AN INVESTIGATION INTO THE RELATIONSHIP BETWEEN MATHEMATICAL ABILITY AND MATHEMATICAL ACHIEVEMENT OF STANDARD SEVEN CHILDREN OF KENYA

BY

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DECLARATION

"This thesis is my original work and has not been presented for a degree in any other University".

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"The thesis has been submitted for examination with my approval as a University Supervisor".

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D E D I C A T I O N

This thesis is dedicated with alot of respect and appreciation to my parents MR. CORNEL APIYO IMBO AND MRS BIRGITTA DIANG'A APIYO whose efforts to educate me have resulted in this work.

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ABSTRACT

This thesis investigated the relationship between Mathematical Ability and Mathematical Achievement in standard seven pupils of Kenya. It further investigated performance differences among pupils attending different types of schools and also between male and female pupils in mathematics.

The study was prompted by the very little research work done in this area in Kenya, and where some work was done already, the results were not conclusive. The study examined four main research questions:

1. How significant is the relationship between Mathematical Achievement and Mathematical Ability, Mathematical Achievement and Mathematical Vocabulary, and Mathematical Achievement and English Language Proficiency.

2. Do the scores of pupils attending the Low cost, Medium cost and High cost schools differ significantly in Mathematical Achievement, Mathematical Ability, Mathematical Vocabulary and English Language Proficiency tests?

3. Do the scores of male and female pupils differ significantly in Mathematical Achievement, Mathematical Ability, Mathematical Vocabulary and English Language Proficiency tests?

4. Which factors account for the variation in performance on Mathematical Achievement test?

The subjects for this study consisted of a total of 634 standard seven pupils from 15 primary schools in Kenya. The schools were of three types, Low Cost, Medium Cost and High Cost, all drawn from Kisumu town within a radius of 10 kilometres, Kisumu town is in Kisumu District in Nyanza Province, Kenya. In each school, under normal classroom conditions, the selected pupils were given tests on Mathematical Achievement, Mathematical Ability, Mathematical Vocabulary and English Language Proficiency. A questionnaire to provide information on pupils' age, class repetition and after-school coaching in Mathematics and English was also given to the pupils.

The results of correlation analysis revealed very strong relationship between Mathematical Achievement and Mathematical Ability, implying that what the pupils achieved in Mathematics was a result of their level of

ability in Mathematics. Strong correlations were also found between Mathematical Achievement and Mathematical Vocabulary and between Mathematical Achievement and English Language Proficiency.

A comparison of the scores of pupils attending Low Cost, Medium Cost and High Cost primary schools by the One-Way ANOVA technique revealed statistically significant differences at $p < .001$ in favour of pupils in High Cost schools.

Significant sex differences were found in Mathematical Ability, Mathematical Achievement and Mathematical Vocabulary in favour of male pupils but not in English Language Proficiency. This clearly showed that the female pupils have a problem in Mathematics.

Step-wise multiple regression analysis revealed that 62% of the variation in pupils' Mathematical Achievement was accounted for by their level of Mathematical Ability, Mathematical Vocabulary, English Language Proficiency, Sex of pupil, Class repetition, Type of school and After-school Coaching in English and Mathematics.

It was concluded that differences in pupil performance in the tests reflected differences in the schools the pupils attended. Further research is therefore required to qualitatively and quantitatively determine which factors within the school environment are responsible for the differences in pupil performance.

It is therefore recommended that if the potential of our youth has to be realized fully, then equal opportunity in education must be provided for all, and one way to do this is to get the schools to be as equivalent in standard as possible.

CHAPTER ONE

INTRODUCTION

1.1 The Research Problem

The major purpose of this study was to investigate the relationship between Mathematical Ability and Mathematical Achievement of standard seven pupils of Kenya.

The education of children is one of the most important priority areas in which the parents and the government show keen interest. Much of what the pupils learn in school is carefully planned to meet the needs of the people and this is reflected in the government's major goals (objectives). The Kenya education system like other countries is a stage wise process. The process starts with pre-primary school stage through to Primary school stage, Secondary and High school stage then to the University. Each stage of education level takes a specified amount of time, and there is a given prescription of subject matter in the school syllabus which one is expected to cover within a given stage. In other words the pupils are expected to have mastered the required content and acquired the desired skills specified in the National Educational Objectives.

