NUMERICAL ANXIETY:

TRENDS AND EFFECT ON MATHEMATICS PERFORMANCE IN
ZAMBIAN PRIMARY SCHOOL CHILDREN

By

Lindiwe Elizabeth Makubalo

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ABSTRACT

Numerical anxiety was investigated in the light of poor mathematics achievement and negative attitudes held by learners towards mathematics. Two instruments, a two dimensional scale measuring general anxiety and numerical anxiety, and a mathematics achievement test comprising items specific to a grade and items identical to all grades, were administered to a total of 270 third, fifth and seventh grade school children.

Numerical anxiety, which was found to be present in varying degrees in the sample has been described as an A - state factor distinct from general anxiety. Results also indicate developmental trends in numerical anxiety; that is, it increases progressively through fifth and seventh grades. Further, contrary to predicted results, negative correlations were obtained between numerical anxiety and mathematics performance in the lower grades. This result is explained in terms of the coping strategy employed by learners. Differences due to sex and type of school were that girls obtained higher numerical anxiety scores at each grade while children irrespectively of sex from schools situated in lower density areas obtained higher numerical anxiety scores. These findings have been discussed in terms of primary and secondary emotional factors that may affect levels of numerical anxiety.

Implications of findings for educators are discussed and suggestions for future research are outlined.
DECLARATION;

I declare that this THESIS has not previously been submitted, even in part, to this or any other University. Where reference is made to other work, acknowledgements have been given.

Author: __________________________

Lindiwe Elizabeth Makubalo
(i)

Approval Page

This dissertation of Lindiwe Elizabeth Makubalo is approved as fulfilling part of the requirements for the award of the master of Arts degree in Educational Psychology of the University of Zambia.

William Leslie Langa Makubalo
and my mother
Alice Nyoni Makubalo

Signed

1. [Signature]

2. [Signature]

3. [Signature]
dedicated to......

my father (late)
William Leslie Langa Makubalo
and my mother
Alice Nyoni Makubalo
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CHAPTER 1

INTRODUCTION

Section(i) Context of the Problem.

Mathematics is a curious subject, psychologically. It has succeeded in dividing people into two camps - the able and the disabled. It is not uncommon to hear the statement "I just can't do maths", as though one is born with mathematic inability. Skemp (1971) writes,

Just as there are said to be cat-lovers and dog lovers: there are those who can do mathematics and there are those who cannot, or think they cannot, and who 'block' at the first drop of a symbol (p.1).

Unfortunately, the current status of mathematics education in Zambia, particularly in the learning situation presents a similar picture. It is generally felt that there is a definite problem related to mathematics learning in Zambia, especially since students tend to underachieve in mathematics at almost all levels of education.

Emanalo (1970) found that Zambian students tend to have strong negative feelings towards the subject. He concluded, "There is no doubt that mathematics is feared and hated by a majority of those who try it from primary school to university" (p.3). Further, Emanalo reported that the most common response to the question "Do you like mathematics?" is "I hate it", "I fear it", "I dread it". These responses seem to be related to feelings of anxiety, it is this that has prompted this study to investigate anxiety directed towards mathematics or numerical anxiety. Better knowledge and a clearer understanding of this problem in mathematics learning may help to deal with the problem.

Other factors which further emphasize the importance of this study are; first mathematics as well as being essential for daily life is an essential tool for science, technology, commerce, agriculture and other fields closely related to national development. Adequate skills in these
areas can only be adopted if pupils react positively, concentrate and do well in mathematics at the very basic elementary level.

Further, this study may go a long way in answering questions related to mathematics achievement and teaching raised by educators. It may open new horizons for curriculum planners who are intent on promoting better academic performance. Finally, and more generally, it will serve as a reference to the general public who have placed themselves in the 'mathematically disabled' camp.

The purpose of this study therefore, is to investigate empirically the phenomenon of numerical anxiety, its relationship to mathematics performance, and developmental trends at 3rd, 5th and 7th grade levels of education. The study also proposes to investigate the relationship between numerical and general anxiety.

In the next section, numerical anxiety will be defined followed by a review of anxiety theory, at the end of which an alternative view will be proposed in relation to numerical anxiety. This will be followed by a review of background studies and other literature related to numerical anxiety and mathematics achievement. Finally, a statement of the hypothesis of this study will be made.

Section(ii)  Review of Literature.

The search for factors which determine performance in academic situations has tended to go in two directions. In one direction has been the search for congenital factors such as ability (Naylor, 1972) and in the other has been the search for non-intellectual factors such as personality and related variables or traits.
Research on intellectual factors has had conclusive findings (such as a high intelligence quotient and analytic ability yielding high mathematics achievement, all other things being equal), but the other direction has been inconclusive and often contradictory (Biggs 1962). One reason for this is the definitional ambiguity of some of these non-intellectual variables. Another reason is that it is often difficult to make sound conclusions from studies that have been too general because they attempt to investigate many interrelated phenomena at once.

In the area of mathematics ability, factor analytic studies of mathematics performance have shown that there are two types of factors which account for the variance and affective or emotional factors (Biggs 1959). This study addresses only one of the non-intellectual determinants of performance, namely anxiety, particularly as it relates to achievement in mathematics. Consequently, this research focuses on Numerical Anxiety.

Anxiety is the general term used to describe an individual's reaction to stressful situations. Spielberger (1972) has identified anxiety as a complex psychological process. This process is a sequence of affective, psychological and behavioral events which may be initiated by stressful external stimuli perceived and interpreted as dangerous by an individual.

Other definitions of anxiety include the following: "A chronic complex emotional state with apprehension or dread as its most prominent component, characteristic of various and mental disorders" (Drever, 1976, p.17).

"A type of cognitive response marked by self doubt, feeling of inadequacy and blame" (Sarason, 1972, p.15). "A response to the mismatch between demands of environment and the behaviors available in a persons repertoire" (Costello, 1976, p.45).
Numerical anxiety which is the chief concern in this study, is a relatively recent concept that has arisen from the investigation of anxiety. Numerical anxiety is an emotional response occurring when a person has to do mathematics. "The number anxious child or adult is by definition deeply disturbed when dealing with numbers and arithmetic operations. The child who simply dislikes mathematics thoroughly may not feel particularly anxious or insecure in his performance" (Biggs, 1959, p.18). Individuals who have chronic numerical anxiety are fairly often individuals with the clinical syndrome known as dyscalculia. A dyscalculic person is one with a specific retardation in mathematics (Magne, 1960).

Very few researchers have investigated numerical anxiety per se. Cohen (1976) notes the dearth of literature in this area, and he can only refer the interested reader on the subject to Lynn (1957), Biggs (1959) and Dreger & Aiken (1957). Biggs (1962) pointed out that this area of research has been neglected as only one piece of research by Dreger & Aiken (1957) was available.

Since then only two major studies by Keeling (1978) and James, Hendel and Darwin (1980) have been undertaken. Because of the few studies, one still finds that literature on numerical anxiety, is meagre. The explanation may lie in the difficulties that arise in attempting to isolate numerical anxiety from the large and inter-dependent literature on psychological and psycho-physiological processes.

Having briefly defined anxiety and outlined the major studies on numerical anxiety, we will now focus our attention on anxiety theory before reviewing literature on numerical anxiety in detail.
Anxiety as a drive (Freud, Hull)

A basic assumption of this theory is that organisms are energy systems and that a moderate level of excitation must be maintained within homoesthetic limits of anxiety. Faber (1954) described anxiety as an "energy source" which intensified all reaction tendencies indiscriminately. In deprivation experiments on rats, drive theorists found that drive was necessary for learning as the deprived animal would learn a maze in order to reduce the drive. "The implication of these studies is that the behavior was a regulating mechanism whose function was to eliminate the spurs to action provided by drive state" (Coffer & Appley, 1965, p. 815).

Learning Theory of Anxiety (Spence, Miller & Mowrer)

The learning theory of anxiety is that a neutral event, through association with an unpleasant event (often a painful one) becomes itself unpleasant and elicits anxiety. It is sometimes called conditioned fear. According to this view, a particular situation becomes fear provoking because it has been associated in the past with a traumatic event through a process of generalization. For example, the fear of heights generalizes to thoughts about high places (Coffer & Appley, 1964). Learning theorists are not quite agreed about the position of learning principles in anxiety research, and consequently vary around the same theme or basic principles of learning theory.

Other Theories (Eysenck, Costello, Sarason)

There are several theories that interpret anxiety (in one way or another) as having important properties from both the behavioral and theoretical perspective. To take a brief look at a few of these theories; Eysenck (1957) a behaviourist and learning theorist attempts to introduce
constitutional factors in theory by proposing that people differ constitutionally in relation to autonomic relativity and introversive predisposition. His argument then, goes as follows:

The sympathetic division of the autonomic nervous system mobilizes the body during stress: some people have over-reactive autonomic systems which respond too readily and too intensely; some people are more introverted than others; introverts are conditioned more easily than extraverts; if then a person inherits a too responsive autonomic system and also inherits intraversive tendencies, he will readily learn stress or fear responses. (p.115)

Costello's criticism of drive reduction theory is that drive reduction ought to be seen as a secondary effect rather than the organisms primary aim. The primary source of anxiety is social adaptation, in the organism's bid to develop into higher levels of being. He also rejects the conditioned learning theory because conditioned responses are readily extinguished, hence it is difficult to account for persisting anxiety responses especially in phobias. He states that anxiety can not be conditioned but it can be particularly susceptible to conditioning because it acts as a warning signal for the individual as well as for those occasionally around the anxious individual.

Another popular theory advanced by Mandler and Sarason (1952), is that anxiety primarily acts as a stimulus. According to this view, two sets of responses are made in a learning situation; the task response, which if correct and relevant will lead to a solution to the task, and the felt response which evokes a set of responses that are not task oriented such as feelings of inadequacy, helplessness or defeat. The anxious individual is said to be cautious in order to reduce anxiety, and will carry this learned response to new situations. The feeling of "being pushed" would arouse the latent anxiety response, whereas anxiety would be absent in a 'neutral' situation (where the subject has more than ample
time or is told that he is not really expected to complete in a testing situation). It is these ideas that gave rise to Sarason's Test Anxiety Scale, (Sarason, 1958).

**Anxiety-Performance Interaction**

To now consider the problem of anxiety-performance interactions in the light of the theories reviewed, an eclectic approach, incorporating ideas advanced by Sarason (1976), Eysenck (1965) and Costello, (1976) is being proposed by the author.

Anxiety can act as a generalized drive in certain cases (Spence, 1953), and also as a specific stimulus leading to its own responses (Sarason, 1976 view). In other words, the author is proposing that in as far as anxiety-performance interactions are concerned; anxiety acts as both inhibitor and motivator. It appears as though up to a certain optimum level, (which may vary from individual to individual) anxiety will motivate better performance; but, surpassing that level, it begins to act as an inhibitor to good performance. This relationship of anxiety and performance can be seen from the observation that although a linear function is sometimes obtained between anxiety and performance in research (Bigg's, 1962), in many instances a curvilinear function is obtained. Biggs suggests that this curvilinear function that sometimes emerges is fairly strong evidence for motivating and inhibiting agents at work; with the positive gradient arising from motivating factors and the negative factor from inhibiting agents. He states:

> Eysenck is right in drawing attention to the curvilinearity of anxiety-performance interactions...... it seems that curvilinearity is a compromise between many relevant factors. (p.99)
To take a closer look at this anxiety-performance interaction mentioned above, numerical anxiety can be seen as an anxiety state that is particularly common to individuals with higher susceptibility to anxiety. This is because these individuals have highly reactive autonomic systems that readily respond to stress. Anxiety consists of a pattern or combination of several fundamental emotion-related processes. Heart rate and blood pressure may increase, there is a shift from ergotropic to trophotropic balance in the body through the loss of sympathetic vasomotor tone. There may even be an increased excretion from adrenol medulla. (Izard, 1972). These individuals tend to interpret more stressful situations as threatening (Costello, 1976).

