in the confines of the classroom, to the outside world. By engaging with mathematics, using these different strategies mentioned, learners would become efficient problem solvers. They would be able to tackle the problems of today with confidence in real life situations when the need arises. When learners are armed with the ability to apply mathematics to their environment, it becomes a powerful tool in interpreting the world they live in.

5.3 RECOMMENDATIONS

As related to the finding of this study, it is proposed that approaches in the classroom should be altered or adjusted in order for the learners to learn the relevance of mathematics in their environment.

- A learner-centered approach to learning is advocated. When learners are actively involved in their lessons, they develop skills, knowledge, values and attitudes that can be used in their daily lives.

- Learning programmes and work schedules should be planned by all educators in advance. These must include themes and context-teaching across all learning areas, so as to encourage integration of subjects.
- The methodology that is used in the classroom should cover teaching strategies such as cooperative learning, problem-solving and the constructivist approach to facilitate learning the relevance of mathematics in the environment.
- Resources should go beyond the use of textbooks, so that the educator could draw up original questions that relate to the learners' real life situations.
- Teachers should be encouraged to use investigations and projects as assessment activities. These allow for learners to extend working beyond the confines of the classroom, thus promoting learning in real-life situations.
- Problem-solving is an effective way to link classroom mathematics with the real world. Therefore, educators should be encouraged to relate most, if not all, of their activities to real-life situations, using problems.
- All mathematics educators should be exposed to in-service-training. These situations should focus on the educators learning the nature, theories and teaching strategies in Mathematics, so as to facilitate teaching the purpose/use of it in their environment.
- Teachers should prepare assessments that test the learners' application of mathematics to real-life situations. This will aid the educators in their reflections on whether they are teaching mathematics in a way that helps learners understand its relevance in their environment.

5.4 RESEARCH RECOMMENDATIONS

Research along similar lines should be conducted on a larger scale, using more than one school. All stakeholders should be involved, including parents and district facilitators of mathematics, with the intention to:

- Examine the extent to which district facilitators and parents can help to promote learning mathematics in a meaningful way.

- To find out whether parents/communities themselves are knowledgeable about the relevance of mathematics in their own lives and their children's daily functioning in the community.
- To find out how parents/communities can help with respect to learners learning the relevance of mathematics in their daily lives to function effectively in society.

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ANNEXURE A

THE STUDENT'S QUESTIONAIRE

Please complete the following questionnaire by answering the questions and placing a tick (√) in the appropriate block (only one block). The aim of the questionnaire is to find out if the students understand the purpose or use of mathematics in their daily lives, and whether the educator teaches in a way that promotes learning the purpose or use of mathematics in their daily lives. **YOUR NAME IS NOT REQUIRED.** All your information remains absolutely anonymous.

1. In which grade are you?

Grade 5 ☐ Grade 6 ☐ Grade 7 ☐

2. Do you use mathematics in other subjects at school?

Very often ☐ Rarely ☐ Never ☐

3. Do you use mathematics in your daily activities?

Very often ☐ Rarely ☐ Never ☐

4. Do you think mathematics will be useful to you in your daily life?

Definitely ☐ Not sure ☐ Never ☐

5. Do you think you will use mathematics when you start work?

Definitely ☐ Not sure ☐ Never ☐

6. Do you think you will use mathematics in your adult life?

Definitely ☐ Not sure ☐ Never ☐

7. Do you think mathematics is important to help you find a good job?

Definitely ☐ Not sure ☐ Never ☐

8. Do you look forward to your mathematics lessons?

Very often ☐ Rarely ☐ Never ☐

9. Is mathematics interesting and fun to you?

Very often ☐ Rarely ☐ Never ☐

10. Do you do mathematics word problems in class?

Very often ☐ Rarely ☐ Never ☐

11. Do you enjoy solving word problems?

Very often ☐ Rarely ☐ Never ☐

12. Are the word problems related to activities in your environment?

Very often ☐ Rarely ☐ Never ☐

13. Do you think that mathematics helps you to think, reason and make good decisions?

Very often ☐ Rarely ☐ Never ☐

14. Do you think mathematics can help you to solve problems in your day to day lives?

Definitely ☐ Not sure ☐ Never ☐

15. Do you participate actively in your mathematics lessons? (by asking questions, answering, solving problems and so on).

Very often ☐ Rarely ☐ Never ☐

16. Do you work in groups when solving mathematics problem sums?

Very often ☐ Rarely ☐ Never ☐

17. Does group work help you to solve problems better?

Very often ☐ Rarely ☐ Never ☐

18. Do you solve mathematics problems quicker when you discuss them with your peers?

Yes ☐ No ☐

19. Do you see mathematics as being meaningful in your daily life?

Very often ☐ Rarely ☐ Never ☐

20. Do you see mathematics as a set of signs and symbols that are difficult?

Yes ☐ No ☐

21. Do you study mathematics because it is useful, important and relevant in your daily life?

Yes ☐ No ☐

22. Do you think that your teacher teaching helps you to solve real life problems?

Very often ☐ Rarely ☐ Never ☐

23. Does your teacher relate the contents of mathematics to problems in real life?

Very often ☐ Rarely ☐ Never ☐

24. Do you enjoy mathematics?

Very often ☐ Rarely ☐ Never ☐

25. Which teaching method do you think you can use to help you learn the purpose/use of mathematics in your daily life?

Option	Frequency	% Frequency
Teacher telling you Group work Reading and working alone		

YOUR COOPERATION IS HIGHLY APPRECIATED

ANNEXURE B

THE TEACHER'S QUESTIONNAIRE

Please complete the following questionnaire as truthfully, honestly and objectively as possible by answering the questions and placing a tick (√) in the appropriate block (only one block). The aim of this questionnaire is to find out, to what extent teachers use methodology that can enhance the learning of the purpose or use of mathematics in our environment.

