PERCEPTIONS AND ATTITUDES OF ZAMBIAN HIGH SCHOOL PUPILS TOWARDS MATHEMATICS: A CASE OF SELECTED SCHOOLS ON THE COPPERBELT.

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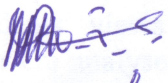
DECLARATION

I, Peter Mulendema, hereby declare that this dissertation represents my own work, and that it has not been previously submitted for a degree, diploma or other qualifications at this or any other university.

Signed: 

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ABSTRACT

One's perception and attitude towards Mathematics affects their conception of how it should be learned and presented (Ernest, 1998). This study was a survey of high school pupils' perceptions and attitudes towards Mathematics in the Copperbelt Province of Zambia. Pupils' perceptions and attitudes were assessed using the Questionnaire on Learner Perceptions and Attitudes towards Mathematics (QLPAM). From a population of about 4350 pupils, the QLPAM scales were administered to 100 pupils in Grades 10, 11 and 12 classes in four schools. Focus Group Discussions (FGDs) were also conducted with the pupils and teachers of Mathematics. Data from the questionnaires were summarized and scored accordingly in terms of positive and negative perceptions and attitudes. Descriptive analyses were used to describe the respondents' views regarding their perceptions and attitudes towards Mathematics. FGDs were analysed using the Qualitative Focus Group Content Analysis (QFGCA) technique. The Pearson correlation analysis was conducted in order to explain the relationship between learners' perceptions and attitudes towards Mathematics. A Pearson correlation coefficient, $r = 0.5079$ was obtained and was rejected at both the 5% and 1% levels of significance. An Analysis of Variance (ANOVA) was conducted to test the differences in learners' perceptions and attitudes towards Mathematics according to schools and it showed that learners' perceptions and attitudes towards Mathematics were not significant ($\alpha = 0.05$) among the four schools. The findings of this study show that pupils rank Mathematics second to English as the most liked subject. The findings also indicated that learners regard Mathematics as the most difficult subject to learn. The study revealed that 87.6 percent of the learners in the sample have positive perceptions and 94.4 percent have positive attitudes towards Mathematics. Findings also revealed that teachers of Mathematics have given little regard to non-cognitive issues such as learners' feelings, perceptions, attitudes, beliefs and interests. In general the study concludes that learners in high schools in Zambia have positive perceptions and attitudes towards Mathematics even though they regard the subject as the most difficult subject to learn. If learners' performances are to improve, teachers of Mathematics and other educators need to understand their perceptions and attitudes towards Mathematics. Perceptions and attitudes are essential for learners' development and seldom change without significant intervention. Therefore, teachers must be informed about the importance of non-cognitive factors in the learning process through Continuous Professional Development (CPD). The study recommends for reforms in the Mathematics curriculum and in teaching approaches. The study further recommends that the MoE should establish an Educational Television Channel (ETVC) on which positive perceptions and attitudes could be promoted through programmes that can help learners and teachers appreciate Mathematics.

DEDICATION

I dedicate this dissertation to all my children, Sarudzai, Kudzai, Fungai, Mutiti and Precious. My children put education first and the rest second as knowledge is power.

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OPERATIONAL DEFINITION OF TERMS

For the purpose of this research study, the following definitions of terms are used.

1. **Perceptions of Mathematics:** This refers to an individual's particular way of understanding or thinking about Mathematics.
2. **Learners:** This refers to high school pupils in Grades 10, 11, and 12.
3. **Attitudes:** This refers to particular behaviours towards Mathematics and the learning of it. An attitude is a relatively enduring system of affective reactions based on beliefs which have been learned about the characteristics of a social object – in this case Mathematics.
4. **Mathematics:** Hare (1999: 6) quoted Weisstein who stated that "Mathematics is a broad ranging field of study in which the properties and interactions of idealised objects are examined..., an extremely rich and diverse set of tools, terminologies, and approaches which range from the purely abstract to the utilitarian."
5. **Value of Mathematics:** The importance or usefulness of Mathematics in an individual's life.

TABLE OF CONTENTS

CONTENTS **PAGE**

LIST OF TABLES

ACRONYMS

AIEMS	–	Action to Improve English, Mathematics and Science
CDC	-	Curriculum Development Centre
CDO	-	Curriculum Development Office
CPD	-	Continuous Professional Development
COSETCO	-	Copperbelt Secondary Teachers College
ECZ	–	Examinations Council of Zambia
ETV C	-	Education Television Channel
FAWEZA	-	Forum for African Women Educationists in Zambia
FGDs	-	Focus Group Discussions
INSET	-	In Service Education Training
LCT	–	Learner Centred Teaching
MoE	-	Ministry of Education
MUCE	-	Mufulira College of Education
PNES	-	Post Newspaper Education Supplement
QFGCA	-	Qualitative Focus Group Content Analysis
QLPAM	-	Questionnaire on Learner Perceptions and Attitudes Towards Mathematics
SMASTE	–	Strengthening of Mathematics, Science and Technology Education.
TED	-	Teacher Education Department
UNISA	-	University of South Africa
UNZA	-	University of Zambia
VVOB	–	Flemish Office for International Cooperation and Technical Assistance

CHAPTER ONE

INTRODUCTION

1.1: Background of the Study

Mathematics is one of the compulsory subjects in schools in Zambia. It is considered vital and necessary in the natural sciences, economics, many courses and fields like accountancy, insurance, education and industries. Mathematics, world over, has contributed to the development of nations through technology. Globally, the subject of Mathematics has been and is still the main driving force to economic development. According to Lemmer (2000:34), "Mathematics, science and technology are strongly influenced by the global context. Many studies indicate that proficiency in these disciplines is a prerequisite for economic success." This perception of Mathematics has accorded the subject great value.

The value of Mathematics has also been emphasised by Walter (1975:1) who says, "large numbers of men and women who use Mathematics in connection with their work will rightly agree in stressing the great value of the practical aspect of the subject, shopping around the corner, planning a flight to the moon, designing a bridge, or evaluating the result of a piece of research in education, medicine or agriculture which all involve Mathematics." It is the value of something that builds up the perceptions and attitudes of an individual towards that thing. In this case, learners' values of Mathematics depend on their perceptions and attitudes towards Mathematics.

This gives Mathematics a lot of value in some way even though it may not be appreciated by the majority of the society because of the high failure rate of learners

in the subject. This is the concern, which has been shown by the Ministry of Education (MoE) and the Zambian community at large.

A mention that someone has studied Mathematics sends different messages to many and causes many people to raise their eyebrows at that person with glee. Parents measure the intellectual abilities of their children by looking at their performance in numeracy or Mathematics. This is an indication that many, regardless of whether they have studied Mathematics, value Mathematics in some way. Burton (1992:69) asserts that, "Everyone has, as a matter of fact, a certain image of Mathematics, without necessarily knowing much about the subject." It is in such cases that certain perceptions about Mathematics exist in peoples' minds according to their past experiences and the kind of society they live in. This value accorded to Mathematics makes the subject a necessary tool to the advancement of technology, and for the development of a nation.

In Zambia, Mathematics is a subject in which learners have generally performed poorly. In national examinations, learners have performed most poorly in Mathematics as indicated in the ministry of education policy document in which the government has shown concern. Other stakeholders, like Teacher Education Department (TED), Strengthening of Mathematics, Science and Technology Education (SMASTE) and donor agencies like the Flemish Office for International Cooperation and Technical Assistance (VVOB) have also shown this concern. This poor performance in Mathematics has led to a situation whereby, very few school leavers are ready to take up courses that require the study of it. So far no studies have been conducted in a perspective that could find out the kinds of perceptions and attitudes of learners towards Mathematics.

Despite government and other stakeholder attempts to improve pupil performance in Mathematics and to encourage learners to study Mathematics in their tertiary education very little, if any, improvements in learner performance in Mathematics have been recorded (MoE, 1996). One area that needs to be explored, particularly here in Zambia, is that of surveying learners' perceptions and attitudes towards Mathematics. Learners' perceptions and attitudes towards Mathematics could be some of the main cornerstones in the teaching and learning of the subject.

Hence, this research was considered necessary so as to help in understanding the perceptions and attitudes that Zambian high school pupils have towards Mathematics, and to explore their impact on the learning process of Mathematics.

1.2: Statement of the Problem

Zambia like any other country takes Mathematics and other sciences as being pivotal to a nation's advancement in technology; a necessary tool to the development of a nation's economy, without ignoring the importance of other subjects. In Zambia, Mathematics is a subject in which learners have generally performed poorly in both class tests and national examinations as indicated in the Ministry of Education (MoE) policy document in which the government has shown concern about this state of affairs. MoE (1996:52) says, "The overall unsatisfactory performance in the school certificate examinations is attributed, in a large measure, to poor performance in Mathematics and science." Further, MoE (1996: 54) says, "Clearly there is a situation here which requires urgent attention and major interventions, the pupils themselves and the country as a whole cannot sustain a continuation of the unsatisfactory performance in Mathematics and Science and subsequent impairment of the national potential for technological development." This poor performance in Mathematics in national examinations has had negative effects on pupils who could have intended to study Mathematics in their later years. Many learners avoid studying Mathematics even before they face it.

Various strategies like Learner Centered Teaching (LCT), In Service Education Training (INSET), and Action to Improve English, Mathematics and Science education (AIEMS) have been put in place and tried but very little improvement has been seen in learner performance in Mathematics. This is a worrying situation to the Mathematics educators and the government as is indicated in the policy document, 'Educating our Future'. Mathematics is regarded as an important subject because it helps learners develop flexible problem-solving and data analysis skills and an inquiring mind and to feel comfortable with temporary confusion or state of

inconclusive results.

It is not clear how learners' performances in Mathematics are influenced by their perceptions and attitudes towards it. Hence, there is need to investigate the perceptions and attitudes learners have towards Mathematics and assess their impact on learning.

1.3: Overall Objective

This study, out of concern for the extent of poor performance among high school learners in Mathematics as stated earlier, aims at exploring the perceptions and attitudes Zambian high school pupils have towards Mathematics. It attempts to identify the kinds of perceptions and attitudes learners have towards Mathematics. It also attempts to look at the impact of these perceptions and attitudes on the learning process of Mathematics.

1.4: Specific Objectives

The specific objectives of this study were;

1. To find out what the learners' perceptions of Mathematics are.
2. To establish the kinds of attitudes learners have towards Mathematics.
3. To explore the impact of learners' perceptions and attitudes to the learning of Mathematics.
4. To determine whether learners' perceptions vary according to schools.
5. To determine whether learners' attitudes towards Mathematics vary according to schools.

1.5.1: Research Questions

This study advanced the following research questions;

1. What are Zambian learners' perceptions about Mathematics?
2. What are Zambian learners' attitudes towards Mathematics?
3. Do Learners' perceptions and attitudes towards Mathematics have any impact on learning?

1.5.2: Hypotheses

1. H_0 : $x_1 = x_2 = x_3 = x_4$ .i.e. All the means in learners' scoring in perceptions of Mathematics in the four schools are significantly equal.

   H_1 : All the means in learners' scoring in perceptions of Mathematics in the four schools are not significantly equal.

2. H_0 : $x_1 = x_2 = x_3 = x_4$ .i.e. All the means in learners' scoring in attitudes towards Mathematics in the four schools are significantly equal.

   H_1 : All the means in learners' scoring in attitudes towards Mathematics in the four schools are not significantly equal.

1.6: Significance of the Study

There are a number of reasons why this study was significant. Firstly, findings of the study are likely to influence teachers of Mathematics and learners in their perceptions and attitudes towards Mathematics. Many Grade Twelve school leavers avoid taking up courses that utilize Mathematics or have a Mathematical component. This could be due to attitudes learners developed while at the high school level. The learning of Mathematics depends, fundamentally, on the learners' beliefs (which bring out attitudes) and in particular on their perceptions of the nature and meaning of Mathematics.

Secondly, the findings of this study may help Mathematics educators to apply approaches that instill into the learners, positive perceptions and attitudes towards Mathematics. Thirdly, the results could also be used by the MoE in policy making and by the Curriculum Development Center (CDC) for assessment and evaluation purposes. The Mathematics curriculum does not put much emphasis on the need for learners to develop positive attitudes towards Mathematics. The research findings of this study may therefore enable the Curriculum Development Office (CDO) to see the importance of developing good attitudes and perceptions of Mathematics among learners. Fourthly, Mathematics educators and researchers could use the findings for the improvement of the teaching of Mathematics and for conducting further research. Fifthly, the adapted questionnaire used in this study may also serve as an instrument for measuring pupils' perceptions and attitudes towards Mathematics including other subjects or disciplines.

Lastly, the results of this study will contribute to the existing Mathematics and Science literature base.

CHAPTER TWO

LITERATURE REVIEW

This chapter discusses learners' perceptions and attitudes towards Mathematics. It focuses on perceptions and attitudes in general as they relate to the learning and teaching of Mathematics and to learners' performance in the subject. Specifically, it considers the general view of this relationship from various types of literature.

Perceptions and attitudes are very important aspects to consider in the study of learners' performance in Mathematics and their future plans to continue studying this subject. This is because they play an essential role in determining learners' behaviour towards Mathematics. They also determine the amount of effort learners put in the learning of Mathematics. Educators believe that an understanding of perceptions and attitudes of learners and what education involves is essential if education is to achieve its ultimate goal (Mwamwenda, 1996).

As indicated earlier, perception is a person's particular way of understanding or thinking about something and in this case Mathematics. How a person perceives Mathematics is a function of both his/her own understanding of the subject independent of others and his/her interpretation of how it is perceived by others. Perception develops from childhood through adulthood as a result of a person's interaction with his/her environment, which includes his/her peers, parents, teachers, the various tasks and responsibilities he/she is assigned to do and the way in which he/she copes with them. Whether a person develops positive or negative perceptions of Mathematics depends on how he/she comes to know and understand it (Mangal, 2001). Mangal (2001:106) has defined perception as "...a highly individualised

psychological process that an organism experiences in organising and interpreting the complex patterns of sensory stimulation for giving them the necessary meaning to initiate his behavioural response." In accordance with this definition, perception is an individual's way of thinking about something and in this case Mathematics. The definition also indicates that perception determines the kind of behaviour an individual will show towards that thing. That means a learner with a positive perception of Mathematics will put more effort and more energies into learning new concepts. Castle (1995:57) indicates that perception "is the application of our intelligence to the impressions made on one or more of our senses that we are able to perceive." This means that perception assists learning and learners can learn to perceive.