Everyone however, experiences anxiety from time to time. Anxiety can be a useful motivator (such as a threat to lazy students), yet as previously mentioned, after a certain optimum level (a homostatic limit in the individual), anxiety can act as a cognitive inhibitor. It seems as though the occurrence of the inhibiting action of anxiety would occur in cases where the individual has not developed adequate coping strategies that serve to reduce anxiety (threat-avoidance responses). The numerically anxious individual will carry and transfer his responses to any mathematics problem solving situation. The author supports Costello's (1976) suggestion that the anxious individual, when experiencing heightened action of the autonomic nervous system, whether consciously (according to Sarason) or subconsciously (according to Costello) will concentrate on this state rather than on the stressful stimulus. This is the numerically anxious individual's way of 'coping' with anxiety. We will now take a closer look at literature related to numerical anxiety and performance interactions.
Background Studies

Research by Sepie and Keeling (1978) identified numerical anxiety as a factor distinct from general and test anxiety. They also found, by dividing 246 eleven and twelve year olds into three groups; over-achievers, achievers and under-achievers, that numerical anxiety more easily differentiated underachievers from the other two groups.

Perhaps the most recent study that has differentiated numerical anxiety from general anxiety is by Rounds, James, Hendel and Darwin (1980). They developed a mathematics anxiety rating scale (MARS) and using factor analytic studies they identified two anxiety factors related to mathematics. They called these Mathematics Test Anxiety (Similar to Sarasons test anxiety, though specific to the mathematics testing situation) and Numerical Anxiety.

Another study that distinctly identifies numerical anxiety as being separate from general anxiety was reported by Dreger and Aiken (1975), who conducted their study with a college population. The Weschler Intelligence scale, the Manifest Anxiety Scale and three 'number anxiety' items were administered to each subject. Galvanic skin response readings were taken at each of these three sub-tests, for each individual. The findings of this study were that at the arithmetic sub-test, high anxiety scores were obtained. Further, a factor study of manifest anxiety and numerical anxiety found the two to be distinct and separate factors (Biggs, 1959).

Biggs (1959) commented that the Dreger and Aiken study should be considered only as suggestive because the study did not adopt a developmental approach (and developmental trends are more easily identified in children who are
still in the process of learning and developing initial mathematical concepts), and because the testing instrument of three number anxiety items was not adequate.

On the basis of Sepie and Keelings' findings, it perhaps can be expected in the present study that numerical anxiety will emerge distinct or separate from general anxiety, and that numerical anxiety will correlate negatively with achievement in mathematics.

To turn our attention to other literature related to numerical anxiety and mathematics performance; McCandless and Castaneda (1956) using the children's version of Taylors Manifest Anxiety Scale (OMAS) observed that children obtaining high OMAS scores tended to perform badly in mathematics and better in mnemonic skills. It was found by Lynn (1957) that anxiety inhibits mathematics performance in a research conducted among British junior school children.

Kerrick (1955) also working with the Manifest Anxiety Scale administered the adult form of the scale and several scholastic tests to a group of air force trainees. A correlation of -.27 was obtained between Manifest Anxiety and mathematics, although a higher correlation was obtained with word knowledge (-.40). This may be an indicator of a language factor operating in this study. This point is expanded below.

Taking a closer look at the role of language: Bernstein's (1960) study on language carried out in England shows how language patterns, which are related to different ways of experiencing the world, vary across different social systems. Bernstein identified two codes, the Elaborate code and the Restricted code which differ in syntax and function (with the Elaborate code being more denotative and complicated). Serpell (1974), has named these
high (H) and low (L) codes respectively. He states that the Zambian child has to learn the high code or English that is used in school, while the low code or vernacular is used outside school. The child faced with a totally different code at school from home, in many ways fails to convey the sorts of meaning with which he is acquainted. Because of the limitations of the H code, the child is being removed temporarily from what he is, and his background. These conflicts easily induce tension which leads to an anxious state (Herbert, 1974). It is expected then, that language will result in higher numerical anxiety in learning situations where English is used to teach children who have greater dependence on vernacular languages at home.

School climate varies from school to school (Findlayson, 1970). The influence on each school that eventually brings about this variance is the socio-cultural and demographic environment of the school (Swift, 1969). Each community has different ideals, aspirations and expectations for its young. Research by Crandall (1963), Katkovsky et al. (1964) show that parent interest and concern in their children's achievements are basic necessities for achievement behaviors and hard work in children.

In relation to the investigation of a sex factor in numerical anxiety, results of studies conducted by Smith (1952), Sweeney (1953) and Hull (1972) have found girls to be less analytically minded and also to do less well on tests of spatial ability. It is for these reasons, according to Biggs (1962), that girls do not perform as well in mathematics as boys. Although no predictions are made on sex differences and numerical anxiety, this area shall be looked at. It is quite conceivable that numerical anxiety may be a contributing factor to generally poorer mathematics performance among girls.
Finally, Davidson (1950) writing on the psychopathology of mathematics concludes that there is anxiety, poor attitudes and low motivation for mathematics in the United Kingdom than for other subjects. In addition there is a negative correlation between anxiety and mathematics performance. Biggs (1962) in a study on motivation, anxiety and mathematics achievement also observed a definite relationship between learning mathematics and emotional reactions. He writes:

Arithmetic learning is in some sense atypical and this can be seen in the fact that the teaching and lay public alike speak of emotional blockages to mathematics learning and not nearly so rapidly of similar blockage in other subjects (p.13).

Anxiety-distinctions made in Research

There are important personality variations found in anxiety research. Although anxiety is experienced by everyone, it varies in quality and quantity from one individual to another, and within the same person from one situation to another. What draws the line between normal and neurotic anxiety is the individuals ability to adequately deal with stress. The individual who repeatedly experiences threat is anxious most of the time; this is called trait anxiety as distinct from state anxiety (Spielberger, 1972). The definitions of anxiety given by Drever (1976) and Sarason (1972) are in fact defining two forms of anxiety - trait and state anxiety respectively. This indiscriminate use of the term anxiety leads us into a discussion on the distinction between state and trait anxiety, an important classification for the present study.

A - State Anxiety and A - Trait Anxiety

As can be seen from the definitions quoted on pages 3 to 4, there is ambiguity in the conceptualization of anxiety. Where as Drever (1976) calls it a "Chronic complex emotional state...", Sarason, (1972) and Costello (1976) call it a "response". This ambiguity (in conceptual status) arises
from the more or less indiscriminate use of the term 'anxiety' to refer to two different types of concepts. Anxiety is most commonly used to denote a complex reaction or response and is also used in reference to a personality trait. In simple terms, the statement "Mary is anxious" could mean one of two things - Mary is anxious now, or Mary is an anxious person. These are A - state and A - trait dispositions respectively.

Empirical evidence of different types of anxiety concepts emerged from factor analytic studies of Cattell and Scheler (1958, 1961) on trait and state anxiety. State anxiety is a transitory emotional disposition that may be defined in terms of subjective feelings of tension, apprehension, worry and nervousness that are experienced by an individual at a particular moment. This state occurs concomitantly with known stimulus conditions during the study and is therefore probably determined by these stimuli (Lazarus, 1966, Spielberger and Sarason, 1978).

An anxiety trait on the other hand refers to relatively stable individual difference in anxiety proneness. It is said to imply a motive or acquired behaviour disposition that predisposes an individual to perceive a wide range of objectively non-dangerous circumstances as threatening. These are responded to with A - state reactions. It seems to be a characteristic that an individual carries about with him. A - trait reactions do not occur with any known stimulus condition, for example during testing. They are determined by stimulus conditions existing prior to the testing. Spielberger (1966) states that A - trait is assumed to reflect residues of past experience that in a way determine individual differences in anxiety proneness, and that those experiences most influencing ones level of A - trait date back to childhood. A high A - trait individual as a result, is more vulnerable to stress and tends to experience anxiety state reactions with greater intensity and with greater frequency over time than those with low A - trait anxiety levels. In this respect, A - state and A - trait differ
not in the nature of the response really, but rather in the quality, with A-trait individual experiencing more stress than A-state persons.

On the basis of the distinction just made between A-state and A-trait, it is argued here that numerical anxiety is fundamentally an A-state reaction. The A-state reaction serves as a signal that initiates a behaviour sequence designed to avoid or otherwise deal with threat. This is because it represents a response to an anxiety provoking situation (mathematics) rather than being a trait that is carried around by the individual all the time.

It is expected that numerical anxiety will be experienced more often by A-trait individuals. An unpleasant early mathematics learning experience would influence individuals to be threatened by encounters with symbols or figures. The mathematics learning or testing situation, then inspires A-state reactions especially in those individuals who are generally anxious or A-trait.

Following this discussion on State and Trait anxiety, we will now turn our attention to factors operative in mathematics performance in schools. These are Primary and Secondary emotional factors.

**Primary Emotional Factors in Mathematics**

Biggs (1962) suggests that there are primary and secondary emotional factors which may be operative in mathematics performance. Primary factors such as emotional stability and intelligence are deeply rooted in the personality of the individual while secondary factors such as parental influence, and learning strategy are derived as a result of external factors. Secondary factors are thus theoretically within easier reach for correction than primary factors which are largely treated by psychotherapy.
Several studies report the relationship between mathematics performance and personality variables. Butcher, Ainswork and Nisbett (1963) found that self sufficiency and conscientiousness were significantly related to scholastic attainment. Barakat (1950), found a positive correlation between emotional stability and mathematics performance. In relation to adjustment, Cox (1961) found significant positive correlations between social adjustment and academic performance of fifth grade boys. Similarly, Feinberg (1947) obtained negative correlations between arithmetic performance and maladjustment. Coopersmith (1967) found that children with low self esteem tended to perform badly at school in comparison to those with higher esteem. A study by Planks (1950) revealed that insecure children show a definite discrepancy between reasoning and computational scores. Magne (1959) arrived at the conclusion that arithmetic difficulties experienced by children of low intelligence are more often due to the intelligence factor, whilst difficulties experienced by children of higher intelligence are usually due to maladjustment. Magne's work was done among Swedish primary school children.

Besides A - state and A - trait factors, there are other personality variables such as personal adjustment and emotional stability that will influence mathematics performance. These variables cannot be controlled and some variance in findings can be attributed to them.

**Secondary Emotional Factors**

Another set of variables affecting performance in mathematics are referred to as Secondary Emotional Factors. These factors are perhaps the more obvious and easier to recognise in mathematics performance. They include parent and teacher attitudes, parent interest in children's work, teaching methods and school climate. The kind of interpersonal relationship with the teacher is vital as this may subjectively increase the difficulty of
understanding. Skemp (1971) identifies the conflict of two types of authority experienced by the teacher. On one hand, the teacher demands respect and authority and on the other, he is looked upon as the holder of superior knowledge. He then finds it difficult to maintain the former "authority" and not the latter simultaneously. Yet, mathematics learning ought to be based on reason and agreement. A highly authoritative teacher will tend to give rules and expects no "whys". This, Skemp states, is a poor teaching method because there is inadequate conceptual analysis of material on the part of the learner. Magne (1976) also identified the fact that teacher pressure can induce anxiety in the learner.

Biggs (1971) and Williams (1958) emphasise the importance of the correct learning strategies and teaching methods in mathematics. Skemp's (1972) analysis follows this argument: The child who is initially taught mathematics with a heavy dependence on rote memorization is initially gratified because he can reproduce facts easily. As material becomes more difficult, memorization proves to be less efficient. This may cause some anxiety, fear, dread, despair or even bafflement towards mathematics. A circular relationship may result where deep negative feelings towards mathematics, result in poor performance which in turn leads to greater negative attitudes and fear for mathematics. Type of attitude is important, studies such as Biggs (1962) found a relationship between negative attitudes to mathematics and poor performance.

Teacher and parent attitudes towards the child are also very important because of the extensive amount of influence these people have on children. Similarly, parent expectation of children's school attainment will tend to influence performance. Cohen (1976), suggests that socio-economic status may, to some extent, influence scholastic attainment. Children from higher socio-economic status homes will on average achieve better than those from low socio-economic status homes in most school subjects.
From the literature reviewed on secondary emotional factors, it can be expected that in this study, mathematics performance will be influenced by those factors which together build up and form the numerical anxiety state.