Currently and for some years back the main stages of formal education in Kenya are Pre-primary (Nursery and Kindergarten) (2 years), Primary (7 years), Secondary (4 years), and High School (2 years), and University (3 - 5 years). At the lower stages of formal education pupils are only exposed to a variety of subjects. At the secondary level, they start specializing in their favourite subjects. In Primary Education the subjects covered include English Language (Grammar and Composition), Mathematics, History and Civics, Geography, Science, Religion, Arts and Crafts and Music. At the end of the primary education, that is after seven years, all these subjects, with the exception of arts and craft, religion and music are examined through a National Examination. The National Examination is known as Certificate of Primary Education (C.P.E.). Success or failure in this Examination determines whether a pupil proceeds for Secondary Education in a Government Institution, Private or Harambee school or simply drops out if unable to join any of these.

One critical issue in the Primary Education set up in Kenya is that the Primary Schools' maintenance varies a great deal in terms of school equipment, teaching staff, etc. The range is from the very poorly maintained schools to the very well maintained High Cost Schools. Most of the poorly maintained schools are found in the rural areas while the well maintained ones are found in the urban areas. In between there exist schools that vary in strength of maintenance. All the pupils attending these various schools are exposed to and are expected to cover the content of each subject in the primary schools syllabus. This exercise is the school's and its teachers' responsibility. By the end of primary education all the pupils take the Certificate of Primary Education (C.P.E.) Examination. Selection for secondary education is done on the basis of their performance in the C.P.E.

A careful analysis shows that when the results of pupils from all the schools are compared, a pattern emerges in the performance of pupils attending the different types of schools. Such patterns were shown in the studies of Somerset (1974) and King (1974), and observation shows that they have persisted upto today. Precisely the pattern indicates that pupils who attend the High Cost schools always on the average perform better than those who attend the Low Cost schools. The differential performance by pupils attending the different school types would imply that pupils in certain types of schools are superior intellectually to the ones in the other type of schools. Whether such a case is true or not requires investigation.

Although at the individual schools, end of term tests are taken by pupils and there is a Mock Examination just before the National Examination, the results of the end of term tests and Mock Examination are never considered for any decision making purposes at a national level. However, the disparity in pupil performance and the pattern revealed for pupils attending different school types generate concern and warrant investigation. Most important would be to determine whether what the pupils achieve in the National Examination is a reflection of their potential ability. This is in an attempt to establish whether the potential of the pupils have been realized in our Education System. An investigation of this kind would appear quite difficult since it would involve scrutinizing pupil performance in the various subjects, in an attempt to identify the nature, cause and where such differences occur. It would also involve identification of pupils' specific abilities in relation to their achievements.

To be able to carry out a study whereby pupils' achivement would be analysed in relation to pupils' ability and other related factors, mathematics as a subject was chosen because:

1. It is one of the most important subjects in the Primary Schools Syllabus and one which is

tested on its own as a paper at C.P.E. Examinations.

2. Mathematics is a subject where there are specific Mathematical Ability factors which determine pupils's performances in it. Such Mathematical Ability factors have been isolated (Werdelin, 1958; Krutetskii, 1976; Eshiwani, 1974; etc.)

3. It is a subject where sharp differences in performance has consistently been registered between males and females (Maccoby, 1966; Sherman, 1974; 1978; Eshiwani, 1974; Omar Sheikh, 1976; etc.)

In this study the main concern was to determine (a) the relationship between pupils' Mathematical Ability* and Mathematical Achievement*, (b) performance differences among pupils (c) sex-differences in Mathematical Performance and (d) factors responsible for the variation in Mathematical Achievement.

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*Mathematical Ability refers to a composite of factors that is, Spatial Ability, Mathematical Reasoning Ability, Computation and Numeration Ability and Problem Solving Ability. These factors determine the level of performance in Mathematics.

*Mathematical Achievement refers to the mathematical skills a pupil has developed through his/her general experience during primary education based on the primary school mathematics syllabus.
Detailed operationalization of these terms and others will be found in chapter three of this thesis.

This was in an attempt to identify the cause of the disparity in performance between pupils attending different types of schools. Though the disparity in performance of pupils attending the different types of schools have been known to exist, very little research has been done. The Kenya National Examination Council compiled results of item analysis of performance on examination questions for different categories of schools, and results on sex differences in performance. Table 1.1 below shows the performance of bpys and girls in C.P.E. 1979 and 1980 Mathematics Paper.