Many researchers such as Mwamwenda (1996), Rawnsley and Fisher (1998) and Alausa (2000) have indicated that perceptions are very important to an individual as they play a pivotal role in the way they see the world and how they feel about what they meet and experience in their day to day lives. Perceptions depend partly on the individual's cognitive style and partly on the individual's wealth of experiences in the physical and social environment to which they have been exposed (Mangal; 2001). Goldstein (1980:148) says; "Perception is not a passive process. It is influenced by expectations, past experiences, language and culture." Mangal (2001), supports Castle (1995:59) who says that, "Briefly then, we receive impressions through our senses; these impressions stimulate memory of similar experiences; our minds connect the old with the new; and thus perceptions take place." This assertion suggests that the learners' learning process and understanding of Mathematics is affected by their way of life. The way people live in a particular place and the way they are brought up by their parents and the type of community they live in

determine the kind of perceptions individuals will have towards Mathematics. Goldstein (1980:149), further says; "Perhaps the most consistent influence on perceptions is past experience." By past experience, Goldstein means that learners' upbringings are normally influenced by the kinds of societies, cultures and community beliefs and myths in which they are actively involved have the greatest influence on the learners' cognitive and socialization process. The assertion also means that a learner whose past experience with Mathematics was that of success will develop a positive perception of Mathematics and a learner whose experience with Mathematics was that of failure will develop a negative perception of Mathematics. Additionally, in a society in which teachers, adults, peers and parents perceive Mathematics in a particular way, be it positively or negatively, learners will also perceive Mathematics in similar ways.

The importance of perception in the learning process is also emphasised by Winkler (1998: 63), who states that, "The process of making sense is called perception and without perception, children will see shapes, but not recognize them, they will hear but not understand what they mean, and they will feel objects without understanding what they are. Clear perceptions of the outside world are the foundations of learning." This means that learners can only learn if they are able to perceive what they are being taught. This pronounces the importance of perceptions in the teaching and learning processes.

In the teaching and learning processes it is important to understand the kinds of perceptions learners have which help the teacher to effectively plan and adopt correct approaches in teaching and learning activities. Jacobs *et al.*, (2002:242), have seen the importance of perceptions in the learning process as they state that,

"Perception is regarded as one of the most important foundations of effective teaching and meaningful learning." This means that the way learners perceive Mathematics will determine how much effort and time they will put into learning it. A child with a positive perception of Mathematics will be willing to participate in learning it while the one with a negative perception will be less willing to learn even if they are present in the classroom.

The study of perceptions of Mathematics dates back to the time of scholars like Plato (427-347 BC) and Aristotle (384-327 BC). Mathematicians, Mathematics educators, economists, engineers, researchers and many other professionals hold various perceptions about Mathematics. Perceptions about Mathematics are different because individuals hold different perceptions that are a result of past experience, which leads to many people having different attitudes towards Mathematics. It is perceptions and other factors like attitude, beliefs and school environment that build up the nature of Mathematics.

Many Mathematicians and scientists have held various perceptions of Mathematics. Thompson (1997: 40) says; "Plato took the position that objects of Mathematics had an existence of their own beyond the mind, in the external world." In this case Plato perceives Mathematics as being some truth that is in existence and needs to be discovered and to be learnt. Such a perception entails its own way of teaching and learning Mathematics. Plato's student, Aristotle had a different perception of Mathematics. He perceived Mathematics as being based on experienced reality. In this context, Aristotle perceived Mathematics as being formed and invented by people to solve problems they experience from time to time. Dossey (1997:40), states that, "For Aristotle, Mathematics is rather based on experienced reality, where

knowledge is obtained from experimentation, observation and abstraction." The implications of the various perceptions is that if we are not careful undesirable perceptions of Mathematics may be passed on from one generation to another and thus making Mathematics difficult to study. Aristotle holds a rather flexible perception of Mathematics and he implies that it is what we encounter in the environment that creates the Mathematics we learn.

Hare (1999: 16) states that, "Mathematics is a broad ranging field of study in which the properties and interactions of idealized objects are examined. Whereas Mathematics began merely as a calculation tool for computation and tabulation of quantities, it had blossomed into an extremely rich and diverse set of tools, terminologies, and approaches which range from the purely abstract to the utilitarian."

With such varied definitions of Mathematics highlighted above, learners are bound to perceive the subject in various ways. This means that if learners perceive Mathematics as a subject that is not forced on them, they will be able to learn new concepts and enjoy learning the subject. Perception involves regular attendance which is possible if the learner is interested in the specific subject (Castle; 1995). By attendance it could mean that learners' full participation in the learning process is achieved through their acceptance, interest and setting of the mind towards learning.

Perceptions of Mathematics have kept on changing from generation to generation and this could be due to factors like political systems, cultural changes, economic dilemmas, and social settings. This trend of change in the perceptions of Mathematics instruction can therefore be well addressed by moving up with time and

coming up with approaches that relate to the perceptions of learners and that can also address the issues of political systems, cultures, economics and social settings in the teaching of Mathematics. Despite the above highlighted sentiments about Mathematics, Zambia and the whole world, numbers of men and women taking up the challenge of studying Mathematics is continuously declining (Burton: 1992). The decline could be due to the high failure rates in public examinations.

In Zambia, for example, the MoE policy document observes that many school leavers do not do well in Mathematics. As stated earlier, the MoE (1996: 53) states that, "The overall unsatisfactory performance in school certificate examinations is attributed to the poor performances in Mathematics and science." The MoE (1996), goes on to attribute the cause of this poor performance to deficiencies in facilities, resources or the teaching itself, imbalance of the curriculum, expectations of the learners themselves, and other unknown reasons. In a way the MoE (1996) implies that the learners' poor performance could be due to perceptions of the subject by both teachers and learners.

For example, a Grade Eleven pupil from Lundazi High School in the Eastern Province of Zambia stated in the Post Newspaper Education Supplement [PNES] (2005:ii) that, "Parents and teachers keep encouraging us to do well in Mathematics and reminding us on how important the subject is. Some parents even go to the extent of saying, 'a certificate without Mathematics is not a good certificate'. Our direct response to our guardians is that Mathematics is a difficult subject and even our teachers didn't do well in Mathematics either." In this case a pupil speculates that the high pupil failure rate in Mathematics is due to two factors namely, the teachers themselves as failures in teaching the subject and the subject itself being

difficult to learn. Of course, such a perception of Mathematics has its own implications. Recognising the negative implications of such a perception of Mathematics, a pupil in the Post Newspaper (Education supplement, 2005: ii) went on to say that, "But if we continue with the spirit that we are failures in the Mathematics and we cannot pass it, Zambia as a country too will become a failure. Instead, let's have confidence in ourselves and work towards the goal of improving. To all students out there I urge you not to look at Mathematics as a difficult subject." From this quotation, it is clear that the pupil realises that some of his fellow pupils in Zambia generally regard Mathematics as a difficult subject though he feels that such a perception is retrogressive and urges all pupils to develop positive perceptions of the subject. For the individual learner to learn he/she must enjoy whatever they are learning. Willingness to learn depends on the individual's experiences in the course of being taught the given subject.

Another factor that is of great importance in learning Mathematics is the attitudes of learners towards Mathematics. This is because attitudes play an essential role in determining learner behaviour towards Mathematics. Opperheim (1979:105), defines attitude as "...a state of readiness, and a tendency to act or react in a certain manner when confronted with certain stimuli." Further, Hare (1999: 24) quoted the definition from Shaw and Wright (1967) who defined attitude as "a relatively enduring system of affective, evaluative reactions based upon and reflecting the evaluative concepts or beliefs which have been learned about the characteristics of a social object or class of objects."

In accordance with the above definitions one could define attitude as an individual's behaviour towards Mathematics. It can also be noted that an individual's attitudes

are present but dormant most of the time (Goldstein, 1980). Attitudes are usually expressed in speeches or other behaviours only when the object of the attitude is perceived. This means that a person may have strong attitudes for or against Mathematics but these become aroused only when confronted by the subject of Mathematics or problems that can be solved by Mathematical methods. The impact of attitudes in the learning of Mathematics has not been explored much by Mathematics educators, particularly in Zambia, even though there is literature mostly in psychological studies that show the importance of considering the role of attitudes in the learning of Mathematics. Psychologists like Baron and Byrne (2004:126) have stated that, "Attitudes seem to operate as schemas- mental frameworks that help us to interpret and process many kinds of information. Moreover, they strongly colour our perceptions and thoughts about the issues, persons, subjects or groups to which they refer." This assertion made by Baron and Byrne (2004) shows that perceptions influence learner's attitudes towards the subjects they learn in school.

The importance of attitudes in the learning and teaching of Mathematics is further emphasised by Harlen (1997:39) who stated that, "Pupils' attitudes affect the willingness of individuals to take part in certain activities, and the way in which they respond to persons, objects or situations." This shows that learners will only understand or be ready to learn new concepts in Mathematics if they are willing and are ready to learn. Learning is an example of change (from ignorance to knowledge, skill and understanding) and change requires two things for it to be effective, namely: readiness and capability. Learners will, of course, be ready and willing to learn if their perception of Mathematics is positive and those with negative perceptions will not learn, as they will not be ready to do so. This means that attitudes are formed from the perceptions a learner has about Mathematics.

Oppernheim (1979), states that attitudes could be as a result of beliefs formed by the individual's perceptions about Mathematics and these perceptions are determined in part by our cognitions, which set limits on what we are most likely to perceive. This means that the cognitive levels of learners and the society as a whole play a part in the way Mathematics is perceived and hence the development of certain attitudes towards it, i.e. positively or negatively.

Though in part also, beliefs are a reflection of learners' perceptions of Mathematics and if learners believe that they can do well in Mathematics they are likely to have positive attitudes towards it and vice-versa. Research on learners' perceptions of Mathematics has been done elsewhere as reported by Mwamwenda (1996; 367) who asserts that Wolf and Blix (1981) states that, "a pupil's attitudes to Mathematics serve as a predictor of his performance in Mathematics." Central to this finding is that learners' attitudes towards Mathematics can help to predict their performance in the subject. Further, perceptions of Mathematics are cardinal in the sense that a learner with positive perceptions of Mathematics is more likely to have positive attitudes towards Mathematics, which is likely to lead to good performance (Mwamwenda, 1996).

McLeod (1997), states that there are two different ways in which attitudes towards Mathematics appear. Firstly, attitudes may result from the automatising of a repeated emotional reaction to Mathematics. For example, if a learner has repeated negative experiences with 'adding', the emotional impact will usually lessen in intensity overtime and eventually the reaction to addition will become automatic. McLeod (1997: 581) also says, "If a negative experience is repeated several times there will

be less physiological arousal and the response will become a stable one that can be measured through the use of a questionnaire." And secondly, attitudes may result from an assignment of an already existing attitude to the recent or new but unrelated task. This can be seen in a learner who has a negative attitude towards problem solving in a Mathematical setting, and may attach the same negative attitude towards problem solving in a geographical setting.

From the preceding paragraphs it can be noted that most researchers agree with the notion that past experiences, beliefs, culture and cognition of the learner have great influence on the learner's perceptions and attitudes towards Mathematics and learning in general. This brings us to the controversy that has centred on whether it is primarily 'nature' (what we have inherited at birth) or 'nurture' (what we experience during our lives), which determines our perceptions and attitudes (Donald, Lazarus and Lolwana, 2000). These researchers linked perceptions and attitudes to constructivism, a theoretical framework that asserts that learning is through the formation of constructs by the learners themselves. There are various forms of constructivism but all with a common understanding of analysing the learning process. In this context social constructivism is emphasized. According to Donald, Lazarus and Lolwana (2000: 3), "Constructivism is a theoretical perspective in which human beings are seen as active agents in their own development and that knowledge is not passively received but actively constructed cognitively and through socialization." Constructivism goes beyond both assertions of the 'nurture' and 'nature' controversy. It accepts both and puts emphasis on the fact that development is something that happens to human beings. Donald, Lazarus and Lolwana (2000:40), state that, "constructivism shifts this emphasis to a more active position where human beings are seen as active agents in their own development. In other

words, human beings are shaped by both nature and nurture, but they are also active in shaping their own development." Baron (2001:122), supports this idea and says, "There is a growing consensus among behavioural scientist that most, if not all, aspects of perception involve both nature and nurture". Even though behaviourist and constructivists differ on their view of Mathematics, they both agree to the nature- nurture controversy. This 'constructivist' view comes from Jean Piaget (1980) and others such as Lev Semenovich Vygotsky (1962), Jerome Bruner (1956) and Hebb (1972). Even though there is a general consensus that perception involves nature and nurture among behavioural scientists and constructivists, very few studies have been conducted, particularly in Zambia, in relation to the learning and teaching of Mathematics.

It is also important to point out here that the teaching-learning relationship is both for teachers and learners (Ernest, 1988). Teachers, of course, teach more than they learn from the pupils and learners learn more than the teachers. But such a relationship enriches both parties in the sense of values and beliefs. This kind of learning again is grounded in constructivism, which states that knowledge is a construction of the individual learner and such constructions depend on each individual's perception of the world around him/her. Bruner (1956), in his theoretical framework states that learning is an active process in which learners construct new ideas or concepts based upon their current or past knowledge. The perceptions of Mathematics that learners may have, do not only depend on the environment (the world around them), but could also depend on the way the individual learner recognises and understands concepts as stated earlier. Jacobs *et al.*, (2002:4), state that, "Such perceptions depend partly on the individual's cognitive style and partly on the individual's wealth of past experiences in the

physical and social environment to which he/she has been fortunately or unfortunately exposed prior to the learning encounter concerned." The way learners behave towards learning Mathematics can be seen to emanate from their perceptions of the subject. Jacobs *et al.* (2002: 242), emphasise that, "Perception is regarded as one of the most important foundations of effective teaching and meaningful learning."