Literature reviewed in this chapter on anxiety theories and studies related to numerical anxiety seem to show that Numerical anxiety may be a A - state reaction that is largely influenced by secondary emotional factors. It is proposed that numerical anxiety can best be explained by combining Sarason (1972) and Costello's (1970) theories of anxiety: and that is basically, numerical anxiety is learned over a period of time.

On the basis of literature reviewed, the following hypotheses were formulated:

(i) Numerical anxiety will be present in a sample taken from primary schools in Zambia.

(ii) Numerical anxiety is a factor distinct from general anxiety.

(iii) Average numerical anxiety scores will increase progressively from the third to seventh grade.

(iv) There will be differences in numerical anxiety across the three schools, by grade.

(v) There will be a higher negative correlation between numerical anxiety and mathematics performance at the seventh grade than at the fifth and third grades.

Having stated the hypotheses, we will now proceed to discuss the method that was employed to test these hypotheses.
CHAPTER 2

METHOD

Research Design

In the first stage of this study, a preliminary survey was conducted at an urban Lusaka primary school. Three grades, 3rd, 5th and 7th grade were tested on both a mathematics achievement test, and on an anxiety test. The aim of this study was to give the investigator an opportunity to administer the Children's Manifest Anxiety Scale (CMAS)\(^1\) and obtain information regarding possible difficulties in its administration and comprehensibility of the items. On the basis of results, some items of CMAS were omitted and others paraphrased.

Mathematics Achievement Tests\(^2\) developed to test 3rd, 5th and 7th grade, described in more detail below, were also administered in order to ascertain whether the items included were suited for the grade for which they were constructed. Unsuitable items were omitted from the test. The pretesting also enabled the researcher to determine the time required for test administration.

Research Instruments

a) Three Grade Mathematics Achievement Tests (GMAT), one for each of 3rd, 5th and 7th grades were constructed. They were of roughly equal difficulty relative to what a child is expected to know at the particular grade (this being defined by the mathematics syllabus for that grade). This is the basis of comparison of performance across the three grade levels. Each GMAT of 30 items consisted of two subscales, the Grade Items (G.I) and the Identical Items (I.I) components.

1. See Appendix 1.
2. See Appendix 2.
The test construction involved a thorough and systematic examination of the primary school mathematics syllabus (See Appendix 8) and text-books for each grade. Topics covered at each level are; Numeration and notation, Addition and Subtraction, Multiplication, Division, Number patterns, Equalities and Inequalities, Money, Measurement, Time and Temperature. At 5th grade Factors and Decimals are introduced and at 7th grade Perimeter, Area, Volume, Proportion, Averages, Number bases and Graphs are introduced.

In the tests, each topic was represented by about 3 items. This meant of course that the 7th grade test had fewer than 3 items from each topic because of the greater number of subjects covered. A specification table has been constructed for each GMAT specifying the number of items from each section (see Appendix 6). The number roughly reflects the emphasis given to the different topics during instruction. It was intended, in the test construction exercise, that the first and second terms work, for each grade, be equally represented (third term's work was eliminated as testing was done in the second term).

The identical items (II) component which consisted of ten items was arrived at by a close examination of topics common to all grades (which in fact cover the greater section of each grades material). One or two items (depending upon the weighting of that section in the syllabus), were selected for the (II) component. An interesting observation was that some problems that appear in the 3rd grade text sometimes recur in an identical form in 5th and 7th grade tests. These were the kind of items that were given preference for inclusion in the (II) component of the test.

The GMAT's that were finally arrived at each consisted 30 items, 20 of which were grade items and 10 identical items. After the construction of the tests, they were submitted to mathematics specialists of the Curriculum Development Centre of the Ministry of Education for a final
check as to their suitability for the population for which they were intended. (As no further pre-testing was carried out after construction of the instruments was finalized, no reliability figures were available for these tests).

b) The anxiety scale developed for this study consisted of two factors - General Anxiety (GA) and Numerical Anxiety (NA).

The General Anxiety sub-scale was developed from the Childrens Manifest Anxiety Scale (CMAS) developed by Casteneda, McCandless and Palermo (1953). The Childrens Manifest Anxiety Scale is a 53 item test consisting of 42 anxiety and 11 lie detector items. Lie detector items provided an index of the subjects tendency to falsify answers to anxiety items. Casteneda et al, using a 4th, 5th and 6th grade American sample obtained a test retest reliability of .90 for the anxiety scale and .70 for the lie scale. The present sub-scale (See Appendix 3) is made up of 18 anxiety and 7 lie detector items from CMAS. Items considered unsuitable for the present study on the basis of their cultural bias were changed, reworded or dropped.

As a matter of definition, one might raise a question regarding the adequacy of the general anxiety scale. Biggs (1962) who was faced with a similar problem wrote:

One striking thing about previous work is the non-replicability of the measures of the major independent variable. To test drive theory, Taylor constructed and used MAS; A propose of inhibition theory, Eysenck used his own MPI, while Sarason in his turn tested interfering response theory with GA and TA scores of his own devising, while all these scales undoubtedly intercorrelated significantly, intercorrelation is such, as mandler and Cowen (1958) state in connection with the GA and MAS instruments, as to indicate similarity but not identity of traits measured... (p.292)
The numerical anxiety subscale was developed in part by revising the three items constructed by Dreger and Aiken (1957) (See Appendix 4). An additional twelve items were constructed on the basis of CMAS items. This scale, from the study done by Dreger and Aiken on American college students, appears to tap both emotionality and arousal in mathematics.

In all then, the present Anxiety Scale or 'Questionnaire' for purposes of testing, is a forty item scale including seven lie detector items (numbers 17, 30, 34, 36, 41, 47 and 52), fifteen numerical anxiety items (numbers 3, 7, 10, 13, 17, 18, 20, 23, 26, 30, 32, 34, 37, 40) and eighteen general anxiety items (the rest of the items). The tests employed in this study are summarized in Table 1 below.

<table>
<thead>
<tr>
<th>GRADE</th>
<th>MATHEMATICS ACHIEVEMENT TEST</th>
<th>ANXIETY SCALE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GI</td>
<td>NA</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>20</td>
<td>15</td>
</tr>
</tbody>
</table>

Note: Abbreviated scale names are: (GI) - grade items, (II) - identical items, (NA) - numerical anxiety, (GA) - General anxiety and (LD) - Lie detector.

Subjects

A stratified random sample of 288 primary school children served as subjects. Those who tended to falsify responses to the anxiety scale as indicated by the lie detector items were omitted leaving a total sample of 270. The subjects were obtained from three Lusaka primary schools, one located in the low, one in the medium and the other in the high density residential
area (which roughly represent high, medium and low socio-economic groupings respectively). One of each of the 3rd, 5th and 7th grade classes was randomly selected from each of the three schools. 30 children, 15 male and 15 female were randomly selected from each class. The table below summarises the sample categorized by school, grade and sex.

Table 2

Summary of sample by grade, school and sex

(N = 270)

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>GRADE 3</th>
<th></th>
<th>GRADE 5</th>
<th></th>
<th>GRADE 7</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>JPS</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>NPS</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>KPS</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

Note: Abbreviated school names are Jacaranda primary school (JPS), Northmead primary school (NPS) and Kaunda Square primary school (KPS).

Procedure

The four questionnaire measures - An anxiety scale, the 3rd Grade Mathematics Achievement Test, 5th Grade Mathematics Achievement Test and 7th Grade Mathematics Achievement Test, comprised the main research instruments. Each test was administered on a group basis, to a class by the researcher and a research assistant.

In the administration of the Anxiety scale, each item was read aloud twice by the researcher in English and repeated once in Chinyanja (the local lingua franca). This was done for the benefit of those who were not very proficient in English. The question was repeated if so requested.
Instructions given (see appendix 7) emphasized that there were no wrong, and no correct answers. The children were also assured that their answers to certain questions would not be divulged. Each question was responded with 'yes' or 'no'.

One problem that arose was that in certain cases children did not know whether to respond with a Yes or No for an affirmative response. (Some questions were phrased in the positive and others in the negative form in order to check against respondent 'Yes' and 'No' sayers error). This is because a common linguistic error made in English spoken in Zambia is to negate rather than affirm clauses. For example, the question "You haven't been to town have you?" would normally be responded to by "Yes I haven't" instead of "No I haven't". Some questions such as question 18 presented a problem.

To overcome this problem, the researcher after reading the question, gave guidance to explain how the question ought to be answered. For example:

question: I wish I did not have to do maths at school
researchers guidance: If you are happy about doing maths at school, your answer should be No. (Researchers writes on chalk-board HAPPY-NO.). But if you are not happy about doing mathematics at school and would be pleased if you stopped doing it at school, your answer is yes. (Researcher writes on chalk-board, NOT HAPPY-YES).

In the administration of each Grade Mathematics Achievement Test (QMAT), each child was distributed with a test paper and before the test began, group instructions were given. Instructions emphasized that each person was to work on their problems individually, without consulting friends and neighbours. Subjects were free to ask questions concerning print and words that could not be understood. The children were also encouraged to work as quickly and as accurately as possible (although this was not a
speeded test). They were assured once again that the results of the tests would not be divulged.

In scoring, a point was allocated to each question if the response was indicative of either numerical anxiety or general anxiety. After an overall score had been obtained, general anxiety and numerical anxiety items were extracted and each individual was given a score on both anxiety subscales, as well as on the lie detector items. Scores could range from 0 to 15. Persons who scored high on the lie detector items were not included in the sample as this indicated that they either had a tendency to falsify responses or they did not quite understand the questions. In all, 18 subjects were excluded from the sample.

In the absence of normative data, an arbitrary cut off point for the categorization of high, medium and low numerical anxiety was decided on. 0 to 5 points were categorized as low numerical anxiety, 6 to 9 medium numerical anxiety and 10 to 15 points were categorized as high numerical anxiety.

In scoring the Grade Mathematics Achievement Tests, each paper was given a score for grade items (GI) and another for identical items (II). An overall score was given for each individual by adding the two subscores. The total possible score was 40 points-20 items worth a point each and 10 item worth 2 points each (see appendix 5).

Data Analysis

All hypotheses were statistically analysed. To test hypothesis I, that numerical anxiety would be present in a sample from primary schools in Zambia, the Chi squared test was computed. At df 2 when $x^2$ obs. crit, $x^2$ crit = 48.45 while $x^2$ obs. = 9.49. The Chi square test was also employed to test the third hypothesis that there would be comparatively

See Appendix 7
higher numerical anxiety at higher grade levels and that there would be a progressive increase from 3rd to 7th grade in numerical anxiety level; and the fourth hypothesis that there would be significant differences in the incidence and levels of numerical anxiety across the three schools (socio-economic group differences).

Pearson's product moment correlation was computed to test the second hypothesis, that numerical anxiety is a distinct anxiety factor.

Analysis of Variance (ANOVA) was computed to investigate the relationship between grade level and performance on the identical items component of the Grade Mathematics Achievement tests.

Inter-item consistencies were calculated using the Alpha coefficient for each of the three mathematics achievement tests.

The results obtained for these computations are presented in the following Chapter.
Hypothesis 1

The first hypothesis, that numerical anxiety is present in the Zambian primary school population was confirmed. The chi-squared test for k independent samples was computed and confirmed the presence of numerical anxiety. At df 2 when \( x^2 \) obs \( \geq x^2 \) crit; \( x^2 \) crit = 48.45 at \( x^2 \) obs = 9.49. Out of the total Lusaka urban primary school population, a sample of 270 third, fifth and seventh grade children was selected using the stratified random sampling method. This sample was found to have varying degrees of numerical anxiety, 17.4% of the sample was found to have a high numerical anxiety level, 30% had medium anxiety and 52.6% had low numerical anxiety. Table 3 presents percentages of subjects showing various levels of anxiety.