TABLE 1.1

MEAN AND STANDARD DEVIATION OF PERFORMANCE IN C.P.E. 1979 AND 1980 MATHEMATICS PAPER FOR MALE AND FEMALE PUPILS (NATIONAL)*

	1979				1980			
	BOYS		GIRLS		BOYS		GIRLS	
	MEAN	S.D	MEAN	S.D	MEAN	S.D	MEAN	S.D.
Rural	52.5	15.4	46.1	12.9	52.7	15.4	45.9	13.1
Urban	55.8	17.1	50.5	15.8	55.9	16.8	50.1	15.6

From the table differences are seen to exist between performance of boys and girls, and between rural and urban

* The results were got official from the Kenya National Examination Council, Computer Sheets for C.P.E. 1979 and 1980 results.

pupils. The differences have been consistent over the years. Clearly the sex difference in mathematical performance and the environmental influences due to attending different school types, some located in urban and some in rural areas deserved further research. One of the influencesof the environment or pupil home background on performance has to do with language used in the schools for instruction and at home. In Kenya, English Language is used as a medium of instruction in the schools though it is a second language for all the pupils. According to Vygotsky's (1962) finding that language is important for concept formation, it is clear that the language used for instruction in mathematics would influence learning and performance in mathematics. Therefore it was important to determine pupils' level of English Language Proficiency and establish its relationship with Mathematical Achievement. On the other hand mathematics has been viewed to be a specialized language (Aiken, 1972) implying it has unique vocabulary and terms. An explanation of variation in pupil Mathematical Achievement would require an understanding and established level of knowledge of Mathematical Vocabulary.

1.2 Research Questions

The study attempted to provide solution to the following questions:

1. How does Mathematical Ability relate to Mathematical Achievement?

2. Do pupils from the different types of schools differ in their Mathematical Ability, Mathematical Achievement, Mathematical Vocabulary and Proficiency in English Language?

3. Do male and female pupils differ in their Mathematical Ability, Mathematical Achievement, Mathematical Vocabulary and Proficiency in English Language?

4. Which factors are responsible or account for the variation in Mathematical Achievement?

1.3 Important Variables in the Study

A study of this kind is subject to very many intervening variables. Where assessment is involved it is expected that a number of factors would influence the outcome. However in this study attempt was made to control as much as possible the intervening variables.

The main variables for the study were Mathematical Achievement, Mathematical Ability, Mathematical Vocabulary, English Language Proficiency, Type of school and Sex of pupil. In addition to these variables, factors which could implicitly have an influence on the study such as age of the pupil, class repetition, after-school coaching in Mathematics and English were considered. The dependent variable was Mathematical Achievement while Mathematical Ability, Mathematical Vocabulary, English Language Proficiency, Type of school and Sex of pupil were the independent variables.

The factors within each school type, like teachers, school amenities, teaching aids, et cetra, were all considered under the variable Type of School, such that difference in the school types would account for such variation.

1.4 Significance of the Choice of Variables

All the variables mentioned above were expected to provide information regarding the performance differences among pupils attending different school types.

That was mainly because the dependent variable which was Mathematical Achievement was deemed to be significantly influenced by the independent variables.

1.5 Significance of the Study

Through its nature and purpose such a study would be expected to provide more information in the relative status of the schools. That kind of information could assist in curriculum organization and when it comes to ratifying certain important decisions on the organization of the primary schools. The applicability of the findings of such a study might not be restricted to the primary education level alone, it could be applicable to all levels of education where the situation and organization are similar to the one which provoked the study.

The fact that much importance is attached to school performance especially when it comes to selection for further education and future careers is unquestionable. This would imply that school performance is determinant of future success. This is why it is important to determine whether what a pupil achieves is a reflection of his ability. As a goal for National Development it must be ascertained that pupil potential is fully realised.

The finding by ILO (1972), that school performance bore the greatest direct relationship to occupational achievement would serve to elucidate the fact. Therefore a study focusing on factors that influence subject achievement could be viewed as one way of trying to alleviate any shortcomings within the education system and the evaluation program.

Finally the importance of medium of instruction must not be underestimated. The fact that English Language is a second language to many pupils and teachers would require that certain measures be taken if it is found to influence the teaching/learning progress.

CHAPTER TWO

REVIEW OF LITERATURE

2.1 Introduction

In this chapter attempt is made to review literature that is related to the study. The main areas covered in the review include Mathematical Ability, Achievement and Ability in Mathematics, Mathematics and Language, and Mathematics and Sex. Though much of the reference was expected from Kenya or East Africa, scarcity of literature related to the study has led to reviewing more studies elsewhere.

2.2 Mathematical Ability

The review of literature on Mathematical Ability covered two major approaches of study, that is, Theoretical approach and Empirical approach. The Theoretical approach involved general definition of Mathematical Ability and what it was thought to be. The Empirical approach involved carrying out tests and analysis, mainly factor analysis, to be able to identify factors that composed Mathematical Ability. A number of researches have been done in the past on Mathematical Ability and here only a few important ones will be reviewed. From the reviews, Mathematical Ability will be defined operationally, and then important factors to

Mathematical Ability identified. Tests based on the important factors which were used in the past by several researchers will be adapted for this study.