The main argument is to emphasise how important it is to consider the influence of underlying attitudes and perceptions on the ongoing discourses in society and to be able to detect specifically what the effects of such underpinnings may be on educational dispensations within a broader societal context. One aspect that needs to be considered when we talk about perceptions and attitudes is people's value of Mathematics. Values underpin people's behaviour. Examples of values are legion: professional conduct, self-discipline, honesty, respect for humanity and nature, tolerance for different viewpoints, curiosity to find the truth, appreciation of learned knowledge to mention but just a few.

From the definitions of perceptions, attitudes and values, it can be noted that for learners to have positive perceptions and attitudes towards Mathematics, they should be ready to learn and this is initiated by the kind of perceptions they have towards the subject. This idea is also supported by Ugwuegbu and Siann (1988: 288) who state that, "Similarly a study of Isaacs (1976), in Jamaica, showed that any pupil's performance in Mathematics was influenced by the student's perception of his ability to do Mathematics." So learners, who feel that they will or can do well in Mathematics are likely to succeed and those who feel they cannot do well are likely to fail or perform badly. These feelings about Mathematics are brought about by the

kind of perceptions learners and society has towards Mathematics. In turn, perceptions breed attitudes in learners that could be positive or negative in relation to the societal needs and values. It is these attitudes that affect the efforts learners are going to put into learning Mathematics. Some learners will go into class already convinced that they will not understand the Mathematics they will be taught. This view is noted by Harlen (1997:36) who says, "These attitudes affect not only what is learned but the effort put into the tasks given which in turn affect the likelihood of success." The main point to note here is that an attitude will influence how the learner is going to respond to a particular task or situation. Harlen (1997: 39) further notes that, "Pupils' attitudes affect the willingness of individuals to take part in certain activities, and the way in which they respond to persons, objects or situations." This shows that the teacher, on one hand and the society on the other shape the perceptions and attitudes of the learners of Mathematics in the course of their social interaction.

The linguistic analysts (Encarta Encyclopedia, 2000) undertake to examine the actual way key epistemological terms such as 'perceptions', 'knowledge' and 'attitudes' are used and they formulate definitive rules for their use in order to avoid verbal confusion. According to Encarta Encyclopedia @ Microsoft (2000), "Perception is a process by which organisms interpret and organize sensation to produce a meaningful experience of the world." This means that perception describes one's ultimate experience of the world. Gestalt psychologists approach to perception is that human beings respond holistically to experience and that an accurate perception of one's own needs and of the world is vital in order to balance one's experience and achievement (Encarta Encyclopedia @ Microsoft, 2000). Perception is influenced by the context in which an object appears.

The other factor that should be considered in the formation of perception and attitudes of learners towards Mathematics is the role of language in the learning process. Mathematics has its own universal language that uses many different symbols. This unique language of Mathematics has some influence on learners' perceptions of Mathematics. The symbols used in Mathematics have their own side effects on the learners' perception of Mathematics. At times a learner may fail to solve a Mathematical problem, which has certain symbols but can be able to solve the same problem if presented with other more appealing symbols. For example, learners may be asked to solve an equation written in the form, '$a^2 + 4a + 4 = 0$' where 'a' is a variable. Learners may fail to solve the above equation but solve correctly, the same equation presented in the form '$x^2 + 4x + 4 = 0$'. The learner may fail to solve a quadratic equation with the variable 'a' because he/she could have been introduced only to the variable 'x' and the change of variable symbol from 'x' to 'a' may seem strange. In this case the symbolic language of Mathematics has its own effects in the teaching and learning of Mathematics.

Goldstein (1980: 121) noted that, "All thought is dependent on language and the structure of language influences the manner in which the environment is perceived and understood." Goldstein (1980) clearly shows that language influences individual perceptions and attitudes of learners towards Mathematics. It also implies that teachers and parents need to use appropriate language as they communicate with the learners, as what they say to and about learners could have great influence in the way learners may perceive Mathematics and other subjects. This implies that perceptions and attitudes could be regional depending on the language and culture of an indigenous grouping. The language used in Mathematics textbooks has its own effects. Some textbooks use language that may cause many readers to perceive

Mathematics as a difficult subject as noted from, MoE (2004: 25) which states that, "The Rainbow progression Ladder on this page illustrates the meaning of the colour levels ...Blue; Most difficult level. Here you introduce topics which are most difficult for the grade." Such a statement can easily have adverse implications to a teacher of Mathematics. The statement may cause the reader to believe that the level of the Mathematics to be taught is most difficult and it implies that learners would find it difficult to learn. Probably, a better word or terminology could be 'more challenging level' or 'extension activity' instead of 'most difficult'.

Teachers also have an influence on learners' perceptions and attitudes in learning of Mathematics. The role of teachers in the formation of perceptions and attitudes is noted by Dekker and Lemmer (1998: 15) who state that, "Teachers constitute the most important educational influence on pupils' learning of Mathematics. Teachers communicate acceptable standards of achievement in various subjects including Mathematics through a myriad of explicit and hidden messages." From this statement it is right to say that learners will always take it that what ever behaviour and information the teacher shows or gives to them is the correct and appropriate one. This assertion is further echoed by the MoE (1996: 54) in its policy document, which emphasises that, "The difficulties of many pupils with Mathematics and science go back to the way they were introduced to these areas in the primary school." Truly, this takes us back to the notion of experiences shaping learners' perceptions and attitudes. Children often imitate adults in most of the things they do. It can therefore be assumed here that what humans do is usually an imitation of what others do, with their awareness and in most cases without their awareness, meaning that perceptions of Mathematics are similarly affected, often negatively.

Lemmer (2000), has a similar view that teachers and parents transmit most of the values or perceptions and attitudes learners have towards Mathematics. These non-cognitive processes are transmitted through their own words and actions with or without their knowledge. Lemmer (2000:8) further states that, "What lives in the hearts of teachers and parents will colour their teaching or behaviour even if they remain silent about certain matters." Lemmer's assertions are supported by Mwamwenda (1996: 367) who states that, "... teachers who like the subject and are good at it are well endowed to stimulate favourable attitudes in their pupils that are essential for the learning, whereas teachers who dislike the subject or are not competent in it are likely to infect their pupils with similar feelings of dislike and similar cognitive incompetence."

As was mentioned earlier, learners' beliefs play a vital role in the formation of perceptions and attitude. Mwamwenda (1996), argues that learners' behaviours are determined by their beliefs, and therefore, teachers' and learners' beliefs play an important role in the learning of Mathematics. Mwamwenda (1996), further indicates that a teacher's belief is more important than his teaching techniques. For teachers to teach Mathematics within a given social environment and for them to use appropriate methods of teaching that would bring positive perceptions and attitudes towards Mathematics to learners there is need to understand learners, their family background, ethnic beliefs, cultural values and their parent's value system of education. Gal and Ginsburg (1994), have indicated in their studies that beliefs in the learning processes may be filters through which learners interpret experiences and events. It is therefore possible to argue persuasively that in the final analysis the study of Mathematics depends on learners' perceptions and attitudes.

Further, Hare (1999), says that from a student's first year in school, he/she is able to perceive differences in teacher expectations for his/her own performance from that of his/her classmates. Hare (1999) goes on to say that the widely given explanations for why students do not learn Mathematics are the inadequacies of their teachers' knowledge of Mathematics.

As can be noted from arguments in the preceding paragraphs, perceptions and attitudes are important factors to consider in the teaching and learning processes of Mathematics. Studies conducted by Ugwuegbu and Siann (1988), Mangal (2001), Donald *et al.* (2000), Walters (1975), Rawnsley and Fisher (1998) and Alausa (2000) indicate the importance of positive perceptions and attitudes towards Mathematics and the learning of it. Even though these studies have indicated the importance of perceptions and attitudes in the learning of any subject, very few studies have been conducted which focus directly on the study of perceptions and attitudes towards Mathematics from an African perspective. Most of these studies have just assumed that perceptions and attitudes play an important role in the learning and teaching of Mathematics. For example, Rawnsley and Fisher (1998) concluded that, "Students' perceptions of the social environment of learning accounted for a median of 30% of the variance in cognitive, affective and behavioural post course measures. Efforts at generalizing these results suggest consistency across different school subjects and different languages and cultures." According to the above quotation it means that learners' perceptions and attitudes are not affected by past experiences of the learners and are not influenced by culture and environment. The study done in Australia by Rawnsley and Fisher (1998) concluded by assuming that the findings were true in all parts of the world regardless of other factors like race, past experiences of the learners and culture. Such a conclusion negates what Goldstein

(1980) had asserted that language, culture, and the kind of environment influence the learners' perception of what they are being taught.

Studies conducted by Alausa (2000), in Namibia, indicated that the learners' past experiences affect their perceptions and attitudes towards Mathematics. During the colonial rule, black Namibians were not allowed to study Mathematics and science because the colonial government regarded them as inherently incapable of learning these subjects (Alausa 2000). With such a past experience the study saw that with 42.1% of the students disagreeing with the statement that, Mathematics would benefit only the brighter learners, as a positive and major shift in the expected Namibian students' perception of Mathematics and science. Alausa (2000), indicates that the experiences of the learners and the society are of great importance in the study of perceptions. Further, the emerging literature on the role of non-cognitive factors in cognitive performance, (Cox, 2001), highlights the practical importance of attending to non-cognitive factors. The importance of non-cognitive factors in the teaching and learning process has also been emphasised by the MoE (1977: 107) in the education reform document in which it recommended that, "Students' non-cognitive areas such as attitudes, interests, human relations should be assessed ..., teachers should do their best to assess students."

In Zambia no study has looked specifically at the perceptions and attitudes of learners towards Mathematics and the learning of the subject has been carried out. An investigation on the Zambian learners' perceptions and attitudes towards the subject was required to assess the kind of perceptions and attitudes learners have towards Mathematics and their impact on the learning of Mathematics. There was also a need to understand the perceptions and attitudes of the learners towards

Mathematics from an African perspective. As Mwamwenda (1996: 20) states, "we know ourselves better than anyone else, and therefore we must assume the role of spokespeople for African behaviour through objective scientific research."

It should be obvious that the study of Mathematics, learners' perceptions, attitudes, beliefs, learner Mathematical knowledge, teacher education and Mathematics teaching and learning has established a place for itself within Mathematics education research. Research has produced information that can be used as a driving force for school Mathematics developers. This study continues with this line of research by looking at high school pupils' perceptions and attitudes towards Mathematics, especially in Zambia.

CHAPTER THREE

METHODOLOGY

3.1: Introduction

This chapter discusses the research design, methodology of data collection, research instruments used and their validity and reliability. It further explains the procedure used to conduct the study.

This research was both quantitative and qualitative in nature and took the form of a survey study. Secondary information was obtained from various publications such as textbooks, journals and previous studies on the same subject from the United Kingdom, United States, and Australia through the Internet and from the University of Zambia (UNZA) library. Secondary information was also obtained from text books from the University of South Africa (UNISA), particularly on data concerning research methods and data analysis, through a friend studying with the institution. Secondary data was also sourced from Mufulira Municipal Council (MMC) and Copperbelt Secondary Teachers College (COSETCO) libraries.

Information was also acquired from primary sources. Primary information was gathered by means of an empirical study. Respondents were required to complete a questionnaire. The questionnaire comprised five-point Likert-type and open-ended questions. The questions were formulated in line with a model established during the literature review. Further permission was sought or obtained from the school authorities to have focus group interviews with the learners and teachers of Mathematics. The teachers and learners were assured that the information obtained would be treated confidentially and that results would be used for academic purposes only.

3.2: Research Design

A survey was chosen as a method of collecting data due to the nature of the data and purpose of study. As advised by Cohen and Manion (1995:83), "Typically, surveys gather data at a particular point in time with the intention of describing the nature of existing conditions, or identifying standards against which existing conditions can be compared...." This was a survey aimed at obtaining a detailed description of the perceptions and attitudes that high school learners have towards Mathematics in the Copperbelt province of Zambia. The survey design was cross-sectional, enabling the researcher to focus on describing the characteristics of a population and in this case the study focused on the perceptions and attitudes of learners - a technique which was adopted from Shaughnessy and Zechmeister (1994).

3.3: Target Population

The study targeted High school learners who were in Grades 10, 11 and 12 in the Copperbelt province of Zambia. The target population was of learners regarded to be at a level and age at which they were likely to form stable perceptions and attitudes towards Mathematics. The ages of the learners ranged from 14 to 21 years. The study also targeted teachers of Mathematics at grade 10, 11 and 12.

3.4: Study Sample

From a population of about 5310 pupils, a sample of 100 (n = 100) learners in grades 10, 11 and 12 in four government run high schools in four districts, in the Copperbelt province of Zambia was drawn. The school sample was selected for the following reasons. Firstly, it would be easily accessible. Secondly, the cost would be fairly low and thirdly, less time would be spent in conducting fieldwork. The districts chosen were Mufulira, Chingola, Kitwe and Ndola, as it was assumed that they

would suffice to be representative of the Copperbelt province of Zambia. From each of the four districts, one school was selected and 25 pupils were randomly selected using stratified sampling from each school. The schools were selected in relation to their accessibility in terms of transport; this was done in order to reduce on transport costs.

According to Caswell (2002), the stratified sampling method entails the use of the natural divisions of the sampling frame; in this case, the grade levels were the strata. Stratified sampling was used so as to ensure that all grade levels in a school, that is, Grades 10, 11, and 12 were adequately represented in the sample. This gave a total of 100 learner participants in the study. The number of participants reduced to 97 (45 males and 52 females) due to the failure of three participants to bring back the questionnaires to the researcher. The three participants who had not submitted back the filled questionnaires were followed up but efforts to meet them failed because, apparently, two were not able to report to school due to non-payment of school user-fees. One could not be met due to persistent absenteeism. Participants at each grade level were selected randomly from the class lists of all pupils in that grade. Random numbers were used to select the participants from each class. A random number would be punched on a calculator and the last two digits gave a number less than the number of pupils in that class, that was the number of the pupil on the class register that was picked. If the number was larger than the number of pupils in that class, the last one digit was picked and the corresponding name of a pupil was selected. For example, if 2835 was the random number punched, pupil number '35' in the class register was selected. And if 9167 was the random number punched, pupil number '7' in the class register was selected.