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NA</th>
<th>GR 3</th>
<th>GR 5</th>
<th>GR 7</th>
<th>TOTALS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
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<td></td>
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<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
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<tr>
<td>HNA</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>20</td>
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<td></td>
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<td>20</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>22</td>
</tr>
<tr>
<td>JACARANDA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MNA</td>
<td>3</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>13</td>
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<tr>
<td></td>
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<td>14</td>
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<tr>
<td>LNA</td>
<td>27</td>
<td>10</td>
<td>25</td>
<td>9</td>
<td>57</td>
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<td></td>
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<td>63</td>
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<tr>
<td>NORTHMEAD</td>
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<td></td>
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<tr>
<td>MNA</td>
<td>11</td>
<td>4</td>
<td>12</td>
<td>4</td>
<td>18</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>LNA</td>
<td>16</td>
<td>6</td>
<td>12</td>
<td>4</td>
<td>4</td>
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<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>KAUNDA SQ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MNA</td>
<td>6</td>
<td>2</td>
<td>12</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>LNA</td>
<td>23</td>
<td>9</td>
<td>14</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>16</td>
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<td></td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>59</td>
</tr>
<tr>
<td>Note: Abbreviated scale names are: HNA - high numerical anxiety, MNA - medium numerical anxiety and LNA - low numerical anxiety.</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
It can be seen from Table 3 that although not always present, numerical anxiety is a fairly common phenomenon in primary schools.

**Hypothesis 2**

The second hypothesis that numerical anxiety is a factor distinct from general anxiety was confirmed. The correlation co-efficients ($r = 0.23$, $r = 0.38$, $r = -0.17$) were not significant for grades 3, 5 and 7 respectively at the level $P < .05$.

**Table 4**

Correlation co-efficients between Numerical Anxiety and General Anxiety by School and Grade.

<table>
<thead>
<tr>
<th>GRADE &amp; SCHOOL</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Jacaranda</td>
<td>0.38</td>
</tr>
<tr>
<td>Northmead</td>
<td>0.37</td>
</tr>
<tr>
<td>Kaunda Sq.</td>
<td>0.06</td>
</tr>
<tr>
<td>Grade mean</td>
<td>0.23</td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Jacaranda</td>
<td>0.39</td>
</tr>
<tr>
<td>Northmead</td>
<td>0.42</td>
</tr>
<tr>
<td>Kaunda Sq.</td>
<td>0.17</td>
</tr>
<tr>
<td>Grade mean</td>
<td>0.38</td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Jacaranda</td>
<td>-0.22</td>
</tr>
<tr>
<td>Northmead</td>
<td>-0.20</td>
</tr>
<tr>
<td>Kaunda Sq.</td>
<td>0.17</td>
</tr>
<tr>
<td>Grade mean</td>
<td>-0.17</td>
</tr>
</tbody>
</table>

There was therefore no significant correlation obtained between numerical anxiety and general anxiety. What is notable though, is that the 3rd and 5th grades obtained positive correlations while the 7th grade, except for Kaunda Square primary, obtained negative numerical anxiety and general
anxiety correlation co-efficients.

Of all the nine classes tested, only two, Jacaranda grade 7 and Northmead grade 7, obtained a negative correlation co-efficient to describe the relationship between numerical anxiety and general anxiety. Although these relationships were not statistically significant (-0.22 and -0.20 for Jacaranda and Northmead respectively), this difference in direction of N.A. and G.A. effects may be an indicator of the effect of grade as well as socio-economic status of children attending these schools, on numerical and general anxiety levels. This is because these schools are situated in high and medium density areas, which represent high socio-economic stratum and average socio-economic stratum respectively.

Hypothesis 3

The third hypothesis, that average numerical anxiety scores will increase progressively from the third to the seventh grade was confirmed. This can be seen in Table 5.

It would appear from these results that numerical and general anxiety are related but the relationship, as shown by the low and non significant correlations, is so weak that the two are separate factors.
Table 5

Numerical Anxiety scores (mean and standard deviations) by school and grade.

<table>
<thead>
<tr>
<th>GRADE</th>
<th>SCHOOL</th>
<th>NUMERICAL ANXIETY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>3</td>
<td>Jacaranda</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>Northmead</td>
<td>6.7</td>
</tr>
<tr>
<td></td>
<td>Kaunda Sq.</td>
<td>4.9</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>5.01</td>
</tr>
<tr>
<td>5</td>
<td>Jacaranda</td>
<td>4.7</td>
</tr>
<tr>
<td></td>
<td>Northmead</td>
<td>7.2</td>
</tr>
<tr>
<td></td>
<td>Kaunda Sq.</td>
<td>7.1</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>6.35</td>
</tr>
<tr>
<td>7</td>
<td>Jacaranda</td>
<td>9.7</td>
</tr>
<tr>
<td></td>
<td>Northmead</td>
<td>8.5</td>
</tr>
<tr>
<td></td>
<td>Kaunda Sq.</td>
<td>6.6</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>8.27</td>
</tr>
</tbody>
</table>

An interesting observation to make from table 5 is the pattern of a progressive increase in mean numerical anxiety scores and standard deviation scores within schools by grade, as well as between schools by grade. For example, mean N.A. scores at Jacaranda primary school were $\bar{x} = 3.5$, $\bar{x} = 4.7$, and $\bar{x} = 9.7$ at 3rd, 5th and 7th grades respectively. At the school level, each school has a different pattern. At Jacaranda there was a steady increase in mean N.A. scores. Northmead observed a similar pattern, but with less variability between grade scores ($\bar{x} = 6.7$, $\bar{x} = 7.2$ and $\bar{x} = 8.5$) at 3rd, 5th and 7th grade respectively. At Kaunda Square however, mean scores increased from 3rd to 5th grade and dropped
at 7th grade ($\bar{x} = 4.9$, $\bar{x} = 7.1$, and $\bar{x} = 6.6$ respectively)

These findings support the suggestions that there will be differences in numerical anxiety across the three grades tested, and that these differences will follow a developmental trend. They also support the predictions made by the 4th hypothesis that inter-school differences will emerge in numerical anxiety levels of children attending different schools.

The chi-squared test for K independent samples was computed to test the null hypothesis that the samples were obtained from the same population. At df 2 when $x^2$ obs $\geq x^2$ Crit; $x^2$ Crit = 48.45 at $x^2$ obs. = 9.49. The obtained chi-squared were 32.49 at 7th grade, 11.91 at 5th grade and 9.15 at 3rd grade. Hence, there was a statistically significant difference between 3rd and 7th graders on numerical anxiety levels. The Lambda co-efficient was computed to investigate the strength of association or 'significance' of the chi-squared test (between numerical anxiety and grade level). Obtained Lambda co-efficients ($\Lambda = 0.23$ at third grade, $\Lambda = 0.21$ at fifth grade and $\Lambda = 0.31$ at seventh grade) show that the chi-square was more significant for 7th than 5th and then 3rd grade, in relation to numerical anxiety levels.

These findings indicate that there are inter-grade differences in the occurrence and levels of numerical anxiety in the primary school. They also support the suggestion of a developmental trend in numerical anxiety during the primary school years.

Hypothesis 4

The fourth hypothesis that there will be an inter-school difference in the incidence and levels of numerical anxiety was confirmed. The chi-square test for K independent samples was computed to test the null hypothesis that the sample was obtained from the same population. $x^2$ obs.
= 22.8 while $x^2_{\text{Crit}} = 9.5$. At $df = 4$, $x^2_{\text{obs}}$ $x^2_{\text{Crit}}$, the null hypothesis that there would be no difference across the three schools was rejected. The results indicated a statistically significant difference between Jacaranda, Northmead and Kaunda Square primary schools in numerical anxiety.

To investigate the degree of association between numerical anxiety and school, obtained by the chi-squared test, the Lambda co-efficient ($\lambda$) was computed. Obtained Lambda co-efficients were as follows: $\lambda = 0.4$, $\lambda = 0.2$ and $\lambda = 0.1$ for Jacaranda, Northmead and Kaunda Square primary schools respectively. They can be interpreted to mean that the association between numerical anxiety level and schools attended was stronger for Jacaranda than for Northmead and Kaunda Square primary schools.

A definite pattern is observed in the case of high numerical anxiety. While Jacaranda primary had 20 cases of high N.A., Northmead obtained 17, while Kaunda Square only obtained 10 (See Table 6). Further, as mentioned under Table 5, mean N.A. scores had a greater increase at Jacaranda primary than at Northmead from 3rd through 7th grade while Kaunda Square mean N.A. scores dropped at the 7th grade level. These findings suggest that the school a child attends and socio-economic status may influence levels of numerical anxiety.

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>HNA</th>
<th>MNA</th>
<th>LNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jacaranda</td>
<td>20</td>
<td>13</td>
<td>57</td>
</tr>
<tr>
<td>Northmead</td>
<td>17</td>
<td>41</td>
<td>32</td>
</tr>
<tr>
<td>Kaunda Sq.</td>
<td>10</td>
<td>27</td>
<td>53</td>
</tr>
</tbody>
</table>

Note: Abbreviated are: HNA - high numerical anxiety, MNA - medium numerical anxiety and LNA - low numerical anxiety.
Hypothesis 5

The fifth hypothesis that there would be a higher negative correlation between numerical anxiety and mathematics performance (grade scores), at the seventh than at the third grade level, was not confirmed. In fact, it was found that the reverse was the case. A high negative correlation was obtained at third than at seventh grade. Although none of the correlations were significant at level \( P \leq .05 \) (\( r = -.28, r = -.26 \) and \( r = -.15 \)) at 3rd, 5th and 7th grade respectively. However they were negative that is, in the expected direction.

Analysis of variance was performed to investigate the relationship between grade level in mathematics performance on the identical items component on the third grade mathematics achievement test, fifth grade mathematics achievement test and seventh grade mathematics achievement test. The obtained \( F \) value of 121.32 was significant (See table 7 below). The null hypothesis that the sample was obtained from the same population was rejected.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Square</th>
<th>( F )</th>
<th>( P \leq .05 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Grp</td>
<td>628</td>
<td>2</td>
<td>314</td>
<td>121.32</td>
<td>3.00</td>
</tr>
<tr>
<td>Within Grp</td>
<td>691</td>
<td>267</td>
<td>2.58</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1319</td>
<td>269</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This indicates that there is a significant difference in performance on the identical items component of the mathematics test across the three grade levels, as expected. ANOVA T Values of \( T_1 \), \( T_2 \), and \( T_3 \) (7th, 5th and 3rd grade respectively) are summarised in the table overleaf.
Table 8

Mathematics performance (I.I) scores across grades (Totals and mean)

<table>
<thead>
<tr>
<th>GRADE</th>
<th>M (I.I) T</th>
<th>M (I.I) M</th>
</tr>
</thead>
<tbody>
<tr>
<td>GR 3</td>
<td>298</td>
<td>3.31</td>
</tr>
<tr>
<td>GR 5</td>
<td>457</td>
<td>5.07</td>
</tr>
<tr>
<td>GR 7</td>
<td>634</td>
<td>7.04</td>
</tr>
</tbody>
</table>

Note: Abbreviated scale names are: M (II) T - Mathematics identical items total, M (II) M - Mathematics identical items mean.

In conclusion, it was found that the relationship between numerical anxiety and mathematics performance is negative (that when numerical anxiety was high, mathematics performance was low). This relationship was found to be stronger at 3rd grade than 5th and 7th grades.

The Chi-squared test was employed to investigate the intersexual difference of numerical anxiety levels. The table below summarises the findings.

Table 9

Categorization of subjects into high, medium and low numerical anxiety by sex.

N = 270

<table>
<thead>
<tr>
<th>SEX</th>
<th>N</th>
<th>HNA</th>
<th>MNA</th>
<th>LNA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Male</td>
<td>135</td>
<td>18</td>
<td>43</td>
<td>16</td>
</tr>
<tr>
<td>Female</td>
<td>135</td>
<td>29</td>
<td>38</td>
<td>14</td>
</tr>
</tbody>
</table>

Note: Abbreviated scale names are: HNA - high numerical anxiety, MNA - medium numerical anxiety, LNA - low numerical anxiety.
When $X^2$ obs $\geq X^2$ Crit Ho is rejected. In investigating the relationship between numerical anxiety and sex, $X^2$ obs = 3.1 and $X^2$ Crit = 5.99. Hence, at df = 2, the null hypothesis that the sample was obtained from the same population was accepted. There was no statistically significant sex difference in the occurrence and level of numerical anxiety.