Mathematics is a subject where there is a belief that to be able to perform well one ought to have an ability in it. Like mathematics, there is a similar belief for Music and Fine Art. The view here, has been that there exist specific abilities linked with performance in certain subjects which make some people to be better than others at those subjects. Goslin (1963, p. 125) thought that ability was a hypothetical construct. He argued that,

> .... although we cannot really see an 'ability' or locate it in the cell structure of the brain or muscles, we can infer its presence or lack of presence in an individual from his performance. The usefulness of an ability construct stems from the fact that it makes possible the prediction of actual performances in similar but not exactly identical situations. Thus the whole notion of human abilities implies a set of responses that are buried deep within the individual .... the manifestation of an ability requires a situation in which that ability is appropriate.

Goslin's arguement tied quite closely with Baldwin's (1958, p. 197) statement that ability refered to;

> .... that characteristic of an individual which permits him to behave adaptively, that is to cause the same result even though from time to time the circumstances vary.

While an exhaustive definition of general ability has never been found, most definitions centre on arguements similar to the ones presented above.

Performance in any given task calls for an ability specific to the task, and high or low performance will be viewed to imply high or low ability in the given task. This issue has led people to have the feeling that they are more able in some and not in other subjects. In Mathematics the feeling of being able or unable is widespread. It is not uncommon to hear a student explain his poor performance in mathematics due to not having the ability or a 'mathematical mind', a term used by a Russian psychologist, Krutetskii. Krutetskii (1969) referred to children who are gifted in mathematics as having a 'mathematical frame of mind'. According to Krutetskii such children found mathematical meanings in many aspects of reality and tended to categorize things in terms of mathematics and logic.

An earlier study by Carlton (1959) established that there were several different types of mathematical minds.

Carlton did a survey of the educational philosophies of fourteen eminent mathematicians and found from the writings of these famous men the following mathematical minds. One type of mind was said to be logical and formal, whereas another to be slow. The distinction between these types of mathematical minds was dealt with most extensively by Poincare (1952), who maintained that geometers were more intuitive, and analysts more logical in their thinking. Though the explanation did not bring out the fact clearly, right from the early days Mathematical Ability had been known to exist as a composite of factors. Operationalizing Mathematical Ability was the most difficult problem and for sometime people have struggled to provide a suitable definition.

Rogers (1918) split Mathematical Ability into two aspects, reproductive and productive. To him, the reproductive aspect was related to the function of memory while the productive aspect was related to the function of thought. Rogers however could not go beyond that.

Betz (1922) defined Mathematical Ability as the ability to have a clear awareness of the internal connections in mathematical material. His definition was quite general.

Hamley (1935) viewed Mathematical Ability as a compound of general intelligence, visual imagery, ability to perceive number and space configurations and to retain such configurations as patterns. Each of those could be subdivided into simpler components.

Although the definitions seemed to vary they were based on the skills required in solving any Mathematical task.

Blackwell (1940) carried a factorial study of Mathematical Ability and interpreted it in two forms. One form was for selective thinking in the realm of quantitative relationships (quantitative thinking) and for deductive reasoning. The other form was the ability to apply general principles to particualr cases in the realm of numbers, symbols and geometric forms.

Meinander (1950) viewed Mathematical Ability as a complex quality including intelligence, memory, interest and volitional factors.

Revesz (1952) examined two basic forms of Mathematical Ability, applicative and productive. Applicative form referred to the ability to find mathematical relationships quickly without preliminary trials, and to apply the appropriate information in analogous instances. Productive form referred to the ability to reveal relationships that do not follow immediately from the available information.

In the early fifties M. K. Barakat reported his factorial study of Mathematical Ability. He studied 300 pupils in four grammar schools with a variety of tests. He succeeded in deriving and identifying six factors known as, G(General), S(Spatial, N(Numerical), M(Memory) and the so called mathematical factors, which in his opinion played a definite part in mathematical thinking. He also attempted to show that the mathematical factor was the ability to manipulate mathematical schemes and relations.

Lee (1955) viewed Mathematical Ability as "ability to succeed in mathematics" and defined it as the ability to understand (grasp) the basic concepts of mathematics and to manipulate them.

Werdelin (1958, p. 13) studied Mathematical Ability through factor analysis and came up with a definition of what he called school Mathematical Ability. He defined it as the ability to understand the nature of mathematical and similar problems, symbols, methods and proofs, to learn them, to retain them in memory and to produce them;

to combine them with other problems, symbols, methods and proofs and to use them when solving mathematical (and similar) tasks.