11. Does your teaching ensure that the learners fully understand the purpose/use of mathematics to everyday life?

Often enough ☐ Rarely ☐ Hardly ever ☐

12. Which of the following does your teaching mostly encourage?

Factual recall ☐

Critical and creative thinking and application ☐

13. Do you assess according to the learners understanding the use of mathematics in their day to day lives?

Often enough ☐ Rarely ☐ Hardly ever ☐

14. Does your assessment questions involve assessing logic, creativity, reasoning and problem solving techniques?

Often enough ☐ Rarely ☐ Hardly ever ☐

15. Do you encourage and allow students to suggest their own projects, problems and questions to solve.

Often enough ☐ Rarely ☐ Hardly ever ☐

16. Do you involve learners in activities that encourage them to use mathematics to support their thinking and reasoning?

Often enough ☐ Rarely ☐ Hardly ever ☐

17. Do you provide opportunities for learners to debate and argue issues based on solving mathematical sums?

Often enough ☐ Rarely ☐ Hardly ever ☐

18. Do you think it is possible to link the learning outcomes to teaching the purpose/use of mathematics in everyday life?

Very possible ☐ Fairly possible ☐ Impossible ☐

19. Do you think that your teaching allows learners to form the link between mathematics and the real world?

Often enough ☐ Rarely ☐ Hardly ever ☐

20. Do you think that there is a relationship between the educator's methodological approaches and the learners learning the purpose/use of mathematics in everyday life?

Often enough ☐ Rarely ☐ Hardly ever ☐

YOUR COOPERATION IS HIGHLY APPRECIATED

ANNEXURE C

THE OBSERVATION PROTOCOL

The researcher observes a lesson of each of the participant educators to find out whether the educators teach the daily lesson's content with reference to the purpose or use of mathematics in our environment or not.

As the general criteria, the findings about the observed aspects will be recorded as displayed on the observation grid (Part I). There will also be some note taking on the findings of the observation shown in part II.

PART I

The teacher	Not at all	Only trying	Achieving
1. Links the content to real life situations.			
2. Links the content to other subjects.			
3. Draws on the learner's life experiences and situations.			
4. Use teaching resources that can aid in learning the purpose/use of mathematics in the environment.			
5. The written and practical work encourages the learning of the purpose/use of mathematics to human life.			
6. Homework encourages use of the environment to solve problems.			

PART II NOTE TAKING

7. Learners are involved in the lesson through:

Exercises from textbooks ☐

Answering educator's questions ☐

Practical application ☐

8. The lesson seems to be concentrating more on:

Factual learning and recall ☐

Practice of skills ☐

Problem solving and application ☐

9. The methodological approach applied in the classroom is through:

Socio-constructivism approach ☐

Direct approach ☐

10. Learners activities involve:

Individual work ☐

Small group discussions ☐

Questioning and answering ☐

11. Content is related to other subjects and/or learners lives outside the classroom.

Yes ☐ No ☐

ANNEXURE D

University of Johannesburg
Dept. Teacher Education
PO Box 524
AUCKLAND PARK
2006

22 August 2005

The Principal Secretary
Ministry of Education
JOHANNESBURG
GAUTENG

Dear Sir/Madam

APPLICATION TO CONDUCT RESEARCH ON PRIMARY SCHOOL MATHEMATICS EDUCATORS AND STUDENTS

Permission is requested to conduct research on three primary school mathematics educators and thirty learners.

The research forms part of a Masters Degree in Teacher Education. The candidate wishes to find out what effects does the educators methodology have on the learners understanding the purpose and use of mathematics in their social environment.

The mathematics taught in the classroom and the learners' ability to apply mathematics in their real-world has been a worrying experience. In general learners are finding it difficult to form the link between mathematics taught in the classroom and its purpose or use in their social environment. In this study, some of the ways to overcome this problem may be discovered. The candidate is a primary school mathematics educator at Lenz public school.

Research will be carried out in the form of observations and self-administered questionnaires to both the teachers and learners. The candidate wishes to carry her research out at one school in the Lenasia area. This should take place over a period of two days. The names of the schools and the respondents will not be revealed in this research paper.

It will be highly appreciated if permission can be granted for this study to be completed.

Thank you in anticipation

I. Reddy	Professor J. Strauss
Candidate	**Supervisor**

University of Johannesburg
Dept. Teacher Education
PO Box 524
AUCKLAND PARK
2006

22 August 2005

The Principal/HOD/Mathematics Educator

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