However, when the Lambda co-efficient ($\lambda$) was computed, it was found that the strongest relationship between N.A. and sex was at 7th grade level ($\lambda = 1.2$), while Lambda co-efficients for 3rd and 5th grade were ($\lambda = -.5$ and $\lambda = -.4$) respectively.

The alpha co-efficient was computed to ascertain the internal consistency reliability of each of the mathematics tests (7th, 5th and 3rd grade) administered. Obtained alpha co-efficients were .48, .41 and .34 respectively. These figures show that the third and fifth grade test had slightly higher internal consistency than the seventh grade test. These figures are generally low. However, the fact that these tests cover a wide variety of topics in the syllabus perhaps explains the low internal consistency.
CHAPTER 4

DISCUSSION

Presence of Numerical Anxiety

The findings regarding hypothesis one confirmed the existence of numerical anxiety among Zambian primary school children (from a sample of 270; 47 had high numerical anxiety, 81 medium numerical anxiety and 142 low numerical anxiety, \( x^2 \) crit was found to be 48.45 when \( x^2 \) obs = 9.49 at 2 df).

As is evident from the discussion in chapter one, it is generally held in Zambia and many other countries that there is a problem related to mathematics learning. It is said that students of mathematics very often dislike mathematics and usually underachieve in the subject, as compared to other subjects (Emanalo, 1973; Skemp, 1973; Biggs, 1962). In the light of this observation, this study has attempted to investigate the nature and trends of numerical anxiety (that may influence negative feelings towards mathematics) in primary school children. It was expected that pupils in higher grades would obtain higher numerical anxiety scores because of the greater exposure to stressful stimuli (secondary emotional factors) that they have received. However, it was found that the reverse was the case. This finding is discussed below.

The findings of this study support the suggestion by Biggs (1958), that negative feelings towards mathematics and numerical application among mathematics learners can go deeper into the personality system than being mere feelings of distaste. These 'feelings' define various levels of the numerical anxiety state. According to Biggs, this state can reach a deeper pathological state known as dyscalculia, that has been studied by Magne (in Biggs, 1958). The present sample did not reveal any cases of dyscalculic children. (These would usually be those individuals scoring
very highly on the numerical anxiety scale and obtaining very poor mathematics achievement grades). In this respect, it was concluded that although there are probably some dyscalculic children in Zambian primary schools, these will be few and far between.

Numerical anxiety then, was found to be present in the sample tested. The findings of this hypothesis also related to those of the third hypothesis that not only showed the presence of this phenomenon, but that there were progressively higher levels of numerical anxiety levels from third through fifth to seventh grade. The general trend observed was that from third grade, numerical anxiety was fairly low or non-existent but tended to increase by seventh grade level. This may not necessarily be the case for each individual.

Jointly, the first and third hypotheses relate to the fifth hypothesis that predicted a negative correlation between numerical anxiety and performance. The findings of this study support the argument advanced by Biggs (1962) that numerical anxiety will interfere with mathematics performance (perhaps as a cognitive disorganizer) and that higher levels of this anxiety state will tend to have a greater negative effect on mathematics performance. However, as results pertaining to the fifth hypothesis show, correlations between mathematics performance and numerical anxiety were not greater for the higher grades as had been expected. In fact the reverse was the case (higher negative correlations were obtained for 3rd followed by 5th grade while 7th grade had the lowest). These findings are explained in terms of the coping strategy employed by different individuals, and are discussed in more detail under the sub-heading Developmental Trends in Numerical Anxiety.
Developmental Trends in Numerical Anxiety

To return to hypothesis three, it has already been mentioned that there is a progressive increase in numerical anxiety from third to seventh grade. It seems to be a phenomenon that emanates from secondary emotional factors (that together interact and build up to form the numerical anxiety state). It would then develop over a period of time during which the learner is continually exposed to stressful stimuli. Research by Skemp (1971), Biggs (1962) and Sanders (1972) indicated that the problem of numerical anxiety originates in the school, that the fault must lie in the classroom.

This study did not investigate the origins of N.A but has identified a developmental trend. There is an increasing presence of numerical anxiety from 3rd to 7th grade. It would seem that the child entering the first grade would have very few if any inhibitions about mathematics but would begin to develop higher levels of anxiety during the primary school years. This is because the child will have had greater exposure to secondary emotional factors, such as parents', teachers' and friends' negative attitudes towards mathematics and poor teaching methods. Very often, parents and even mathematics teachers (who may themselves hold negative attitudes to the subject) overemphasise the difficulty of mathematics to the point where the learner feels threatened and even defeated from the start. Very often too, poor teaching methods such as rote memorization (Skemp, 1973) cause greater anxiety particularly when the learning situation or problem requires operations that do not readily lend themselves to rote learning.

On the basis of these findings, it is predicted that if the same third graders were tested in a longitudinal study, they would score higher on numerical anxiety by fifth grade and even higher by seventh grade. This
is so because here individuals will have been exposed to more secondary emotional factors by fifth and seventh grade than by third grade.

Having noted the importance of the coping strategy in moderating levels of numerical anxiety, this author is suggesting further detailed investigation into the most popular task response used by school children. This information would be useful in an attempt to draw up a programme for imparting this skill to children learning mathematics. This suggestion is based on the findings discussed in more detail in the section on Numerical Anxiety-Performance Correlations, below.

**Numerical Anxiety - Performance Correlations**

The fifth hypothesis, that there would be a higher negative correlation between numerical anxiety and performance at higher rather than lower grade levels has not been confirmed.

The rationale underlying this expectation was that up to an optimum level, numerical anxiety will tend to enhance performance. However, as N.A continues to increase, it will soon begin to act as an inhibitor to learning (Izard 1972). As the pupil progresses from low to high grades, and as secondary emotional variables increase in the influence, the individual's level of numerical anxiety will increase to a much higher level. This would be the level at which numerical anxiety inhibits performance. Contrary to this expectation, a pattern emerged where the lower grades progressively obtained higher negative correlations than the higher grades \(r = -.28, -.26 \text{ and } -.15\) at 3rd, 5th and 7th grades respectively. The obtained correlation co-efficients were not statistically significant, however.

As mentioned earlier, the interpretation of these findings is centered around the strategy that the learner can adopt, to overcome feelings of
anxiety and fear for mathematics. Numerical anxiety will be relatively novel to the child around third grade. When this learner initially experiences numerical anxiety in face of a mathematical problem, an A - state reaction will produce a 'felt' behavioral response. This response will not adequately deal with the problem because the individual concentrates on, and responds to the feelings or emotions he is experiencing, rather than the task at hand. It is contended here that the ability to respond with an adequate or a task - related response is a skill that is learned. Awareness builds up and dawns on the learner who begins to try different strategies to deal with the problem. The child in the lower grade, then, following this line of analysis will not have a well developed coping strategy to overcome the feelings of numerical anxiety. Thus, although the child in higher grades will have been exposed to more stressful secondary emotional factors, they will also tend to respond with more task oriented behavioral sequences that will have been acquired over a period of time. Consequently, these children appear to have less learning inhibitions caused by numerical anxiety.

According to this line of reasoning therefore, it seems that coping strategies moderate the effects of numerical anxiety on mathematics performance. That is, children in higher grades, despite showing higher levels of anxiety rely on previously developed coping strategies to minimize negative effects of N.A on their mathematics performance. This is not true at lower grades because task - related coping strategies have not been developed. As a result, N.A shows a greater negative effect on mathematics performance at lower grades inspite of the low anxiety levels observed. This conclusion however, is purely suggestive and open to further detailed investigation.

School, Status and Numerical Anxiety

Having found that numerical anxiety is present in varying degrees at different grade levels, (with higher levels in the more advanced grades), we can now look at the fourth hypothesis that predicted inter-school differences
in numerical anxiety levels, both within and between grades. The rationale on which this hypothesis was based was school climate and socio-economic group differences.

It is generally held that school climate varies from school to school in many respects (Finlayson, 1970). The socio-economic status of a school judged by the locality of the school, seems to have an effect on the general school climate, and the nature of parental involvement in learning (Herbert, 1974). The findings of this study are that average numerical anxiety levels were higher for higher socio-economic status schools (highest for Jacaranda, then Northmead and followed by Kaunda Square primary school).

Apart from differences in school climate, differences based largely on socio-economic status are also present and these in turn affect school climate. From this authors personal experience, it would seem as though low socio-economic schools are less formal in interpersonal relationships although they may have a fairly strong authoritative structure. There definitely seems to be less social distance between teachers and pupils. According to the present author, this is because the teacher uses English as well as Bemba, Nyanja or the local language spoken in the area. Serpell (1976) describes bilingual people as having two codes; a high code used largely for school work, and a low code or vernacular that is mainly employed for matters concerning 'health and home' (p.28). That is, personal matters tend to be discussed in the low code more often than business matters. It follows, then when the low code is introduced into the school or learning situation, some social distance is removed. This is likely to lead to lower numerical anxiety levels because the child is subjected to less tension, and apprehension during the learning situation.

Further, in low socio-economic schools, particularly in the lower grades where a fair number of pupils have almost no command of the English language,
both high and low codes are used in teaching. Moreover, these schools are in much closer proximity to the community or compound in which they are located. It is not uncommon to find non-school going children playing in the school play-ground with school-goers because the school and home are separated only by a hedge or short fence. Consequently these schools are less institutionalized, and the child is less removed from the familiar, and comfortable routine of home (Herbert, 1974). The demands and stresses of the school situation are less in this case and the child is less predisposed to stress. As a result, the situation in these schools is likely to lead to low numerical anxiety levels.

Parents from high socio-economic groups will generally have higher education than parents from low socio-economic status schools. Parental occupation too, can roughly be equated with parental interest. The educational aspirations of the parents for the child, the literacy of the home and the interest of the parents in the child's work will all have a bearing on the child's level of achievement. Parents who take more active interest in their children's progress at school will often over-emphasise and warn their siblings on the difficulty of the subject. This can increase the child's awareness of the apparent difficulty of mathematics to the point of causing fear. In addition, high socio-economic parents may stress high achievement in school for their children more than low socio-economic parents. Such attention shown to children's school performance could in extreme cases induce anxiety in learning.

In conclusion, the differences observed among the three schools are related to the socio-economic status of the parents and the children, and the climate of the schools they attend. Further, despite the inability of this study to control variables of parents income, occupation and so on, it is evident that such factors do impact on school climate and atmosphere, which in turn
have an effect on numerical anxiety levels among the pupils. Consequently, it is contended that observed differences in numerical anxiety levels across the three schools can be accounted for by the differing parental socio-economic status, parental attitudes, teacher attitudes, and climate that prevail in different schools.

As a corrective measure, it is being proposed in this study that those schools especially low density schools that are found to have high numerical anxiety pupils, look into these factors that may be precipitators of the state. That is, teacher and parents could perhaps be called together for workshops to discuss their own attitudes and ways in which they could have positive influence on young mathematics learners. Further, schools in the higher socio-economic status groups could reconsider the introduction of a certain percentage of vernacular in the teaching process. These along with other measures may lead to lower prevailing anxiety levels in these schools. In addition teachers should be encouraged to be less formal in their interactions with their classes.

**Numerical and General Anxiety - Distinction**

The findings of this study support the findings by Biggs (1958) who described numerical anxiety as a 'specific anxiety' factor. Numerical anxiety and general anxiety were found to be related but distinct factors. In considering the relationship between numerical and general anxiety, a brief analysis of these two phenomena will be made.

As stated in chapter one, numerical anxiety, besides being a 'specific anxiety' (anxiety directed specifically to number work) factor that combines both primary and secondary emotional factors, is an A-state reaction. Thus it serves as a signal initiating a behavior sequence designed to deal with threat (Spielberger and Diaz-Querrero, 1976).
General anxiety on the other hand is made up of primary emotional factors, which are largely personality characteristics (Biggs, 1958). General anxiety, as its name suggests, is not a 'specific anxiety' factor. Being an A - trait, generally anxious individuals will feel threatened by differing stressful stimuli which may not necessarily include anxiety.