3.5: Research Instruments

The instruments used in the study were a questionnaire and semi-structured Focus Group Questionnaires (FGQ) (Appendix A). The questionnaire had Likert-type scales on learners' perception and attitude towards Mathematics, an approach adopted from (Oppenheim, 1979). The five point Likert-type scale questionnaire is a modification of the 152 item scale entitled "Questionnaire in the Teaching of Mathematics", developed by *Ernest (1996). His scale was used to measure primary in-service teachers' attitudes, beliefs, conceptions and views regarding Mathematics teaching and learning. The researcher communicated with Ernest through E-Mail over a month during the development of this survey. The questionnaire (Appendix A) was used to determine the perceptions and attitudes of the learners towards Mathematics. The Focus Group Discussions (FGDs) were used to gather the learners' perceptions and attitudes towards Mathematics and the teachers' views on how these impact on the learning of Mathematics.

The questionnaire included statements about the learners' favourite subject at school, their willingness to pursue further studies in Mathematics or take up jobs, which apply some Mathematics, how they regard Mathematics in their learning process and how valuable it was to them. The questionnaire also included attitude statements on the way learners felt when they attended Mathematics classes, how they reacted when asked to solve Mathematics problems and what they thought about their teachers of Mathematics in relation to the way they taught the subject. Learners' perceptions and attitudes were measured using the Likert Attitude - scaling method, which had items that tried to measure the same perception and attitude or behaviour of learners towards Mathematics (Oppenheim, 1979). Oppenheim (1979: 133),

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states that, "Likert's primary concern was with unidimensionality – making sure that all the items would measure the same thing."

First a pool of perception and attitude items were composed. Then a sample of respondents was sought, and the entire pool of items was tried. In this study, 25 respondents sufficed even though a larger number would have been ideal. The pilot study was conducted at Butondo high school in Mufulira. Each respondent was asked, not merely whether he/she agreed or disagreed with each statement, but to check on all the responses given, i.e. Strongly Agree, Agree, Uncertain, Disagree, and Strongly Disagree. In the main study learner participants were similar to those on whom the scale was used in the pilot study. The scores were as follows, for favourable perceptions or attitudes; 5 for 'Strongly Agree', 4 for 'Agree', 3 for 'Uncertain', 2 for 'Disagree' and 1 for 'Strongly Disagree'. And for unfavourable perceptions or attitudes scores were as follows; 5 for 'Strongly Disagree', 4 for 'Disagree', 3 for 'Uncertain', 2 for ' Agree' and 1 for 'Strongly Agree'. Struwig and Stead (2001:94) stated that, "A Likert-type scale is usually linked to a number of statements to measure attitudes or/and perceptions and 5-point or 7-point scales are often used." After the pilot study, corrections and the best way of administering the questionnaire items and conducting of interviews were sought.

Scoring: Response alternatives for positive items are weighted from 5 (Strongly Agree) to 1 (Strongly disagree). These weights were reversed for alternatives to negative items.

The learners' score in the perception of Mathematics section and the attitudes towards Mathematics section was the sum of the weighted alternatives endorsed by

the learner. High scores reflect positive perceptions or attitude for the construct being measured. The highest score any participant can score in the perception section is 70. Similarly, on the attitude section the highest score a participant can score is 70. Each section has fourteen items (statements) each worth 5 positive points. The lowest score a participant can score is 14. Descriptive analyses were used to describe the participants' views regarding their perceptions and attitudes towards Mathematics.

Coding: The response mode for the perceptions of Mathematics section and the attitudes towards Mathematics were coded as follows: 5- Strongly Agree, 4 - Agree, 3-Uncertain, 2- Disagree and 1- Strongly Disagree.

Validity: Content validity addresses whether or not the appropriate content is in the instrument. It looks at whether the instrument measures what it is intended to measure and whether the instrument elicited accurate information (Hare, 1999). Content validation was established by cross-referencing the content of the questionnaire to those elements reported in the literature, like those of Alausa (2000), Hare (1999), Rawnsley and Fisher (1998), and Ernest (1996). Validity for the questionnaire was also provided by the FGDs with both learners and teachers of Mathematics, whereby the accuracy of the information regarding perceptions and attitudes towards Mathematics was confirmed.

Reliability: Hare (1999), states that, "The basic idea of reliability is summed up by the word consistency." A pilot study was conducted to assess the reliability of the questionnaire. The pilot study was conducted at Butondo high school, which was not included in the main study. One of the aims of conducting a pilot study was to

test the reliability of the questionnaire. To test the reliability of the questionnaire, a split-half test was conducted. According to Mulder (1996), a split-half test measures the internal consistency of the questionnaire.

The split-half test consisted of two half tests (see Appendices E and F). Statements numbered with even numbers formed one half and those with odd numbers as the second half. The results obtained by 25 respondents in the test are shown in Appendices E and F. A score of one (1) indicates which statements were favourably answered and a score of zero (0) indicates which statements were unfavourably answered. The correlation between the scores for the two halves of the test were, $r = 0.7083$ for learners' perceptions and $r = 0.9378$ for learners' attitudes towards Mathematics. The reliability coefficients obtained indicated a high correlation for the learners' perceptions questionnaire and a very high correlation for the learners' attitudes questionnaire. The reliability coefficients in general indicated that the questionnaire was reliable. The other parts of the questionnaire were assessed objectively.

There were two FGDs conducted; one for the learners and the other for the teachers of Mathematics. The FGD with the learners was conducted after participants had completed filling in the questionnaire. The FDG with the teachers of Mathematics (32 teachers) were conducted after interviewing the learners.

3.6: Procedure of Conducting the Study

The questionnaires were administered to the participants. Few oral instructions were given other than those to emphasise that the sought information was not personally threatening, that honest responses were required, and that the items were to be answered without consultation with peers. The questionnaires were given to participants for a day to give them time to read and fill them in accurately. The participants were selected randomly from each class using random numbers sourced from a calculator. The last two digits of the number would be the number of the learner to be selected if the number was less or equal to the number of pupils and if the number was greater than the number of pupils in that class, the one last digit was the number to use to select a learner. After handing in the questionnaires to the researcher, participants were interviewed in groups of about 12 learners using the semi-structured focus group guide. Thereafter, teachers of Mathematics were interviewed as a Focus Group (FG). The same procedure was followed in all the four schools in a period of one month.

Validity for the questionnaire was further provided by the focus group discussions for both learners and teachers of Mathematics, whereby the accuracy of the information regarding perceptions and attitudes of learners towards Mathematics was confirmed. A Qualitative Focus Group Content Analysis (QFGCA) technique was used in this study. A focus group content analysis has its emphasis on meaning rather than on quantification (Stewart and Shamdasani, 1998). This process involves studying the transcript or notes taken carefully by the researcher, sorting the discussion into categories of thought and inquiry. They are organized around the research questions of the study. The analysis is included in the results section.

3.7: Limitations of the Study

This study was limited by the fact that only some selected variables were considered in the learners' perceptions and attitudes towards Mathematics. Variables like, learners' anxiety levels, cultural effects to learning Mathematics, and economic factors which could influence the learners' responses in some way were not considered. These variables could not be considered, as the scope of this study could not contain them. These variables could be considered in future studies by this or any other researcher. However, the results of this study have relevance for all learners in the country.

CHAPTER FOUR

RESULTS

4.1: Introduction

This chapter of the study outlines the findings from the questionnaires and from the FDGs.

Before carrying out the analysis of the data on perceptions and attitudes of the learners towards Mathematics, preliminary analyses revealed that the patterns of responses in the four schools were almost identical. For this reason the results on learners' perceptions and attitudes towards Mathematics in the four schools were combined for the reporting of results.

Summary scores were calculated for the learners' perceptions of Mathematics and attitudes towards Mathematics. Sums indicated a specific type of response preference for each learner in this section of the survey. A learner's score is the sum of the weighted statements on perceptions of Mathematics and on attitudes towards Mathematics. High scores reflected positive perceptions and/or attitudes towards Mathematics. Low scores reflected negative perceptions and/or attitudes towards Mathematics.

Comparative analyses were also used to delineate the responses of the learners. A one way Analysis of Variance (ANOVA) was conducted in order to test whether there was any significance in the school differences in terms of the learners' responses in both their perceptions and attitudes. And a Pearson correlation analysis was also conducted in order to determine the relationship between learners'

perceptions and attitudes. The findings of this study are presented in two parts. The analysis is given separately according to the method of data collection. Results from quantitative data are presented first followed by the results from qualitative data. The number of learners who completed and returned the questionnaire is indicated in Table 4.1. As indicated earlier ninety-seven learners responded to the survey.

Table 4.1: Survey Participants by School Categories

School	Surveys Returned	Percent
Kantanshi	25	100
Mindolo	25	100
Chingola	24	96
Kansenshi	23	92
Total	97	97

Note:
Total observations = 97, frequency missing = 3

The first part of the results presents the learners' rankings of the subjects they like to learn most and the subjects they find most difficult to learn. This part has percentages indicating the subject they like to learn most and the subject they find most difficult to understand. The rankings of the subjects are also indicated in four subjects which were common in all the schools, these are, Mathematics, Physics, Chemistry and Biology. The ranks of the subjects were arrived at by ranking the subject with the highest percentages as '1' and tied ranks were given the same rank by getting the average of the ranks with the same percentage. For example, if two subjects are ranked '4', then there will be no subject ranked '5'. Mathematics was ranked second as the most liked subject in all schools except for Kantanshi High School where Mathematics was ranked third. On the overall, in all the schools Mathematics was ranked second to English as the most liked subject.

On the ranking of the most difficult subject to understand, Mathematics was ranked first in all the four schools with the highest percentage of 39 percent from Mindolo High School which had the highest percentage of learners who liked Mathematics most with a percentage of 39 percent (See Tables 4.2a and 4.2b).

Table 4.2a Learners' Ranking of The Subjects Learners Liked Most

SCHOOLS	ALL		KANTANSHI		CHINGOLA		MINDOLO		KANSENSHI	
Subject	**%**	**Rank**	**%**	**Rank**	**%**	**Rank**	**%**	**Rank**	**%**	**Rank**
Mathematics	28.9	2	12.0	3	29.2	2	39.0	2.0	35.7	2
English	35.1	1	28.0	1	33.3	1	43.5	1.0	36.0	1
Physics	07.2	4	16.0	2	04.2	5	00.0	4.5	08.0	4
Chemistry	04.1	5	08.0	4	08.3	4	00.0	4.5	00.0	5
Biology	09.3	3	00.0	5	16.7	3	08.6	3.0	12.0	3

Table 4.2b Learners' Ranking of the Subjects Learners Found Most Difficult To Learn.

SCHOOL	ALL		KANTANSHI		CHINGOLA		MINDOLO		KANSENSHI	
Subject	%	**Rank**	%	**Rank**	%	**Rank**	%	**Rank**	%	**Rank**
Mathematics	29.0	1	32.0	1.0	25.0	1.5	39.0	1	24.0	1.0
English	11.3	3	08.0	2.0	12.5	3.0	13.0	3	12.0	2.0
Physics	12.4	2	04.0	3.5	25.0	1.5	17.4	2	04.0	3.5
Chemistry	05.2	4	04.0	3.5	4.2	5.0	08.6	4	04.0	3.5
Biology	02.1	5	00.0	5.0	8.3	4.0	00.0	5	00.0	5.0

Learner Perceptions of Mathematics:

The perception of Mathematics section of the questionnaire contained 14 items, each worth five positive points (see 'Scoring' in the methodology section). The highest possible score on this section is 70. If the middle response 'uncertain' were chosen on every item, the middle ground in the summative Likert scale score would be a 42. The mean 'summed' score of learners was 51.3 (SD = 7.9) indicating that overall they had a positive perception of Mathematics.

The sample was then divided on the basis of their score on their perceptions of Mathematics. Participants who scored above the middle ground score were characterized as having positive perceptions; those who scored below the median were characterized as having negative perceptions. By this criterion, 87.6 percent of the sample had a positive perception of Mathematics. The learner responses are shown in Table 4.3.

Table 4.3: Learner Responses for Perceptions Of Mathematics

Type of Response	Number of learners	Percent
Negative	10	010.3
Positive	85	087.6
Equal to Middle ground score	02	002.1
Total (N)	97	100.0

Learners' Perceptions of Mathematics.

Learners' responses were classified in terms of their perceptions of Mathematics and for each item (statement) their endorsements are shown in Tables 4.4a to 4.4n in Appendix F.

Value label for scoring were as follows;

A. For positive perceptions

1 - - Strongly Disagree

2 - - Disagree

3 - - Uncertain

4 - - Agree

5 - - Strongly Agree

B. For negative perceptions

1-- Strongly Agree

2-- Agree

3 -- Uncertain

4 -- Disagree

5-- Strongly Disagree

See Tables 4a- 4n in Appendix F

From the frequency tables presented in Appendix F, of the learners' perceptions of Mathematics, it can be observed that in statements one, five, and nine, learners indicated that they strongly agreed that Mathematics was interesting, very useful in their lives and that all young Zambians should study Mathematics respectively. In statements six and seven, the learners strongly agreed that there were too many facts to learn about Mathematics and that Mathematics was more demanding than other

subjects. This means that even though the results indicate a general trend that learners have positive perceptions of Mathematics, learners have negative perceptions in certain aspects of the subject. In some cases learners' responses range from positive to negative perceptions of the subject as can be noticed in statements thirteen, eight, four and three. The summary of the learners' endorsements is presented in Table 4.5. From the table the highest percentage in the column for 'strongly agree' is 68% against the statement, 'Mathematics is useful in our lives' in which respondents indicated their value of Mathematics. This is complemented by their response to the statement 'Mathematics is not good for people' in which 78% strongly disagreed with the statement. Table 4.5 also shows that in some statements respondents were not sure about whether Mathematics was worth studying as indicated in statement 12.

The ANOVA showed that learners' perceptions of Mathematics were not significant at $\alpha = 0.05$ for schools. This information is shown in Table 4.5.1.

Table 4.4: ANOVA - Table for Perception of Mathematics and school categories

Source	df	Sum of squares	Mean square	Calculated F	Critical F
Model	3	182.572	60.857	0.969	2.70
Error	93	5842.706	62.825		
Corrected Total	96	6025.278			

From Table 4.5.1 the conclusion was that $0.969 < 2.70$ (calculated value is less than

the critical value) so we do not reject H_0 at the 0.05 level of significance and conclude that the learners' average perceptions of Mathematics in the four schools are not different.

Table 4.5: Summary of the learners' responses on their perception of Mathematics.

	Statements	Strongly Agree N (%)	Agree N (%)	Unce-rtain N (%)	Disagree N (%)	Strongly Disagree N (%)
1	Mathematics is interesting	64(67.4)	22(23.2)	06(6.3)	02(2.1)	01(1.0)
2	Mathematics is easy to understand.	24(25.6)	29(30.8)	11(11.7)	21(22.3)	09(9.6)
3	Mathematics is too difficult for me.	13(13.4)	13(13.4)	09(9.3)	27(27.8)	35(36.1)
4	Mathematics is full of unreal ideas.	05(5.4)	05(5.4)	10(10.8)	24(25.7)	49(52.7)
5	Mathematics is for the gifted only.	09(9.5)	04(4.2)	04(4.2)	20(21.1)	58(61.0)
6	Mathematics is more demanding than other subjects.	41(42.7)	30(31.2)	06(6.3)	11(11.5)	08(8.3)
7	There are too many facts to learn about Mathematics.	38(39.6)	34(35.4)	09(9.4)	07(7.3)	08(8.3)
8	Mathematics is full of symbols that are fascinating.	21(22.6)	29(31.2)	11(11.8)	24(25.8)	08(8.6)
9	Mathematics is useful in our life.	66(68.0)	19(19.6)	02(2.1)	03(3.1)	07(7.2)
10	Mathematics is not good for people.	03(3.2)	01(1.0)	02(2.1)	11(11.6)	78(82.1)
11	I don't enjoy learning Mathematics.	09(9.3)	03(3.1)	01(1.0)	24(24.8)	58(59.8)
12	Mathematics is worth doing whether or not you want to be a Mathematician.	35(37.2)	27(28.7)	13(13.8)	11(11.7)	09(9.6)
13	Mathematical language is difficult to understand.	10(10.4)	17(17.7)	12(12.5)	26(27.1)	30(31.3)
14	All young Zambians should study Mathematics.	64(66.0)	21(21.6)	06(6.2)	01(1.0)	05(5.2)

Key: N = Number of Participants % = valid Percentage

Learners' Attitudes Towards Mathematics

The attitudes towards Mathematics section of the questionniare contain 14 statements, each worth five positive points (see 'Scoring' in the methodology section i.e. page 34). The highest possible score in this section is a 70. If the middle response, "uncertain" were chosen on every statement, the middle ground in summative Likert scale score would be a 42. The mean "summed" score of the learners was 53.2 (SD = 7.6), indicating that overall the learners have a positve attitude towards Mathematics. The sample was then divided on the basis of their attitudes towards Mathematics. Participants scoring above the middle ground score were characterised as having positive attitudes; those scoring below the middle ground score characterised as having negative attitudes towards Mathematics. With this criterion, 94.4 percent of the sample population had a positive attitude towards Mathematics. The learner responses are shown in Table 4.6.

Table 4. 6a Learner Response For Attitudes Towards Mathematics

Type of response	Number of learners	Percent
Negative	04	004.1
Positive	92	094.9
Missing freq.	01	001.0
Total (N)	97	100.0

Learners' Attitudes Towards Mathematics

The learners' responses were classified in terms of their attitudes towards Mathematics and for each statement their endorsements are shown in Tables 4.7a to 4.7n in appendix G

Value label for scoring were as follows;

A. For positive attitudes;

1 - - Strongly Disagree

2 - - Disagree

3 - - Uncertain

4 - - Agree

5 - - StronglyAgree

B. For negative attitudes;

1 - - Strongly Agree

2 - - Agree

3 - - Uncertain

4 - - Disagree

5 - - Strongly Disagree

See Tables 4.7a – 4.7n in Appendix G

From the frequencies of the single statements on learner attitudes towards Mathematics, high frequencies were registered in statements one, five and ten in which learners indicated positive attitudes towards Mathematics. In these three statements learners strongly agreed that they request for Mathematics books during their free time, they are interested to learn all they can in Mathematics and they also feel that success in Mathematics gives many opportunities in finding a job or place in a college respectively. The learners also strongly disagreed that they did not like attending Mathematics lessons all the time, and strongly disagreed that Mathematics is full of guess work. In the other statements like in two, six, seven, eight, nine, eleven, twelve and fourteen, the learners were non-commital in their responses. Some negative attitudes noticed from the frequencies included learners indicating that they fail to express their opinions in Mathematics lessons with fifteen percent strongly agreeing that Mathematics syllabus 'D' shouldn't have been compulsory.

On whether learners would study Mathematics in future, twenty-eight percent strongly agreed that they would, while fifteen percent were uncertain. This was not surprising as learners generally showed that they were interested in learning Mathematics but found difficulties to learn it and felt that the subject demanded too much of them. This feeling could discourage the learners to study the subject in future. A summary of the responses of learners' Attitudes towards Mathematics are shown in Table 4.8.

The Analysis of Variance showed that learners' attitudes towards Mathematics were not significant at ($\alpha = 0.05$) for schools as shown in Table 4.8.1

Table 4.6b: ANOVA Table for Attitudes towards Mathematics and School Categories

Source	df	Sum of Squares	Mean Squares	Calculated F	Critical F
Model	3	376.444	125.481	2.251	2.70
Error	93	5184.917	55.752		
Corrected Total	96	5561.361			

From Table 4.8.1 the conclusion was that $2.251 < 2.70$ (calculated value is less than the critical value) so we do not reject H_0 at the 0.05 level of significance and conclude that the learners' average attitudes towards Mathematics in the four schools are not different. This is probably because teachers of Mathematics in the four schools employ the similar teaching approaches.

Table 4. 7: Summary of the learners' Responses On Attitude Towards Mathematics.

	Statement	Strongly Agree N(%)	Agree N(%)	Unce-tain N(%)	Disagree N(%)	Strongly Disagree N(%)
1	I request for Mathematics books during my free time	57(60.6)	25(26.7)	02(2.1)	05(5.3)	05(5.3)
2	Given a choice between going for recess or working at a Mathematical activity, I would choose to do the Mathematical activity.	30(31.6)	36(37.9)	08(8.5)	11(11.6)	10(10.5)
3	Given a Mathematical problem I can volunteer to do research.	38(40.4)	37(39.4)	08(8.5)	03(3.2)	08(8.5)
4	I don't feel like attending Mathematics lessons all the time.	04(4.2)	06(6.2)	05(5.2)	24(25.0)	57(59.4)
5	I am very interested to learn all I can in Mathematics.	69(72.6)	19(20.0)	01(1.1)	01(1.1)	05(5.2)
6	I fail to express my opinions in Mathematics lessons.	14(14.4)	18(18.6)	10(10.3)	34(35.1)	21(21.6)
7	Mathematics syllabus 'D' is too difficult to learn.	10(10.3)	10(10.3)	11(11.3)	32(33.0)	34(35.1)
8	Mathematics shouldn't have been compulsory in the secondary school.	15(15.8)	10(10.5)	01(1.1)	16(16.8)	53(55.8)
9	Studying Mathematics really demands too much of me.	22(23.1)	30(31.6)	04(4.2)	20(21.1)	19(20.0)
10	Success in Mathematics gives many opportunities in finding a job or place in a college.	64(66.0)	27(27.8)	03(3.1)	03(3.1)	00(0.0)
11	I will study Mathematics in future.	27(28.4)	26(27.5)	14(14.7)	14(14.7)	14(14.7)
12	Parents regard Mathematics as the least important subject.	15(15.8)	17(17.9)	08(8.4)	30(31.6)	25(26.3)
13	Mathematics is full of guesswork.	03(3.2)	05(5.3)	02(2.1)	27(28.8)	57(60.6)
14	Most Mathematics teachers make Mathematics difficult.	20(21.3)	10(10.6)	09(9.6)	20(21.3)	35(37.2)

Key: N = Number of respondents
% = Valid Percentage

Qualitative Focus Group Content Analysis (QFGCA) (Learners)

The FGDs with learners were conducted on the same day the learners submitted their completed questionnaires. The results of the FGDs were first sorted into themes according to the research questions of this study.

Learners perceptions of Mathematics: The learners in the Focus Groups (FGs) in the four schools all indicated that Mathematics was a neccessary subject in schools and that it was very important in the development of the nation. They also perceive Mathematics as a subject which is interesting to learn even though they were quick to mention that it is interesting if it is handled (taught) by a competent teacher.

Learners further indicated that even though they like Mathematics, it was involving and needed a lot of devotion to understand. One interesting observation was that female learners had more positive perceptions about Mathematics than their male counterpart. This was observed during the FGDs as most of them felt that Mathematics was easy to understand. In such moments the male counterparts would make statements like, 'To tell the truth, Mathematics is difficult to understand ...' Some even went to the extent of perceiving Mathematicians as people who are not mentally normal. The learners felt that Mathematics was difficult to learn because of its abstract nature and partly because of incompetent teachers.

Similar sentiments on the female learners' responses were echoed by the Forum for African Women Educationists in Zambia (FAWEZA) Science, Mathematics and Technology school mentor coordinator. Banda (2003: 4), states that, "A lot of girl learners had problems in science but they managed to pass in Mathematics, which we thought would give them problems." From this statement it can be noted that

Banda never espected female learners to do well in Mathematics. Other implications could mean that Banda has negative perceptions of Mathematics and does not expect the female learners to do well in the subject.

In general, the results indicate that learners' perceptions and attitudes towards Mathematics are somewhat related according to Pearson's product moment correlation. Pearson's correlation, on the learners' scores on perceptions and attitudes sections was 0.5079 which was significant at both one percent and five percent levels of significance. This means that the scoring of a respondent in the perception and attitude sections was unlikely to have been of chance and is likely to be found again if administered to learners.

Learners' attitudes towards Mathematics: In this part the study the learners showed a rather lower level of positive attitudes towards Mathematics. They indicated that they usually failed to express themselves in Mathematics lessons partly because of the language of the subject and partly because the teachers of Mathematics are unfriendly. They felt that in most cases teachers are not ready to help learners with difficuties in Mathematics.

Learners felt that Mathematics had been made difficult by the teachers of Mathematics about whom they feel the majority are under-qualified and as a result do not have an interest in the subject. The learners compared the teachers in their schools and those who teach them by private tuition. Learners observed that teachers who offer private tuition teach better than the teachers in their schools. The learners also regarded Mathematics as a subject which needs discipline for one to pass it. By discipline, learners meant that if one is to do well in the subject, more

time and effort should be given to the subject. Some learners went on to say that Mathematics should be studied every day for better results, a perspective which is in agreement with what they indicated in the questionniare.

Qualitative Focus Group Content Analysis (QFGCA) (Teachers of Mathematics)

Teachers of Mathematics indicated that the performance of learners in the past one to two years has declined in all the four schools especially as indicated by the results of learners who sat for Grade 12 examinations in 2005. The teachers felt that the cause of this fall in percentages of the pass rate is two-fold, firstly, it could be due to over enrolment of learners in the Mathematics classes. And secondly, it could be due to poor staffing levels in high schools. This scenerio was common in all the four schools. The poor staffing levels were in agreement with what the learners said that most teachers of Mathematics are under-qualified to teach Mathematics effectively. Teachers also felt that some teachers have had poor training especially those who obtained a diploma certificate by distance learning especially from Nkrumah, Copperbelt and Chalimbana Teachers Training Colleges. The Heads of Mathematics departments in all the four schools felt that teachers who obtained diploma certificates through distance education have been failing to teach Mathematics effectively. The teachers further argued that the training of teachers nowadays is poor due to over enrolment of teacher trainees in most colleges and as a result there is no individualised attention given to them.

Teachers of Mathematics also indicated that learners come from primary schools with negative perceptions and attitudes towards Mathematics. They insisted that most of the learners who go into Grade 10 have failed Mathematics and this

encourages them to perceive Mathematics negatively. Teachers of Mathematics also felt that negative perceptions and attitudes are passed on to learners by other teachers who do not teach Mathematics. They suggested that the training of primary school teachers should be revisited so that learners can begin succeeding in Mathematical learning as effective learning with children aware of their successes makes for positive images.

On how learners react to the learning of Mathematics, the teachers of Mathematics felt that learners go to Mathematics classes with preconceived ideas and beliefs that Mathematics is a difficult subject and as a result they are already demoralised to learn the subject. The teachers felt that the negative attitude towards Mathematics seem to develop in the primary school as most learners tend to have negative experiences in Mathematics while they are at primary school level. The teachers further felt that learners perform badly in Mathematics because most of them go into senior grades without passing the subject in the junior grades.

4.2: Summary of Findings

The following is a brief summary of the findings of this research study:

More than 80 percent of the learners in high schools in the Copperbelt province of Zambia have positive perceptions and attitudes towards Mathematics. Some learners have negative perceptions and attitudes towards Mathematics in some aspects like it being a difficult subject to learn.

One interesting finding was that the research indicated that female learners were more positive in their perceptions and attitudes towards Mathematics. A reverse of

what was obtaining in previous times when female learners were more negative in their perceptions and attitudes towards Mathematics.

The research findings further indicated that Mathematics is the second most liked subject to English by learners. Although Mathematics is the second most liked subject, learners regard Mathematics as the most difficult subject to learn. Further, learners perceive Mathematics as an interesting and necessary subject to be studied by all young Zambians.

Sixty-eight percent of the learners strongly agreed that Mathematics was useful in their lives. Findings through FGDs indicated that most learners go into high school with negative perceptions and attitudes that Mathematics is difficult to learn and demands too much of their efforts.

Findings indicated that learners, despite being in different schools and taught by different teachers, have similar perceptions and attitudes towards Mathematics.

Further, the findings indicated that teachers do not use appropriate methods of teaching such as discussion, group work, inquiry, discovery and problem-solving methods that promote the understanding of Mathematics by learners. This could be due to poor knowledge of Mathematics or teachers themselves have negative perceptions and attitudes towards Mathematics or they lack motivation in the form of inadequate or poor In-service training and remuneration. This could also be due to lack of Continuous Professional Development (CPD) programmes for teachers in the schools.