One way to explain the relationship between numerical and general anxiety is that they are as related to each other, as state anxiety is to trait anxiety. That is, a high A - trait individual will have greater predisposition, and will respond with greater frequency to various A - state stressful stimuli than the low A - trait individual. Following this line of thinking, numerical anxiety, although fundamentally an A - state reaction, will be experienced more often and with greater intensity by an individual with high G.A.

While this relationship between numerical anxiety and general anxiety has been identified, the finding of this study was that there was no statistically significant correlation between N.A and G.A scores across the three grade levels ($r = 0.23$, $r = 0.38$, $r = -0.17$ at 3rd, 5th and 7th grades respectively, at $P < 0.5$). To understand this relationship further we would require to make an analysis of numerical anxiety's etiology.

The essential components that build numerical anxiety are both primary emotional factors (personality variables) and secondary emotional factors (environmental variables). The primary factors seem to determine how quickly and easily one can be affected by secondary factors because they largely deal with predisposition to stressful stimuli. Secondary factors are those that will affect and influence the levels of N.A that can be attained. The effect of A - trait on N.A appears only to be a secondary nature. (A high A - trait individual will not necessarily have high N.A, it will depend to a large extent on the amount of exposure to stressful
stimuli). It would seem that primarily, numerical anxiety is acquired or learned by exposure to secondary emotional factors.

According to this author's analysis, the coping strategy employed by the individual, may intervene in the development of the numerical anxiety state in that individual. The numerical anxiety state acts as a stimulus that elicits a response which if corrected and relevant will lead to the solution of the problem (task response). The individual may on the other hand respond with feelings of inadequacy, fear and hopelessness (felt response), (Costello, 1976). One is soon accustomed to either a task or felt response and when faced with a numerical problem, the latent response is aroused.

The discussion on the fifth hypothesis under the sub-heading Numerical Anxiety - Performance Correlations, argued that younger children, in the lower grades will more often respond with a felt response because they have not yet learned the task response. This explained the fact that pupils in the higher grades obtained greater numerical anxiety scores, yet the lower grades obtained a greater negative correlation between numerical anxiety and mathematics performance.

Although the correlations between numerical anxiety and general anxiety were not significant, we did find that there was a positive relationship between these two factors. The explanation given for this finding is that numerical and general anxiety are both anxiety factors, except that numerical anxiety is a 'specific' anxiety (or an anxiety that only affects mathematical learning and performance). The two, however, have one thing in common, the nature of response, which is the anxiety response.

In the main, this hypothesis attempted to investigate the relationship between numerical and general anxiety, and found that the two are separate factors of anxiety, yet have few similarities, particularly in the type of factors that may cause the numerical or general anxiety states.
The findings on this hypothesis support those of Biggs (1958) and the suggestions put forward by Dreger and Aiken (1957). However, of more practical value, the findings on this hypothesis in themselves call for a closer analysis of this phenomenon in Zambia. It has been learned that poor mathematics may not be due to laziness to 'think' as is often said by many teachers. It is also evident that it is not only the 'general anxious' individual who will develop a real fear for mathematics. The identification of the numerical anxiety phenomenon in Zambia, by this study, indicates that there may be a serious problem in relation to mathematics learning in this country. A closer analysis of numerical anxiety would be a step towards finding ways in which the development of numerical anxiety could be moderated or prevented.

Finally, a test of sex related differences in N.A was performed in order to observe whether male and female pupils varied on numerical aneity. Although the Chi-squared test did not reveal any significant differences on N.A between boys and girls, on the whole girls are found to have higher mean numerical anxiety scores at all grades. This observation is supportive of literature on general anxiety (Biggs, 1962; Hutt, 1972) which shows that females are usually more 'anxious' than males. This could be because females are said to be more 'people oriented' (Hutt, 1972) and are generally socialized to be more sensitive to feelings of other people. This may in turn cause girls to be more influenced by teacher, and parent attitudes and prejudices. That girls may be more susceptible to secondary emotional factors which may increase their anxiety levels.

**Implications and Suggestions For Future Research**

The present study has been able to make several interesting and valuable findings concerning the phenomenon of numerical anxiety.
It was found that in fact numerical anxiety is present in Zambian primary school children. The author suggests that numerical anxiety is a specific anxiety factor directed only to mathematics, and that this state is fairly common among mathematics learners (who are no doubt labelled as 'lazy' by parents and mathematics teachers who are not aware of 'numerical anxiety'. In fact, negative correlations obtained between numerical anxiety and mathematics performance suggest that this anxiety factor may be a cause of mathematics underachievement at various levels. The identification of a definite causal relationship between the two variables is left to subsequent research, however.

This study is the first of its kind in Zambia and can therefore be seen as a starting point in this direction of Educational and Psychological research. It has overcome the weakness of the related Dreger and Aiken (1957) study, that only employed three 'number anxiety' items by developing a twelve item numerical anxiety component to the Anxiety scale. Further it has adopted a developmental approach to the study of numerical anxiety (a sample of 3rd, 5th and 7th grade pupils were tested), that has revealed developmental trends in the numerical anxiety state. Internal consistencies were calculated for each test used, although the values are low possibly due to the multidimensionality of the mathematics syllabi.

It should, however, be mentioned that although findings of the present study suggest interesting trends that deserve further study, these findings are somewhat tentative because of a few shortcomings. A major weakness is related to the unknown test validity of measuring instruments. Both the GMAFs' and Anxiety Scales constructed were not standardized tests and the alpha coefficients of reliability obtained for the mathematics tests were not high. Secondly and perhaps of less importance, the ability factor was not taken into account in the investigation of the relationship between numerical anxiety and mathematics performance. But, since the sample was selected by the random method, it can be assumed that ability was randomly distributed.
Consequently this is not a serious shortcoming.

Future researchers in this area of study may also improve on their research by taking the following factors into consideration; teacher and parental attitudes towards mathematics and children's progress at school, parental occupation and the socio-economic status of parents and their children, and the age of children being tested. Perhaps subsequent research may be interested in answering a question arising from this study - 'what is the status of numerical anxiety at the secondary school level?' It would also be interesting to design a longitudinal study that may attempt to investigate the developmental origins of this state. It would no doubt be helpful for research aimed at prevention and treatment methods in numerical anxiety.

Although it is beyond the scope of the present study to discuss prevention and treatment of numerical anxiety, lest readers be left in utter despair, a few methods are being proposed. First, it has been noted that teacher and parental attitudes have a lot of bearing on children. As suggested earlier, it could be helpful for teachers and parents to meet together in workshops to examine their attitudes, discuss the problems of mathematics learning and ways of dealing with children learning mathematics. In this way self-help will certainly help learners too. Secondly, schools that are situated in low density residential areas (or high socio-economic group schools) may want to consider ways to lessen social distance between teachers and learners, for example by introducing some vernacular in teaching or changing seating arrangements in the classrooms. The more recent teaching methods such as group discussion and schematic learning (Skemp, 1971) could be employed.

To move from the preventive to treatment methods, a serious study of coping strategies presently employed by many young mathematics learners needs to be investigated. With a clearer understanding of coping strategies, these
could be introduced into the school curricula as a skill learned from the earliest grades. With these skills the child who does feel threatened by the inhibiting look of a mathematics problem may adopt an adequate coping strategy.

Finally, besides being very interesting, research in numerical anxiety is very important. The author gives all her encouragement to researchers interested in this area of educational psychology.
CHAPTER 5

SUMMARY AND CONCLUSIONS

The present study sought to investigate the existence of numerical anxiety, its relationship to general anxiety and possible associations existing between numerical anxiety and mathematics performance in a sample from primary schools in Zambia. N.A (which was defined as a state anxiety factor that is aroused specifically when dealing with arithmetic applications, Biggs, 1958), was found to be present to a fair degree. Also observed was the developmental trend of numerical anxiety: Progressively higher mean N.A levels were obtained from third grade through fifth to seventh grade. The major contributing factor to numerical anxiety was suggested as secondary emotional factors such as poor learning strategy, attitudes of parents and teachers and other interpersonal relationships. Also important is the school climate and the socio-economic status of the parents and children, all of which determine, certain behavior of both children, parents and teachers.

Although secondary emotional factors were said to be important in determining levels of N.A that can be reached, it is believed that primary emotional factors - or personality characteristics largely determine the individuals predisposition to N.A. It was suggested that a strong modifier of numerical anxiety may be the coping strategy that an individual adopts in order to deal with feelings of fear, dread and discomfort that accompany N.A. The individual who has adopted an appropriate strategy - the task-related response - will reduce the negative effects of numerical anxiety on mathematics performance, more than one who gives a felt or non task-related response.

Interestingly enough, this coping strategy seems to be a learned behavior. It is not necessarily from the outset that an individual can make an adaptive coping response. Adaptive coping strategies develop as the
individual gets more and more exposed to anxiety provoking situations. This is important because it follows, that in the school, children could be taught skills that would develop the correct response (task response) when dealing with mathematical problems. This way, from the earliest grade, N.A. could be dealt with by the individual before it has reached high levels.

Negative correlations were obtained between numerical anxiety and mathematics performance at all grade levels, the relationship being stronger at lower grades. This result is explained in terms of lack of coping strategies at lower grades.

The relationship between N.A. and G.A. was investigated. It was found that N.A. and G.A. are two distinct anxiety factors that only differ in what the anxiety is directed to. It is suggested that more research be done in this area of numerical anxiety so that those children presently with high N.A. could learn to overcome it and also for preventive measures.
APPENDIX I

The Children's Form of Manifest Anxiety Scale (CMAS)

1. It is hard for me to keep my mind on anything.
2. I get nervous when someone watches me work.
3. I feel I have to be best in everything.
4. I blush easily.
5. I like everyone I know.
6. I notice my heart beats very fast sometimes.
7. At times I feel like shouting.
8. I wish I could be very far from here.
9. Others seem to do things easier than I can.
10. I would rather win than loose in a game.
11. I am secretly afraid of a lot of things.
12. I feel that others do not like the way I do things.
13. I feel alone even when there are people around me.
14. I have trouble making up my mind.
15. I get nervous when things do not go the right way for me.
16. I worry most of the time.
17. I am always kind.
18. I worry about what my parents will say to me.
19. Often I have trouble getting my breath.
20. I get angry easily.
21. I always have good manners.
22. My hands feel sweaty.
23. I have to go to the toilet more than most people.
24. Other children are happier than I.
25. I worry about what other people think about me.
26. I have trouble swallowing.
27. I have worried about things that did not really make a difference later.
28. My feelings get hurt easily.
29. I worry about the right things.
30. I am always good.
31. I worry about what is going to happen.
32. It is hard for me to go to sleep at night.
33. I worry about how well I'm doing at school.
34. I am always nice to everyone.
35. My feelings get hurt easily when I'm scolded.
36. I tell the truth every single time.
37. I often get lonesome when I'm with people.
38. I feel someone will tell me I do things the wrong way.
39. I am afraid of the dark.
40. It is hard for me to keep my mind on my school work.
41. I never get angry.
42. Often I feel sick in the stomach.
43. I worry when I go to bed at night.
44. I often do things I wish I had never done.
45. I get headaches.
46. I often worry about what could happen to my parents.
47. I never say things I shouldn't.
48. I get tired easily.
49. It is good to get high grades in school.
50. I have bad dreams.
51. I am nervous.
52. I never lie.
53. I often worry about something bad happening to me.
Answer all the questions.

1. $\square + 9 = 18$

2. 
   \begin{align*}
   12 & \phantom{5} 582 \\
   + & \phantom{5} 22 \phantom{5} 581 \\
   \hline
   \text{15} & \phantom{5} 295
   \end{align*}

3. 
   \begin{align*}
   233 \\
   - & \phantom{5} 155
   \end{align*}

4. 
   \begin{align*}
   106 \\
   \times & \phantom{5} 12
   \end{align*}

5. There are 6 girls and every girl has two books. How many books are there?

6. Moyo has 48 chickens in 4 houses. How many are there in one house?

7. 
   \begin{align*}
   16 \\
   \times & \phantom{5} 4
   \end{align*}

8. Put $\rangle$ or $\langle$ in each box:
   \begin{align*}
   90 & \phantom{5} 900 \\
   50 & \phantom{5} 9 + 7
   \end{align*}

9. $27 \div 3 = $

10. 122n _____ Kwacha _____ ngwee.