In the discussion section that follows, the findings are evaluated and interpreted further.

CHAPTER V
DISCUSSION

5.1: Introduction

This chapter discusses the findings of this study by evaluating and interpreting the findings according to the research questions and hypothyses of the study.

Results of this study suggest that learners in the Copperbelt province of Zambia have positive perceptions and attitudes towards Mathematics. However, it is evident that more work is needed in changing the way Mathematics is taught in the classroom. One method is through changing the Mathematical attitudes and perceptions of learners and their teachers. Westwell (2005:207), states that, "One of your aims as a Mathematics teacher is to see that your pupils develop positive attitudes towards Mathematics. Not only can this support more learning, but it is also a valid objective in its own right."

This study was conducted out of concern to establish the kinds of perceptions and attitudes learners have towards Mathematics. The researcher questioned the origins of the learners' poor performance in Mathematics and maintained that it had to start in the classroom with the perceptions and attitudes of learners towards the subject. Hare (1999), validated this thought. He stated that perceptions of Mathematics are as a result of learners' experiences both in the classroom and outside the learning situations.

MoE (1977: 42), in the educational reforms document recommended that "Students' non-cognitive areas such as attitudes, interests, human relations, etc, should also be assessed." Further, MoE (1996), in its policy document 'Educating

our Future' also added fuel to the researcher's thinking. The MoE reports confirmed that there was a problem in the performance of Grade 12 pupils in their final examinations particularly in Mathematics. MoE (1996:54) states that, "... clearly, there is a situation here which requires urgent attention and major intervention; the pupils themselves and the country as a whole can not sustain a continuation of this unsatisfactory performance in Mathematics." The researcher thought that one area, which has not been explored fully, is the non-cognitive factors that affect pupils.

The researcher's concerns led to a study that examined the perceptions and attitudes of high school pupils in the Copperbelt province of Zambia. Questionnaires were administered to learners in government run high schools namely, Kantanshi, Mindolo, Chingola and Kansenshi. FGDs were also conducted. Learners and teachers of Mathematics constituted the focus groups in each school. The study was conducted with Grades 10, 11 and 12 learners. It set out to explore the perceptions and attitudes of learners by looking at three questions namely, 'what are Zambian learners' perceptions about Mathematics?' 'what are Zambian learners' attitudes towards Mathematics?' and 'do learners' perceptions and attitudes towards Mathematics have an impact on learning?' Data collected were analysed through descriptive analyses, frequencies, frequency rankings of the subjects, Focus Group Content Analysis (FGCA), the calculation of Pearson's correlation coefficient and Analysis Of Variance (ANOVA). The results are discussed with regard to the three research questions and two hypotheses of the study.

Question one: What are the learners' perceptions about Mathematics?

Majority of the learners in the province have a positive perception about Mathematics. An interesting finding was that about 27 percent of the learners were

ambivalent and said that even though they liked Mathematics and that it was an important subject, they perceive it as a difficult subject to learn. It can be noted here that on the relevance of Mathematics as in everyday life, it is possible that learners generally accept and perceive the importance of Mathematics in society rather than considering its applicability to everyday life, concentrating on the idea that it is a necessary aspect of their education. Another dimension that leads learners to perceive Mathematics as a difficult subject is that many of them have not experienced Mathematics learning methods that are meaningful to their 'real world'. This aspect came out clearly in the learner Focus Group Discussions in which learners indicated that most teachers of Mathematics are under- qualified and others are merely not interested in their work. This could be a perception transmitted from the teachers of Mathematics to the learners. This observation is supported by Lemmer (1998:15) who states that, "teachers constitute the most important educational influence on pupils' learning of Mathematics, and they communicate acceptable standards of achievements in various subjects including Mathematics through a myriad of explicit and hidden messages."

Question two: What are learners' attitudes towards Mathematics? About 90 percent of the learners have positive attitudes towards Mathematics. On whether learners are interested to learn all they can, 72.6% strongly agreed that they are interested to learn all they can in Mathematics. Despite being interested to learn Mathematics, only 40.4% strongly agreed that given a Mathematics problem, they would volunteer to do research on it. And only 31.6% strongly agreed that given a choice between going on recess or working on a Mathematics activity, they would choose to do the Mathematics activity. It will be right to note here that in the statements in which the learners were to express their attitudes in relation to full participation in the activity

seemed to have scored lower percentages. This could be because the learners have never been exposed to methods of teaching that demand the active participation of learners. This is not surprising as the teachers indicated this trend during the focus group interviews. The teachers indicated that most of them, if not all, use the lecture method to teach as they claimed they had no time to prepare for their lessons. The lecture method promotes rote learning and memorising contrary to constructivist approach which demand the active participation of the learners. Probably this is one area that needs further research in the Zambian context.

Hare (1999), quoted O'Brien (1999) as having stated that, "As early as the 1930s the Mathematics education researcher William Brownell saw parrot Mathematics as dominant in the United Kingdom and other parts of the world and criticised it heartily, pleading for children to be allowed to find meaning in Mathematics. But the view of Mathematics as isolated bits of information to be transmitted to passive receptors continues to be dominant in American schools." This scenario can be equated to what is happening in most of the Zambian schools today. The teachers have clung to the parrot kind of teaching Mathematics. In view of this, it is imperative for teacher educators to offer refresher courses to teachers of Mathematics in teaching methodologies that will encourage the problem solving approach.

Scholars like Isaacs (1999), Lerman (1983), Hare (1999) and Ernest (1998) have strongly supported the constructivist approach to teaching and learning. They proclaim that Mathematics educators should recognise and build on the abundance of informal Mathematical knowledge that children bring with them to the classroom, which in the past has been ignored or suppressed. They further state that such an

approach would also enhance the building of positive attitudes in children not only towards Mathematics but towards other subjects as well.

Question three: Do learners' perceptions and attitudes towards Mathematics have any impact on learning? Learners' perceptions and attitudes towards Mathematics seem to have their own implications on learning. The learners' perceptions and attitudes have impact on the learning of Mathematics as they determine the effort and preparedness of the learner to the learning situation. Though the performance of learners in the country is poor, still a reasonable number of learners pass and study the subject. This is not surprising, as it has been shown in this research that more than 80% of the learners in the sample have positive perceptions and attitudes towards Mathematics indicating that learners with more of their own effort and with little or less help from teachers pass the subject. This gives another dimension on how perceptions and attitudes impact on the learning of Mathematics. Teachers' perceptions and attitudes to teaching have their own effects on the learning of Mathematics. This dichotomy was clearly stated by Ernest (1998) who asserted that, "The attitudes of both students and teachers towards the learning of Mathematics are of great importance to the learning and teaching of the subject."

Teachers exercise immense power over their learners' academic success, especially in the high school. This power affects one's perception and attitude towards Mathematics. The teacher must convey that Mathematics is exciting and fun. Ernest (1998) states that, "If a teacher is excited, so are the kids." Teachers need to reflect and ask themselves what they can do to help their learners develop and keep positive perceptions and attitudes towards Mathematics. The question is what are the teachers' perceptions and attitudes towards Mathematics and teaching it? This

question can only be answered well if further research could be conducted to ascertain the teachers' perceptions and attitudes even beliefs about Mathematics and the teaching and learning of Mathematics. Teachers' philosophies of Mathematics could be investigated too as these shapes their way of teaching. This kind of study would show the kind of methods teachers are using in teaching the subject. The study could also show how much or what kinds of qualifications are suitable for teaching mathematics and for which level. The study would also show or compare the teaching efficacy of teachers trained through distance learning and teachers trained on full-time basis.

Hypothesis one: H_0: $x_1 = x_2 = x_3 = x_4$, where x_i is the mean of learners' scoring in perception statements a particular school. According to the ANOVA (see appendix page 94) the null hypothesis is not rejected and therefore there are no differences in learners' perceptions of Mathematics in the four schools. This result supports the assertions made by Ernest (1998) who indicates that learners' perceptions and attitudes tend to be similar in schools. This could be so because the teachers teaching these learners are trained in the same colleges and universities.

Hypothesis two: H_0: $x_1 = x_2 = x_3 = x_4$, where x_i is the mean of learners' scoring in attitude statement in a particular school. According to the ANOVA (see appendix page 98) the null hypothesis is not rejected and therefore there are no differences in learners' attitudes towards Mathematics.

In summary the present results confirm that learners generally have positive perceptions and attitudes towards Mathematics. This is due to the learners' positive perceptions and attitudes towards the subject in spite of their teachers' teaching

methods. The study also shows that there is a positive correlation between perceptions and attitudes as indicated by the Pearson's product moment correlation coefficient.

CHAPTER SIX
CONCLUSION AND RECOMMENDATIONS

6.1: Conclusion

In Zambia, learners generally perform poorly in Mathematics in both class tests and national examinations. This situation has been indicated by MoE (1996). Haambokoma *et al.* (2002) reported that teachers were still following the traditional scope of sequence approach to curriculum, which emphasises drill and practice of isolating Mathematical concepts, failing to produce learners with enhanced levels of higher-order thinking and problem-solving abilities.

This study has revealed the important progress made by Mathematics educators and researchers in clarifying the differences among perceptions, beliefs and attitudes and between these and other related constructs such as confidence, self-concept and self-efficacy (McLeod, 1992). Such progress could provide an excellent starting point for Mathematics educators seeking to understand factors affecting their learners' performance and learning.

This study has also revealed that in general, learners in the Copperbelt Province of Zambia have positive perceptions and attitudes towards Mathematics. However, learners have negative perceptions and attitudes in some areas of the subject. The study further reveals that learners regard Mathematics as the most difficult subject to learn. This could be due to the teaching methods teachers are using in schools. From this situation the conclusion is that the learners are ready to learn Mathematics and even perform better than before if only teachers could use methods that enhance the learning of the subject.

This study further revealed that teachers of Mathematics regard Mathematics as a difficult subject that needs a lot of thinking and as a result they are usually not prepared for their lessons. This could be due to their negative attitudes to the teaching of the subject.

The findings of this study also show that perceptions and attitudes of learners impact on their willingness, determination and effort to learning Mathematics. The study has shown that a child with positive perceptions and attitudes towards Mathematics is likely to perform very well in the subject.

In this study it has been noted that some high school teachers indicated that learners develop positive or negative perceptions and attitudes at the primary school level. These assertions need to be verified by conducting a study on the perceptions, attitudes and beliefs of primary school teachers towards the teaching and learning of Mathematics.

These findings are of practical significance as they have implications for teachers. The findings imply that perceptions and attitudes of learners need to be considered by teachers as they plan and institute their teaching in a manner that allows for more learner responsibility, active participation and freedom, in order that the most positive learners' attitudes are present in classrooms.

6.2: Recommendations

This study has a number of findings as indicated in the section on results which are very important to take note of if appropriate measures are to be taken to improve the teaching and learning of Mathematics and education in general. This study suggests the following recommendations;

1. Teachers of Mathematics should use methodologies of teaching that promote positive perceptions and attitudes towards Mathematics in learners. Apart from having sound Mathematical knowledge, teachers must deepen their understanding of the subject; learn to think about academic content from pupils' point of view and present Mathematics lessons in appropriate and engaging ways.

2. In order to bring or encourage teachers to use methods of teaching that fully involve learners in the learning process, the MoE should come up with a deliberate policy or programme that would bring about reforms in the teaching and learning of Mathematics at all levels of the education system. This could be done by first choosing one or two provinces to start pilot projects and hold CPD workshops in actual classrooms with the teachers of Mathematics for a period of about one year. Teachers could then be assessed and certificated or externally accredited.

3. Mathematics educators at all levels and stakeholders like the government, donor agencies and other interested parties should draw up a curriculum that emphasises methodologies of teaching, particularly on perceptual and attitudinal and other non-cognitive variables like self-efficacy, confidence, to

mention just but a few, rather than on Mathematics content as the situation is now. Restructuring the curricula in colleges and universities can help the relevant people do this. Colleges and Universities must teach pre-service teachers with methodologies that are in line with problem-solving approaches.

4. A free Educational Television Channel (ETVC) should be opened in Zambia. On this channel subjects like Mathematics, Science and Technology could be featured. Allowing viewers to ask questions on areas they find difficult to comprehend could help them appreciate the subjects. Such a programme has been introduced in South Africa on 'MindSet Learn' channel. This could be done in Zambia too, by seeking for help from banks, donors, non-governmental organisations and companies like Multi-choice Zambia, mining companies, to mention but a few. Such a channel can help learners, countrywide, to develop positive perceptions, attitudes and value for Mathematics, Science and Technology.

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Appendix A

QUESTIONNAIRE

THE UNIVERSITY OF ZAMBIA
SCHOOL OF EDUCATION

This questionnaire is for Grade 10, 11 and 12 pupils in the year 2006. The questionnaire serves as a tool for conducting a study on the pupils' perceptions and attitudes towards Mathematics on the Copperbelt province of Zambia.

Dear respondent,

I hope you will find it interesting to answer questions in this questionnaire. Your opinion will help the researcher to come up with the rightful information about pupil perceptions and attitudes towards Mathematics.

The questionnaire is anonymous and your answers to this questionnaire will be kept strictly confidential. The results of the research will strictly be used for research purposes only. I request you to answer the questions as accurately as possible, by this I mean, you should give real and true answers.

Thank you for your cooperation in this matter. For further information or clarifications, you can contact the researcher on the address below;

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PERCEPTIONS AND ATTITUDES TOWARDS MATHEMATICS QUESTIONNAIRE

Instructions:

This questionnaire is in three parts, the first part has questions about you, the second part has statements about your perceptions of mathematics and the third part has statements about your attitudes towards mathematics.

In (1) put a tick in the box that is appropriate to your response or fill in the blank spaces. And in (2) and (3) Read each item carefully and put a tick (√) underneath the column that best expresses your feeling about each statement.

1. PERSONAL DATA

Question 1.1

Gender	
Male	
Female	

Question1.2 Age: .....

Question 1.3 Grade: .....

Question 1.4

At which school are you?	
Mindolo High School	
Chingola High School	
Kantanshi High School	
Kansenshi High School	

Question 1.5

What subjects do you like learning most? Rank them according to preference

1st [.....]

2nd [.....]

3rd [.....]

4 th [.....]

5 th [.....]

6 th [.....]

7 th [.....]

8 th [.....]

Question 1.4

Which subjects do you find most difficult to learn? Rank them according to difficult. 1st [.....]

2nd [.....]

3rd [.....]

4 th [.....]

5 th [.....]

6 th [.....]

7 th [.....]

8 th [.....]

2. YOUR PERCEPTIONS ABOUT MATHEMATICS

Put a tick (√) in the appropriate box that suits your response to the given statement.

Example: 'Girls like mathematics'

If your answer is "Strongly Agree" Put a tick underneath "Strongly Agree" as shown below;

Statement	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
Girls like mathematics	√				

	STATEMENTS	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1	Mathematics is interesting.					
2	Mathematics is easy to understand.					
3	Mathematics is too difficult for me.					
4	Mathematics is full of unreal ideas.					
5	Mathematics is for the gifted only.					
6	Mathematics is more demanding than other subjects.					
7	There are too many facts to learn about Mathematics.					
8	Mathematics is full of symbols that are fascinating.					
9	Mathematics is useful in our life.					
10	Mathematics is not good for people.					
11	I don't enjoy learning Mathematics.					
12	Mathematics is worth doing whether or not you want to be a Mathematician.					
13	Mathematical language is difficult to understand.					
14	All young Zambians should study Mathematics.					

3. YOUR ATTITUDE TOWARDS MATHEMATICS

Put a tick (√) in the appropriate box that suits your response to the given statement.

	STATEMENTS	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1	I request for Mathematics books During my free time.					
2	Given a choice between going for recess or working at a Mathematical activity, I would choose to do the mathematical activity.					
3	Given a Mathematical problem I can volunteer to do research.					
4	I don't feel like attending Mathematics lessons all the time.					
5	I am very interested to learn all I can in Mathematics.					
6	I fail to express my opinions in Mathematics lessons.					
7	Mathematics syllabus 'D' is too difficult to learn.					
8	Mathematics shouldn't have been compulsory in the secondary school.					
9	Studying Mathematics really demands too much of me.					
10	Success in Mathematics gives many opportunities in finding a job or place in a college.					
11	I will study Mathematics in future.					
12	Parents regard Mathematics as the least important subject.					
13	Mathematics is full of guess work.					
14	Most Mathematics teachers make Mathematics difficult.					

Thank you for completing the questionnaire.
The questionnaire should be returned to the researcher.

Appendix B

FOCUS GROUP INTERVIEW SCHEDULE (FOR LEARNERS)

1. Which subject do you like most to learn?
2. Why do you like this subject? (Many other questions may be posed after this question and will depend on the participant's response.)
3. How would you define the subject Mathematics?
4. How do you regard the subject of Mathematics, is it a good or bad subject to learn? If it is a good/bad subject to learn, what do you think makes the subject to be good/bad?
5. When it is time to learn Mathematics, how do you feel.

Appendix C

FOCUS GROUP INTERVIEW SCHEDULE (TEACHERS OF MATHEMATICS)

1. How is the performance of pupils in Mathematics at this school?
2. If it is good/bad, what do you think is the cause of this good/bad performance by learners?
3. How do you think learners regard Mathematics?
4. How do learners react to the learning of Mathematics?
5. What causes learners to react in this way?

Appendix D - 1

Frequencies of Learners' Responses on Perception Statements

Table 4.4a: Statement 1: Mathematics is interesting.

Value	Freq.	%	Valid %
1	01	01.0	01.0
2	02	02.1	02.1
3	06	06.1	06.3
4	22	22.7	23.2
5	64	66.0	67.4
Missing Freq.	02	02.1	0.00
Total	97	100	100

Table 4.4b: Statement 2: Mathematics is easy to understand.

Value	Freq.	%	Valid %
1	09	09.3	09.6
2	21	21.6	22.3
3	11	11.3	11.7
4	29	30.0	30.8
5	24	24.7	25.6
Missing Freq.	03	03.1	00.0
Total	97	100	100

Table 4.4c - Statement 3: Mathematics is too difficult for me.

Value	Freq.	%	Valid %
1	35	36.1	36.1
2	27	27.8	27.8
3	09	09.3	09.3
4	13	13.4	13.4
5	13	13.4	13.4
Missing Freq.	00	00.0	00.0
Total	97	100	100

Table 4.4d - Statement 4: Mathematics is full of unreal ideas.

Value	Freq.	%	Valid %
1	05	05.2	05.4
2	05	05.2	05.4
3	10	10.3	10.8
4	24	24.7	25.7
5	49	50.5	52.7
Missing Freq.	04	04.1	00.0
Total	97	100	100

Table 4.4e - Statement 5: Mathematics is for the gifted only.

Value	Freq.	%	Valid %
1	09	09.2	09.5
2	04	04.1	04.2
3	04	04.1	04.2
4	20	20.6	21.1
5	58	59.9	61.0
Missing Freq.	02	02.1	00.0
Total	97	100	100

Table 4.4f - Statement 6: Mathematics is more demanding than other subjects.

Value	Freq.	%	Valid %
1	41	42.4	42.7
2	30	30.9	31.2
3	06	06.2	06.3
4	11	11.3	11.5
5	08	08.2	08.3
Missing Freq.	01	01.0	00.0
Total	97	100	100

Table 4.4g - Statement 7: There are too many facts to learn about Mathematics.

Value	Freq.	%	Valid %
1	38	39.2	39.6
2	34	35.1	35.4
3	09	09.3	09.4
4	07	07.2	07.3
5	08	08.2	08.3
Missing Freq.	01	01.0	00.0
Total	97	100	100

Table 4.4h - Statement 8: Mathematics is full of symbols that are fascinating.

Value	Freq.	%	Valid %
1	08	08.2	08.6
2	24	24.7	25.8
3	11	11.3	11.8
4	29	30.0	31.2
5	21	21.7	22.6
Missing Freq.	04	04.1	00.0
Total	97	100	100

Table 4.4i - Statement 9: Mathematics is useful in our life.

Value	Freq.	%	Valid %
1	07	07.2	07.2
2	03	03.1	03.1
3	02	02.1	02.1
4	19	19.6	19.6
5	66	68.0	68.0
Missing Freq.	00	00.0	00.0
Total	97	100	100

Table 4.4j - Statement 10: Mathematics is not good for people.

Value	Freq.	%	Valid %
1	03	03.1	03.2
2	01	01.0	01.0
3	02	02.1	02.1
4	11	11.3	11.6
5	78	80.4	82.1
Missing Freq.	02	02.1	00.0
Total	97	100	100

Table 4.4k - Statement 11: I don't enjoy learning Mathematics.

Value	Freq.	%	Valid %
1	09	09.3	09.3
2	03	03.1	03.1
3	01	01.0	01.0
4	24	24.8	24.8
5	58	59.8	59.8
Missing Freq.	00	00.0	00.0
Total	97	100	100

Table 4L - Statement 12: Mathematics is worth doing whether or not you want to be a Mathematician.

Value	Freq.	%	Valid %
1	09	09.3	09.6
2	11	11.3	11.7
3	13	13.4	13.8
4	27	27.8	28.7
5	35	36.1	37.2
Missing Freq.	03	03.1	00.0
Total	97	100	100

Table 4.4m - Statement 13: Mathematical language is difficult to understand.

Value	Freq.	%	Valid %
1	10	10.3	10.4
2	17	17.5	17.7
3	12	12.4	12.5
4	26	26.9	27.1
5	30	30.9	31.3
Missing Freq.	01	01.0	00.0
Total	97	100	100

Table 4.4n - Statement 14: All young Zambians should study Mathematics.

Value	Freq.	%	Valid %
1	05	05.2	05.2
2	01	01.0	01.0
3	06	06.2	06.2
4	21	21.6	21.6
5	64	66.0	66.0
Missing Freq.	00	00.0	00.0
Total	97	100	100

Appendix D-2

Frequencies of learners' responses on Attitude statements

Table 4.7a:Statement 1: I request for Mathematics books during my free time.

Value	Freq.	%	Valid %
1	05	05.1	05.3
2	05	05.1	05.3
3	02	02.1	02.1
4	25	25.8	26.7
5	57	58.8	60.6
Missing Freq.	03	03.1	00.0
Total	97	100	100

Table 4.7b: Statement 2: Given a choice between going for recess or working at a Mathematical activity, I would choose to do the Mathematical activity.

Value	Freq.	%	Valid %
1	10	10.3	10.5
2	11	11.3	11.6
3	08	08.2	08.5
4	36	37.2	37.9
5	30	30.9	31.6
Missing Freq.	02	02.1	00.0
Total	97	100	100

Table 4.7c: Statement 3: Given a Mathematical problem I can volunteer to do research.

Value	Freq.	%	Valid %
1	08	08.2	08.5
2	03	03.1	03.2
3	08	08.2	08.5
4	37	38.2	39.4
5	38	39.2	40.4
Missing Freq.	03	03.1	00.0
Total	97	100	100

Table 4.7d: Statement 4: I dont feel like attending Mathematics lessons all the time.

Value	Freq.	%	Valid %
1	04	04.1	04.2
2	06	06.2	06.2
3	05	05.2	05.2
4	24	24.7	25.0
5	57	58.8	59.4
Missing Freq.	01	01.0	00.0
Total	97	100	100

Table 4.7e: Statement 5: I am very interested to learn all I can in Mathematics.

Value	Freq.	%	Valid %
1	05	05.2	05.2
2	01	01.0	01.1
3	01	01.0	01.1
4	19	19.6	20.0
5	69	71.1	72.6
Missing Freq.	02	02.1	00.0
Total	97	100	100

Table 4.7f: Statement 6: I fail to express my opinions in Mathematics.

Value	Freq.	%	Valid %
1	14	14.4	14.4
2	18	18.6	18.6
3	10	10.3	10.3
4	34	35.1	35.1
5	21	21.6	21.6
Missing Freq.	00	00.0	00.0
Total	97	100	100

Table 4.7g: Statement 7: Mathematics syllabus 'D' is too difficult to learn.

Value	Freq.	%	Valid %
1	10	10.3	10.3
2	10	10.3	10.3
3	11	11.3	11.3
4	32	33.0	33.0
5	34	35.1	35.1
Missing Freq.	00	00.0	00.0
Total	97	100	100

Table 4.7h: Statement 8: Mathematics shouldn't have been compulsory in the secondary school.

Value	Freq.	%	Valid %
1	15	15.5	15.8
2	10	10.3	10.5
3	01	01.0	01.1
4	16	16.5	16.8
5	53	54.6	55.8
Missing Freq.	02	02.1	00.0
Total	97	100	100

Table 4.7i: Statement 9: Studying Mathematics really demands too much of me.

Value	Freq.	%	Valid %
1	22	22.7	23.1
2	30	30.9	31.6
3	04	04.1	04.2
4	20	20.6	21.1
5	19	19.6	20.0
Missing Freq.	02	02.1	00.0
Total	97	100	100

Table 4.7j: Statement 10: Success in Mathematics gives many opportunities in finding a job or place in a college.

Value	Freq.	%	Valid %
1	00	00.0	00.0
2	03	03.1	03.1
3	03	03.1	03.1
4	27	27.8	27.8
5	64	66.0	66.0
Missing Freq.	00	00.0	00.0
Total	97	100	100

Table 4.7k: Statement 11:I will study Mathematics in future.

Value	Freq.	%	Valid %
1	14	14.4	14.7
2	14	14.4	14.7
3	14	14.4	14.7
4	26	26.8	27.5
5	27	27.9	28.4
Missing Freq.	02	02.1	00.0
Total	97	100	100

Table 4.7L:Statement 12: Parents regard Mathematics as the least important Subject.

Value	Freq.	%	Valid %
1	15	15.5	15.8
2	17	17.5	17.9
3	08	08.2	08.4
4	30	30.9	31.6
5	25	25.8	26.3
Missing Freq.	02	02.1	00.0
Total	97	100	100

Table 4.7m: Statement 13: Mathematics is full of guesswork.

Value	Freq.	%	Valid %
1	03	03.1	03.2
2	05	05.2	05.3
3	02	02.1	02.1
4	27	27.8	28.8
5	57	58.7	60.6
Missing Freq.	03	03.1	00.0
Total	97	100	100

Table 4.7n: Statement 14: Most Mathematics teachers make Mathematics difficult.

Value	Freq.	%	Valid %
1	20	20.6	21.3
2	10	10.3	10.6
3	09	09.3	09.6
4	20	20.6	21.3
5	35	36.1	37.2
Missing Freq.	03	03.1	00.0
Total	97	100	100

APPENDIX D

Table D_1

Worksheet for Reliability according to Split-half method as adopted from Mulder (1996:212)

Learner responses on their Perceptions of Mathematics in the pilot study.