11. There are _____ fours in 12.

12. What shapes can you see?

   a. $\triangle$
   b. $\square$
   c. $\bigcirc$
   d. 

13. Put $\langle$ or $\rangle$ in each box:
   \begin{align*}
   34 & \phantom{5} 26 \\
   17 & \phantom{5} 21
   \end{align*}

14. Measure each side of Jelita's toy.
   \begin{align*}
   a & = _____ \text{ cm} \\
   b & = _____ \text{ cm} \\
   c & = _____ \text{ cm} \\
   d & = _____ \text{ cm} \\
   e & = _____ \text{ cm}
   \end{align*}

15. Put $\rangle$ or $\langle$ in each box:
   \begin{align*}
   1 & \phantom{5} \frac{1}{2} \\
   3 \times 4 & \phantom{5} 5 \times 2 \frac{1}{2}
   \end{align*}

16. John, Peter and Jelita have only one orange to share. What fraction can each one eat?

17. $26$ ngwee $+$ $48$ ngwee $=$

18. Draw the hand on the clock to show the time 14.15 hours.

19. Kl.5On $=$ _____ ngwee.

20. Write in Arabic numerals - Four point one four. _________
1. I see ____ circles.
   I see ____ squares.
   I see ____ triangle.

2. What is the shape of a one Kwacha note? ________

3. How long is this line?
   ________________
   = ____ cm.

4. Which is the longest line?
   a. ________________
   b. ________________
   c. ________________
   d. ________________
   e. ________________

5. What fraction is coloured?
   = ____

6. What fraction is coloured?
   = ____

7. What is the time?
   ans. = ____________

28. What is the time?
   ans. = ____________

29. What are the missing numbers?
   2, 4, 6, __, __.
   10, 15, 20, __, __.

30. H. T. O.
   1 6 2
   + 3 7
   _____
1. What does the underlined digit mean (thousand, hundred, tens or ones?)
   \[ 303 = \quad \]

2. \[
\begin{array}{c}
12\ 582 \\
+\ 22\ 581 \\
\hline
15\ 295
\end{array}
\]

3. Write in Arabic numerals for this number.
   Thirty nine thousand = \[ \quad \]

4. \[
\begin{array}{c}
106 \\
\times\ 12 \\
\hline
\quad
\end{array}
\]

5. Change this mixed number into an improper fraction.
   \[ 2\frac{1}{2} = \quad \]

6. There are \[ \quad \] fours in 12.

7. What must be added to these numbers to make a thousand.
   a. \[ 430 + \quad = 1\ 000. \]
   b. \[ 990 + \quad = 1\ 000. \]

8. Put > or < in each box
   a. \[ 90 \quad 900 \]
   b. \[ 15 \quad (9 + 7) \]

9. Change this fraction into a decimal.
   \[ \frac{1}{2} = \quad \]

10. Kl.50n = \[ \quad \] ngwee.

11. Find the lowest common factor of
    10: 20: 15 = \[ \quad \]

12. Which shapes can you see?
    \[
    \triangle\ \boxed{}\ \bigcirc\ \boxed{}
    \]
    \[ = \quad = \quad = \quad = \quad \]

13. A wall contains nine rows of bricks. There are 132 bricks in each row. How many bricks are there in the wall?
    ans. = \[ \quad \]

14. Measure each side of Jelita's toy.
    \[
    \begin{array}{c}
    a. \quad \\
    b. \quad \\
    c. \quad \\
    d. \quad \\
    e. \quad 
    \end{array}
    \]

15. Find the product of:
    3 and 4 = \[ \quad \]
    124 and 24 = \[ \quad \]

16. John, Peter and Jelita have only one orange to share. What fraction does each eat?
    ans. = \[ \quad \]

17. Share 3816 equally among 3 people.
    ans. = \[ \quad \]

18. Draw the hand on the clock to show the time 14:15 hours.

19. \[ 50 \div 4 = \quad \]
    \[ 24 \div 4 = \quad \]
20. Write in arabic numerals. Four point one four = ____________.

21. What is the total length of the perimeter of this shape?

\[ \begin{array}{c}
\text{2 cm} \\
\hline
\text{3 cm} \\
\hline
\text{2 cm}
\end{array} \]

22. Which is greater? \( \frac{1}{2} \) or 0.6 = ______ or 0.9 = ______

23. \( \frac{K4}{52n} + \frac{K2}{50n} \)

24. How much will ten books cost if each book costs K2.88n? ans. = ______

25. Are these true, (Yes or No)

\[ \{ \triangle, \nabla, \bigcirc, \bigtriangledown \} \]

(CAT, DOG, MONKEY, PIG)

is a set of triangles. ______

26. Measure these lines. The shortest line is ______

a. ______

b. ______

c. ______

27. What would you use to measure your exercise book? (Kilometre, metre or centimetre) ans. = ______

28. How many centimetres are there in 1m : 12cm ans. = ______

29. Change this mixed number into an improper fraction.

\[ 2\frac{1}{6} = \] ______

30. \( \frac{1}{3} + \frac{5}{8} - \frac{2}{16} = \) ______
11. Change these sets by:
   a. Multiplying each number by 9
      \((3, 4, 7, 8) = \) ________
   b. Dividing each number by 7
      \((21, 35, 42, 49) = \) ________

12. What shapes can you see?

\[ \triangle \quad \square \quad \bigcirc \quad \square \]

\[ = \quad = \quad = \quad = \]

13. You have 44 mangoes in a basket. How many sets of 5 mangoes can you make?

\[ = \]

14. Measure the sides of Jelita's toy.

\[ \begin{array}{cc}
   \text{a.} & = \quad \text{cm} \\
   \text{b.} & = \quad \text{cm} \\
   \text{c.} & = \quad \text{cm} \\
   \text{d.} & = \quad \text{cm} \\
   \text{e.} & = \quad \text{cm}
\end{array} \]

15. How far should a train travelling at 52.5 km/h go in 2.45 hours?

\[ = \]

16. John, Peter and Jelita have only one orange to share. What fraction does each one eat?

\[ = \]

17. A. Let \(A\) stand for \(\{2, 3, 5, 4, 7, 8, 12\}\)
    Let \(B\) stand for \(\{2, 3, 5, 7\}\)
    Draw the diagram for set \(A \& B\)
    Diagram
7. B. Write true (T) of false (F)
   B is the sub-set of A
   A is the sub-set of B
   The intersection of A and B in an empty set
   The intersection of set A and B is the set B
   The union of set A and B is the set A
   4 set A
   4 the intersection of set A and B
   B is a set of prime numbers

8. Draw the hand on the clock to show 14.15 hours.

9. How many grams are in 6 kg?

10. Write in Arabic numerals
    Four point one four =

11. A man borrows K450 for building a house. What amount will he pay for 6 years at 7% simple interest per annum?

12. A book is bought at K0.80n and sold at K0.60n. What in the profit or loss of money made on this book?

13. Add the following numerals written in base five numerals.
    124 five
    + 432 five

14. What is the mass of a car which weighs 750 kg =

25. What is the perimeter of this piece of land?

26. Find the volume of a box 3.5m long, 3.2m wide and 2m deep.

27. 360° = 1 revolution
    90° = 1 right angle
    \( \frac{1}{2} \) a revolution =

28. A school has 48 children in each of 4 classes and 41 children in each of 2 classes. What is the average number of children per class?

29. Find the rule and complete.
    800, 400, 200, 100, __, __, __.
    1, 2, 4, 7, 11, __, __, __.

30. This histogram shows the number of fish caught by Mr Sakala. Draw a graph to show the number of fish he caught. This time using one square for 2 fish.
APPENDIX 3

QUESTIONNAIRE

Answer all the questions with YES or NO.

1. I like everyone I know. ________
2. Sometimes I just feel like shouting. ________
3. Many times when I see a mathematics problem I get scared and I can't think. ________
4. I wish I could be very far from here. ________
5. Other people seem to do things more easily than I can. ________
6. I am always kind. ________
7. I am often nervous when I have to do mathematics. ________
8. Other people do not like the way I do things. ________
9. I always have good manners. ________
10. I am as good in mathematics as I am in other subjects. ________
11. I often feel lonely even when there are people around me. ________
12. I have trouble making up my mind. ________
13. If I had a choice between a science lesson and a mathematics lesson I would choose mathematics. ________
14. I find it difficult to breathe sometimes. ________
15. I get angry easily. ________
16. I tell the truth every single time. ________
17. I am secretly afraid of doing mathematics. ________
18. I do not worry about how well I am doing in mathematics at school. ________
19. I often worry what other people think about me. ________
20. I feel like going to the toilet during the mathematics class more than during other classes. ________
21. Other children are happier than I am. ________
22. I notice my heart beats faster when I have to do a sum on the blackboard than when I have to do English on the blackboard. ________
23. I have worried about things that did not really make a difference later. ________
25. I never swear or say things that I shouldn't say. 

26. I prefer to have my teacher stand and watch me solve problems than to stand and watch me do English. 

27. I never lie. 

28. I am afraid of the dark. 

29. It is hard for me to keep my mind on my school work. 

30. If my teacher gave me a choice of taking a mathematics test or an English test, I would rather do English. 

31. I often do things I wish I had never done. 

32. I wish I did not have to do mathematics at school. 

33. I often have headaches. 

34. I worry that I have not done my mathematics homework correctly, more than I worry about my other homework. 

35. I am nervous. 

36. I get tired easily. 

37. My hands usually sweat while doing mathematics problems. 

38. I have bad dreams sometimes. 

39. I sometimes worry that I won't be able to do the next exercise in mathematics. 

40. I enjoy mathematics more than English.
APPENDIX 4

Number Anxiety Scale

- Dreger & Aiken (1957)

3. I am often nervous when I have to do mathematics.

9. Many times when I see a mathematics problem. I just 'freeze up'.

38. I was never as good in mathematics as in other subjects.
Question Number:

GRADE MATHEMATICS ACHIEVEMENT TESTS - POINTS ALLOCATED FOR EACH TEST

APENDIX 5
### Grade 3 Mathematics

#### Specification Table

<table>
<thead>
<tr>
<th>CONTENT AREA</th>
<th>NUMBER OF ITEM ON TEST</th>
<th>ITEM NO. ON TEST</th>
<th>IDENTICAL ITEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Numeration &amp; Notation</td>
<td>3</td>
<td>18,30,20</td>
<td>- 20 + 18</td>
</tr>
<tr>
<td>2. Addition &amp; Subtraction</td>
<td>3</td>
<td>1,2,2</td>
<td>- 2</td>
</tr>
<tr>
<td>3. Multiplication</td>
<td>3</td>
<td>4,5,7</td>
<td>- 64</td>
</tr>
<tr>
<td>4. Division</td>
<td>3</td>
<td>6,11,9</td>
<td>- 46</td>
</tr>
<tr>
<td>5. Number Pattern</td>
<td>3</td>
<td>23,24,14</td>
<td>- 14</td>
</tr>
<tr>
<td>6. Equalities &amp; Inequalities</td>
<td>3</td>
<td>13,15,8</td>
<td>- 8</td>
</tr>
<tr>
<td>7. Money</td>
<td>3</td>
<td>17,10,19</td>
<td>- 10</td>
</tr>
<tr>
<td>8. Measures &amp; Time</td>
<td>3</td>
<td>27,28,29</td>
<td>- 29</td>
</tr>
<tr>
<td>9. Fractions</td>
<td>3</td>
<td>25,26,16</td>
<td>- 16</td>
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<tr>
<td>10. Shapes</td>
<td>3</td>
<td>21,22,12</td>
<td>- 12</td>
</tr>
</tbody>
</table>
# Grade 5 Mathematics

## Specification Table

<table>
<thead>
<tr>
<th>CONTENT AREA</th>
<th>NUMBER OF ITEMS ON TEST</th>
<th>ITEM NO. ON TEST</th>
<th>IDENTICAL ITEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Numerical &amp; Notation</td>
<td>3</td>
<td>1,3,20</td>
<td>20</td>
</tr>
<tr>
<td>2. Number Line</td>
<td>2</td>
<td>26,14</td>
<td>14</td>
</tr>
<tr>
<td>3. Addition &amp; Subtraction</td>
<td>3</td>
<td>20,2,8</td>
<td>2,8</td>
</tr>
<tr>
<td>4. Multiplication</td>
<td>3</td>
<td>4,13,15</td>
<td>4</td>
</tr>
<tr>
<td>5. Division</td>
<td>3</td>
<td>6,17,19</td>
<td>6</td>
</tr>
<tr>
<td>6. Factors &amp; Multiples of No.</td>
<td>2</td>
<td>11,30</td>
<td>-</td>
</tr>
<tr>
<td>7. Fractions</td>
<td>2</td>
<td>9,29</td>
<td>-</td>
</tr>
<tr>
<td>8. Money</td>
<td>3</td>
<td>10,23,24</td>
<td>10</td>
</tr>
<tr>
<td>9. Measures/Time/Temp.</td>
<td>3</td>
<td>27,28,18</td>
<td>18</td>
</tr>
<tr>
<td>10. Decimal Fractions</td>
<td>3</td>
<td>5,22,16</td>
<td>16</td>
</tr>
<tr>
<td>11. Measurement &amp; Drawing</td>
<td>3</td>
<td>8,12,25</td>
<td>12</td>
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</table>
### Grade 7 Mathematics

#### Specification Table

<table>
<thead>
<tr>
<th>CONTENT AREA</th>
<th>NUMBER OF ITEMS ON TEST</th>
<th>ITEM NO. ON TEST</th>
<th>IDENTICAL ITEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Numeration &amp; Notation</td>
<td>3</td>
<td>1,29,20</td>
<td>20</td>
</tr>
<tr>
<td>2. Addition &amp; Subtraction</td>
<td>2</td>
<td>2,5</td>
<td>2</td>
</tr>
<tr>
<td>3. Multiplication &amp; Division</td>
<td>3</td>
<td>11,4,6</td>
<td>4,6</td>
</tr>
<tr>
<td>4. Fractions</td>
<td>3</td>
<td>7,9,16</td>
<td>16</td>
</tr>
<tr>
<td>5. Measures, Time &amp; Temp.</td>
<td>3</td>
<td>19,18,24</td>
<td>18</td>
</tr>
<tr>
<td>6. Perimetre, Area &amp; Vol.</td>
<td>2</td>
<td>25,20</td>
<td>-</td>
</tr>
<tr>
<td>7. Ratio + Proportion</td>
<td>2</td>
<td>15,21</td>
<td>-</td>
</tr>
<tr>
<td>8. Money</td>
<td>2</td>
<td>10,22</td>
<td>10</td>
</tr>
<tr>
<td>9. Averages</td>
<td>1</td>
<td>28</td>
<td>-</td>
</tr>
<tr>
<td>10. The Number Line</td>
<td>2</td>
<td>14,3</td>
<td>14</td>
</tr>
<tr>
<td>11. Equalities &amp; Inequalities</td>
<td>1</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>12. Number bases</td>
<td>2</td>
<td>13,23</td>
<td>-</td>
</tr>
<tr>
<td>13. Measurement &amp; Drawing</td>
<td>3</td>
<td>17,12,27</td>
<td>12</td>
</tr>
<tr>
<td>14. Graphs</td>
<td>1</td>
<td>30</td>
<td>-</td>
</tr>
</tbody>
</table>
APPENDIX 7

INSTRUCTIONS

Mathematics Test:

"In front of you is a mathematics test we would like to work as quickly and as carefully as possible. You will have enough time to finish the test. If you do not understand a question, put up your hand and ask. Please work on your own and don't ask your neighbours for any help. Try your best to answer all questions, even the difficult ones. Remember don't work with someone else, your teacher will not see the test results".

Anxiety Test:

"In front of you is a questionnaire or a set of questions that we would like you to answer. The questions are about different things, please answer them truthfully. After all there are no right and no wrong answers. Just as some of you prefer Coke to Fanta, others prefer Fanta to Coke. So even with these questions answers will not be the same because we do not feel the same about different things. Remember that no-one will be told what your answers were. If you have any questions, raise your hand".
APPENDIX 8

MATHEMATICS SYLLABI

GRADE III

1. Numeration and notation:
   Reading and writing numerals and vertical addition and subtraction
   with numbers up to 1000; stress the meaning of place value.

2. Addition and subtraction:
   (a) Development of Grade II work.
   (b) Develop and use all compositions for addition and subtraction.
   (c) Extend techniques of addition and subtraction of whole
       numbers up to 1000 using regrouping.

3. Multiplication:
   (a) Revise tables of 2, 3, 4, 5 and 10.
   (b) Build up and learn the tables of 6, 7, 8 and 9.
   (c) Vertical multiplication of numbers to three figures multiplied
       by numbers from 2 to 10.
       Products limited to 1000.
   (d) Factor pairs within limit of tables.

4. Division:
   (a) Division by 2, 3, 4, 5, 6, 7, 8, 9 and 10 (dividends to 1000).
   (b) Multiplication as inverse division.

5. Number patterns:
   Using even and odd numbers.

6. Equalities and inequalities:
   (a) Consolidation of Grades I and II work.
   (b) Finding the missing number in a given mathematical statement
       involving the four known operations.
7. Money:
   (a) Revision of Grades I and II work.
   (b) Recognition of the two and ten Kwacha bank notes.
   (c) Addition and subtraction to K10.
   (d) Simple shopping exercises. Getting and giving change for purchases first up to K2, then K10.

8. Measures and time treated practically:
   (a) Length: metre, centimetre: m, cm.
   (b) Mass: kilogram: kg.
   (c) Capacity: litre, l.
   (d) Time: telling time - 1 hour, ½ hour, ¼ hour and 5 minutes intervals using the 24-hour clock.
   (e) Calendar: 1 year, month, week and day.

9. Fractions:
   (a) The idea of a fraction as part of a whole.
   (b) Practical work with ½, ¼, ⅕ and ⅕.

10. Shapes (square, circle, rectangle and triangle):
    (a) Recognition of shapes.
    (b) Drawing of shapes using squared exercise books.
    (c) Using shapes to draw pictures.

11. Problems:
1. Numeration and notation:
   (a) Reading and writing numerals and number words to 100,000.
   (b) Meaning of specific digits of a decimal numeral; stress place value.

2. Number line:
   (a) Addition, subtraction, multiplication and division of whole numbers using the number line.
   (b) Ordering whole numbers; inequalities.

3. Addition and subtraction:
   Revision in number compositions and extensions (sums and minuends to 100,000).

4. Multiplication:
   (a) Constant practice in all tables up to ten times ten.
   (b) Multiplication by 100.
   (c) Multiplication by multiples of 100.
   (d) Multiplication by multipliers with not more than three digits (products to not more than 100,000).
   (e) Awareness and use of properties of multiplication; the properties of one and zero.

5. Division:
   (a) Continue practice in all tables to ten times ten.
   (b) Division by multiples of 100.
   (c) Division by divisors with three digits (dividends to not more than 100,000).

6. Factors and multiples of numbers:
   (a) Prime and composite numbers.
   (b) Multiples.
   (c) Recognition of L.C.M.
7. Fractions:
   (a) Revision of Grade IV work.
   (b) Proper and improper fractions.
   (c) Addition, subtraction and multiplication of simple fractions.
   (d) Division of whole numbers by fractions.
   (e) Division of fractions by whole numbers.
   (f) Simple equivalent fractions.

8. Money:
   (a) The four rules.
   (b) Shopping and simple bills.

9. Measures, time and temperature:
   (a) Four rules applied to length, weight and capacity.
   (b) Time: Telling and writing the time in minutes - four rules:
        24-hour clock.
   (c) Temperature: Practical work in reading the temperature using
degrees Celsius: °C.

10. Decimal fractions:
    (a) Decimal names for common fractions up to two places.
    (b) Four rules applied to decimals to two places.

11. Measurement and drawing:
    (a) Revision of Grade IV work.
    (b) The idea of area: square centimetre: cm².
    (c) Making square centimetres.
    (d) Using square centimetres to find area of rectangles.
    (e) Making and using square metres for larger areas.
    (f) Recognition of:-
        (i) rectangular prisms;
        (ii) right circular cylinders;
        (iii) cones;
        (iv) spheres.
GRADE VII

1. Numeration and notation:
   (a) Consolidation of previous work. Emphasis on place value.
       Notation to 1 000 000.
   (b) Roman numerals up to 1 000 (reading and writing only).

2. Addition and subtraction:
   Revision and consolidation of previous work.

3. Multiplication and division:
   (a) Consolidation of previous work.
   (b) Random practice of all tables to 10 times 10 (with emphasis on
       the meaning of factors, multiples, and products); also multi-
       plication and division by 20, 30, 40,... 90.
   (c) Multiplication and division by 10, 100 and 1 000 emphasis on
       the understanding of place value).
   (d) Multiplication and division by numbers represented by numerals
       with not more than three digits.

       (NOTE: For multiplication multipliers can go up to four digits).

4. Fractions:
   (a) Four rules applied to common fractions.
   (b) Four rules applied to decimal fractions.
   (c) Four rules applied to percentages.

       (NOTE: It is important that teachers should help their pupils
       to develop an understanding of the important mathematical
       idea that fractions are numbers; that they have common
       names, decimal names and per cent names. This is a most
       useful unifying concept which pupils should understand.

5. Measures, time and temperature:
   Revision and consolidation of previous work.
6. Perimeter, area and volume:
   Revision, consolidation and extension of previous work.

7. Ratio and proportion:
   (a) Revision of Grade VI work.
   (b) Simple proportion by the fractional method.

8. Money:
   (a) Four rules.
   (b) Simple bills and accounts.
   (c) Marketing, profit and loss.
   (d) The idea of interest (without using formula).

9. Averages:
   (a) Consolidation of previous work.
   (b) Averages applied to money and other concrete quantities.

10. The Number Line:
    (a) Positive and negative whole numbers and zero.
    (b) Using the number line for the addition and subtraction of
        positive and negative numbers.

11. Equations and inequalities:
    (a) Very simple study of equations and inequalities.
    (b) Use of equations in very simple problems.

12. Number bases:
    Addition and subtraction in base 5 and 8.

13. Measurement and drawing:
    (a) Ability to recognise: an angle; a right angle; angle less than
        a right angle; angle greater than a right angle.
    (b) Simple exercises on measuring angles up to 180° using a
        protractor.
14. Graphs:

(a) Revision of Grade VI work.
(b) Ability to read pie charts (sector).
APPENDIX 9

Grade 3, 5 & 7 Mathematics

Identical Items Component

2.  
   \[
   \begin{array}{c}
   12582 \\
   + 12581 \\
   \hline
   \end{array}
   \]

4.  
   
   \[
   \begin{array}{c}
   106 \\
   \times 12 \\
   \hline
   \end{array}
   \]

6. Moyo has 48 chickens in 4 houses. How many are there in one house?

8. Put < or > in each box

   \[
   \begin{array}{c}
   90 \square 900, \\
   50 \square 9 + 7 \\
   \hline
   \end{array}
   \]

10. 122n = ________ Kwacha ________ ngwee.

12. What shapes can you see?

   \[
   \begin{array}{c}
   (a) \\
   \square \\
   (b) \\
   \square \\
   (c) \\
   \triangle \\
   (d) \\
   \square \\
   \hline
   \end{array}
   \]

14. Measure each side of Jelita's toy.

   \[
   \begin{array}{c}
   a = \underline{\quad} \text{cm} \\
   b = \underline{\quad} \text{cm} \\
   c = \underline{\quad} \text{cm} \\
   d = \underline{\quad} \text{cm} \\
   e = \underline{\quad} \text{cm} \\
   \hline
   \end{array}
   \]
16. John Peter + Jelita have only one orange to share. What fraction does each one eat? = 

18. Draw the Hands on the clock to show 14.15 hours.

20. Write in Arabic Numerals
   (a) Four point one four. = 

   [Image of a clock face with numbers 1 through 24 in a circular layout]
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