	Statements (items)														TOR	X	Y			
Resp..	1	2	3	4	5	6	7	8	9	10	11	12	13	14		Even	Odd	X^2	Y^2	XY
1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	11	05	06	25	36	30
2	1	1	1	1	1	1	0	0	1	1	1	1	1	1	12	06	06	36	36	36
3	0	0	0	1	0	0	1	0	0	0	0	1	0	0	03	02	01	04	01	02
4	1	0	0	1	1	0	0	1	1	1	0	1	0	1	08	05	03	25	09	15
5	1	1	1	1	1	0	1	0	1	1	1	0	1	1	11	04	07	16	49	28
6	1	1	1	1	1	1	0	0	0	1	1	0	1	1	10	05	05	25	25	25
7	1	0	1	0	0	0	0	0	0	1	1	1	0	1	06	03	03	09	09	09
8	1	0	1	1	1	0	1	0	1	1	1	0	0	1	09	03	06	09	36	18
9	1	1	1	1	1	1	0	1	1	1	1	1	1	1	13	07	06	49	36	42
10	0	1	0	0	1	0	0	0	1	1	0	1	1	1	07	04	03	16	09	12
11	1	0	1	1	1	1	0	1	1	1	0	0	0	1	09	05	04	25	16	20
12	1	1	1	0	0	0	0	1	1	1	1	1	1	1	10	05	05	25	25	25
13	1	0	0	0	0	0	0	1	0	0	0	0	0	0	02	01	01	01	01	01
14	1	0	1	1	1	0	0	1	1	1	1	0	0	1	09	04	05	16	25	20
15	1	1	1	1	1	0	0	0	1	1	1	1	1	1	11	05	06	25	36	30
16	1	1	1	1	1	1	0	0	1	1	0	1	0	1	10	06	04	36	16	24
17	1	1	1	1	1	0	0	0	1	1	1	0	1	1	10	04	06	16	36	24
18	1	0	1	1	1	0	0	1	1	1	1	1	0	0	09	04	05	16	25	20
19	1	0	1	1	1	0	0	0	0	1	1	0	1	1	08	03	05	09	25	15
20	1	0	1	1	1	0	1	1	1	1	1	1	0	1	11	05	06	25	36	30
21	1	0	1	0	1	0	0	1	0	1	0	0	1	1	07	03	04	09	16	12
22	1	0	1	1	1	0	0	1	1	1	1	1	0	1	10	05	05	25	25	25
23	1	1	0	1	1	0	0	0	1	1	1	1	0	1	09	05	04	25	16	20
24	1	1	1	1	1	0	1	0	1	1	1	1	1	1	12	05	07	25	49	35
25	1	1	1	1	1	0	0	0	1	1	1	0	1	1	10	04	06	16	36	24
N(25)	23	13	20	20	21	05	05	10	19	23	18	15	13	22	227	108	119	508	629	542

Table D_1 shows which items were correctly answered by the learners in the pilot study. There are also two further columns added which show what scores are obtained in the two halves of the test, even numbers and odd numbers. The correlation between the scores for the two halves of the test is as follows;

$$r = \frac{N\Sigma XY - \Sigma X \Sigma Y}{\sqrt{[N\Sigma X^2 - (\Sigma X)^2]\,[N\Sigma Y^2 - (\Sigma Y)^2]}}$$

Substituting the values from the table we have;

$$r = \frac{25(542) - (108)(119)}{\sqrt{[25(508) - (108)^2 - [25(629) - (119)^2]}}$$

$$r = \frac{698}{1272.9116}$$

$$r = 0.5483$$

The effective length of the test shortened by dividing it into two parts, and provision is made for the fact that the test is actually twice long. The Spearman-Brown formula indicates how the reliability of a test is increased were it expanded by identical items. The Spearman-Brown formula is;

$$r_{tt} = \frac{nr}{1 + (n - 1)r}$$

Where; r_{tt} = reliability coefficient of the expanded test.
r = reliability coefficient of the shorter test.
n = by how many times the expanded test is as long as the shorter test.

In the above split-half, n = 2 and the formula is amended to;

$$r_{tt} = \frac{2r}{1 + r}$$

$$\text{Therefore } r_{tt} = \frac{2(0.5483)}{1.05483} = 0.7083.$$

The reliability of the test is therefore 0.7083 .

Table D_2
Worksheet for reliability according to Split-half method as adopted from Mulder (1996:212).
Learner responses on their Attitudes towards Mathematics in the pilot study.

	Statements (items)															X	Y			
Resp.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	TOR	Even	Odd	X^2	Y^2	XY
1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	11	06	05	36	25	30
2	1	1	1	1	1	1	1	1	1	1	1	1	1	0	13	06	07	36	49	42
3	1	0	0	0	1	0	1	1	0	1	0	0	0	1	06	03	03	09	09	09
4	0	0	0	0	1	0	1	0	0	0	0	1	1	0	04	01	03	01	09	03
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14	07	07	49	49	49
6	1	1	1	1	1	1	1	0	1	1	1	1	1	1	13	06	07	36	49	42
7	1	1	1	0	1	0	1	1	0	1	0	1	1	0	09	04	05	16	25	20
8	1	1	1	1	1	1	1	1	0	0	1	1	1	1	12	06	06	36	36	36
9	1	1	1	1	1	1	1	1	1	1	0	1	1	1	13	07	06	49	36	42
10	0	0	0	1	1	0	0	0	0	1	0	0	1	1	05	03	02	09	04	06
11	1	1	1	0	1	0	0	0	0	1	1	1	1	1	09	04	05	16	25	20
12	0	0	1	1	1	1	1	1	0	1	0	1	1	1	10	06	04	36	16	24
13	0	0	0	1	1	0	0	0	0	0	0	0	0	0	02	01	01	01	01	01
14	1	1	1	1	1	0	1	0	0	1	0	1	1	1	10	05	05	25	25	25
15	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14	07	07	49	49	49
16	1	1	0	1	1	1	1	1	1	1	1	1	1	1	13	07	06	49	36	42
17	1	1	1	0	1	1	1	1	0	1	1	1	1	1	12	06	06	36	36	36
18	1	1	0	1	1	0	0	0	1	1	0	1	1	1	09	05	04	25	16	20
19	1	0	1	1	1	1	1	1	0	1	1	1	1	1	12	06	06	36	36	36
20	1	1	1	1	1	1	0	1	0	1	1	0	1	1	11	06	05	36	25	30
21	1	0	1	1	1	0	1	0	0	1	0	0	0	1	07	03	04	09	16	12
22	1	1	1	1	1	1	1	1	1	1	0	1	1	1	13	07	06	49	36	42
23	1	1	0	1	1	1	0	1	0	1	0	1	1	0	09	06	03	36	09	18
24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14	07	07	49	49	49
25	1	1	1	1	1	1	1	1	1	1	0	1	1	0	12	06	06	36	36	36
N(25)	21	18	18	20	25	16	19	17	10	22	12	19	21	19	257	127	126	721	702	703

From Table D_2 we have;

$$r = \frac{N\Sigma XY - \Sigma X \Sigma Y}{\sqrt{[N\Sigma X^2 - (\Sigma X)^2]\,[N\Sigma Y^2 - (\Sigma Y)^2]}}$$

Substituting the values from the table we have;

$$r = \frac{25(703) - (127)(126)}{\sqrt{[25(721) - (127)^2 - [25(702) - (126)^2]}}$$

$$r = \frac{1573}{1781.5454}$$

$$r = 0.8829$$

The effective length of the test shortened by dividing it into two parts, and provision is made for the fact that the test is actually twice long. The Spearman-Brown formula indicates how the reliability of a test is increased were it expanded by identical items. The Spearman-Brown formula is;

$$r_{tt} = \frac{nr}{1 + (n - 1)r}$$

Where; r_{tt} = reliability coefficient of the expanded test.

r = reliability coefficient of the shorter test.
n = by how many times the expanded test is as long as the shorter test.

In the above split-half, n = 2 and the formula is amended to;

$$r_{tt} = \frac{2r}{1 + r}$$

$$\text{Therefore } r_{tt} = \frac{2(0.8829)}{1.8829} = 0.9378$$

The reliability of the test is therefore 0.9378 .

APPENDIX F

The Analysis of Variance (ANOVA) for the four schools in which the study was conducted on learners' Perceptions of Mathematics: according to their summed up scores.

Kantanshi			Chingola			Mindolo			Kansenshi	
Score X_1	$(X_1)^2$		Score X_2	$(X_2)^2$		Score X_3	$(X_3)^2$		Score X_4	$(X_4)^2$
57	3247		37	1369		50	2500		53	2809
60	3600		38	1444		55	3025		50	2500
29	841		53	2809		39	1521		53	2809
44	1930		50	2500		42	1764		53	2809
57	3247		42	1764		50	2500		51	2601
56	3136		39	1521		66	4356		48	2304
43	1849		54	2916		58	3364		62	3844
48	2304		52	2704		59	3481		57	3249
67	4489		54	2916		54	2916		50	2500
45	2025		52	2704		50	2500		57	3249
50	2500		63	3969		57	3249		57	3249
25	625		50	2500		58	3364		52	2704
53	2809		54	2916		58	3364		46	2116
59	3481		55	3025		52	2704		48	2304
51	2601		50	2500		56	3136		56	3136
58	3364		30	900		46	2116		49	2401
51	2601		54	2916		51	2601		23	529
51	2601		51	2601		53	2809		49	2401
58	3364		55	3025		52	2704		60	3600
43	1849		54	2916		49	2401		53	2809
55	3025		37	1369		54	2916		54	2916
54	2916		56	3136		46	2116		55	3025
61	3721		57	3249		59	3481		56	3136
55	3025		41	1681		-			47	2209
44	1930		-			-			61	3721
N_i=25	$\sum(X_1)^2$ 67096		N_2= 24	$\sum(X_2)^2$ 59350		N_3 =23	$\sum(X_3)^2$ 64888		N_4 =25	$\sum(X_4)^2$ 68930

Note: N_i = the total number of respondents in a school where i = 1, 2, 3, 4.

$N = N_1 + N_2 + N_3 + N_4$

- blank space means the respondent withdrew from the interviews (i.e. did not respond back).

ONEWAY ANALYSIS OF VARIANCE (ANOVA) OF LEARNERS' PERCEPTION

1). Testing Problem

H_o: $x_1 = x_2 = x_3 = x_4$

H_1: All the means are not equal

2). Test Statistic

$$F = \frac{MSTR}{MSE}$$

3). Critical Region

$f_{cal} > f_{\alpha}(K-1, N-k) = f_{0.05}(3, 93)$

$\Rightarrow f_{cal} > 2.70$

4). Calculation

$$SST = \sum_{i=1}^{K} \sum_{j=1}^{n_i} X^2_{ij} - \frac{X^2..}{N}$$

$$= 57^2 + 60^2 + \ldots + 61^2 - \frac{(4966)^2}{97}$$

$$= 260264 - \frac{24661156}{97}$$

$$SST = 6025.2784$$

$$SSTR = \frac{(\sum_{i=1}^{N} X)^2}{}$$

$$= \frac{(1274)^2}{25} + \frac{(1178)^2}{24} + \frac{(1214)^2}{23} + \frac{(1300)^2}{25} - \frac{(4966)^2}{97}$$

$$= 64923.04 + 57820.16667 + 64078.08696 + 67600 - 254238.7216$$

$$= 254421.2936 - 254238.7216$$

$$SSTR = 182.5720$$

Therefore, SSE = SST - SSTR

= 6025.2784 - 182.5720

SSE = 5842.7064

Source	SS	df	MS	F
Model	182.572	3	60.857	0.969
Error	5842.706	93	62.825	
Calculated Total	6025.278	96		

Conclusion

$f_{cal} = 0.969$ and $f_{\alpha} = 2.70 \Rightarrow f_{cal} < f_{\alpha}$ so we do not reject H_o at the 0.05 level of significance and conclude that the average perceptions of learners in the four schools are not different.

APPENDIX G

The Analysis of Variance (ANOVA) for the four schools in which the study was conducted on learners' Attitudes towards Mathematics: according to their summed up scores.

Kantanshi		Chingola		Mindolo		Kansenshi	
Score X_1	$(X_1)^2$	Score X_2	$(X_2)^2$	Score X_3	$(X_3)^2$	Score X_4	$(X_4)^2$
53	2809	43	1849	53	2809	56	3136
60	3600	43	1849	51	2601	50	2500
44	1936	55	3025	57	3249	54	2916
33	1089	47	2209	48	3304	63	3969
63	3969	42	1764	51	2601	55	3025
64	4096	48	2304	56	3136	48	2304
49	2401	51	2601	45	2025	43	1849
58	3364	53	2809	66	4356	55	3025
63	3969	49	2401	56	3136	62	3844
33	1089	56	3136	53	2809	63	3969
52	2704	60	3600	42	1764	59	3481
24	576	53	2809	58	3364	58	3364
55	3025	49	2401	62	3844	49	2401
67	4489	53	2809	53	2809	52	2704
62	3844	48	2304	48	3304	58	3364
59	3481	46	2116	44	1936	52	2704
51	2601	48	2304	59	3481	54	2916
62	3844	58	3364	55	3025	60	3600
57	3249	54	2916	55	3025	53	2809
45	2025	47	2209	55	3025	61	3721
64	4096	60	3600	62	3844	53	2809
55	3025	52	2704	43	1849	53	2809
67	4489	38	1444	60	3600	58	3364
58	3364	44	1936	-		52	2704
52	2704	-		-		57	3249
$N_1=25$	$\sum (x_1)^2$ 75838	$N_2=24$	$\sum (x_2)^2$ 60463	$N_3=23$	$\sum (x_3)^2$ 66896	$N_4=25$	$\sum (x_4)^2$ 76536

Note: N_i = the total number of respondents where i = 1, 2, 3, 4

$N = N_1 + N_2 + N_3 + N_4$

- blank space means the respondent withdrew from the interviews (i.e. did not respond back).

ONEWAY ANALYSIS OF VARIANCE (ANOVA) OF LEARNERS' ATTITUDES TOWARDS MATHEMATICS

1). Testing Problem

H_o: $x_1 = x_2 = x_3 = x_4$

H_1: All the means are not equal.

2). Test Statistic

$$F = \frac{MSTR}{MSE}$$

3). Critical Region

$f_{cal} > f_\alpha (K-1, N-k) = f_{0.05}(3, 93)$

$\Rightarrow f_{cal} > 2.70$

4). Calculation

$$SST = \sum_{i=1}^{K} \sum_{j=1}^{n_i} X^2_{ij} - \frac{X^2_{..}}{N}$$

$$= 53^2 + 60^2 + \ldots + 57^2 - \frac{(5157)^2}{97}$$

$$= 279733 - \frac{26594649}{97}$$

$$SST = 5561.3608$$

$$SSTR = \left(\sum_{i=1}^{N} X\right)^2$$

$$= \frac{(1350)^2}{25} + \frac{(1197)^2}{24} + \frac{(1232)^2}{23} + \frac{(1378)^2}{25} - \frac{(5157)^2}{97}$$

$$= 72900 + 59700.375 + 65992.348 + 75955.360 - 274171.639$$

$$= 274548.083 - 274171.639$$

$$SSTR = 376.444$$

Therefore, SSE = SST - SSTR

= 5561.361 - 376.444

SSE = 5184.917

Source	SS	df	MS	F
Model	376.444	3	125.481	2.251
Error	5184.917	93	55.752	
Calculated Total	5561.361	96		

Conclusion

$f_{cal} = 0.969$ and $f_{\alpha} = 2.70 \Rightarrow f_{cal} < f_{\alpha}$ so we do not reject H_0 at the 0.05 level of significance and conclude that the average attitudes of learners in the four schools are not different.