Burt (1967, p. 126) emphasized that "Mathematical Ability has almost always been regarded as a distinct ability or gift". To him Mathematical Ability was undoubtedly a composite, with the essential constituent including an ability to form, retain and use associations between numerical or at least non-verbal symbols.

Although the definitions so far reviewed were theoretical and seemed to vary, they were based on the skills required in solving a mathematical task. From the review of literature presented it was clear that efforts were concentrated in operationalizing Mathematical Ability in an attempt to identify its main factors. The two main methods used in the researches were factor analysis and logical analysis. Aiken (1973) presented a summary of the findings of different researchers on the factors that compose Mathematical Ability. Through various factor analytic investigations the representative Mathematical Ability factors obtained were;

Deductive (general) reasoning - (Blackwell, 1940; Kline, 1960; Very, 1967; Werdelin, 1958, 1966; Wooldridge, 1964).

Inductive reasoning - (Werdelin, 1958)

Numerical ability - (Kline, 1960; Very, 1967; Wooldridge, 1964, Werdelin, 1958, 1966).

Spatial - perceptual ability - (Blackwell, 1940; Kline, 1960, Very, 1967, Werdelin, 1966).

Verbal comprehension - (Blackwell, 1940; Kline, 1960, Very, 1967; Werdelin, 1958, 1966, Wooldridge, 1964).

On the other hand based on logical analysis, Krutetskii (1966) isolated the components of Mathematical Ability. He did this through his observations and impressions of the responses of Russian school children to Mathematical problems. The basic components of Mathematical Ability he found were;

(a) formalized perception of mathematical material,

(b) generalization of mathematical material,

(c) 'curtailment' of thought,

(d) striving for economy of mental forces

(e) flexibility of thought

(f) mathematical memory, and

(g) spatial concepts.

Comparing the factors and components of Mathematical Ability, only spatial ability appeared to be the common one. It would be expected that the factors and components of Mathematical Ability should mean the same thing since both were measures of Mathematical Ability. Studies to show the relationship between the factors and components of Mathematical Ability have not been done. However, the main problem would be on the measurement of the factors or the components of Mathematical Ability. Due to the subjectivity that might arise from observations and impressions, the method of assessment adopted in logical analysis, the tendency has been to use the factors rather than the components when assessing the level of Mathematical Ability.

Over the last ten or so years, further attempts to operationalize Mathematical Ability has been minimal. However, Wilson, et al. (1968) in carrying out the National Longitudinal Study of Mathematical Ability, viewed

Mathematical Ability as composed of;

(a) Mathematical Reasoning Ability

(b) Spatial - Perceptual (Visualization) Ability

(c) Numerical (Computatational) Ability.

(d) Problem Solving Ability.

Wilson combined inductive and deductive reasoning abilities to form Mathematical Reasoning Ability, and replaced verbal comprehension ability with problem solving ability. He also carried out his study through factor analysis and found the four factors already mentioned to compose Mathematical Ability. His group, "School Mathematics Study Group" also constructed tests based on each of the factors of Mathematical Ability and validated them. The tests have been used by Eshiwani (1974, 1980) and Wamani (1980) in studying the Mathematical Ability of School Children. These factors of Mathematical Ability have been operationalized as follows:

(a) Mathematical Reasoning Ability was defined as the ability to discern information through some logic and abstraction and use it to process mathematical tasks. It involved the use of induction and deduction in solution to mathematical problems and the ability to process logical propositions quickly.

The important tests for this factor were found to be, Arithmetic Reasoning Test and Five Dots Test. (Thurstone, 1938; Wilston, *et al*., 1954; Hills, 1960).

(b) Spatial - Perceptual (Visualization) Ability- was defined as the ability to perceive spatial patterns or to maintain orientation with respect to objects in space; the ability to keep one or more definite configurations in mind so as to make identification inspite of perceptual distractions. It also involved the ability to perceive objects rapidly despite confusing background, and also rapid perception of similarities. In general spatial - perceptual ability was viewed as the ability to perceive, interpret or mentally rearrange objects as spatially related.

The important tests were Hidden Figures Test and Foarm Board Test (Gottschaldt, 1926; Witkin, 1950, Guilford, *et al*., 1952; Bennett, *et al*., 1952 Jackson, 1956; Michael, *et al*., 1957; Gardner, *et al*., 1960; Kagan and Moss, 1962).

(c) Numerical (Computational) Ability was defined as the ability to manipulate and compute with figures. It involved keenness and accuracy in handling numerical operations.
The important tests were found to be computational or Numerical Operations Test and Whole Number Comprehension Test. The speed element was found to be very important in these tests (Thurstone, 1938; Michael, et. al., 1957).

(d) Problem Solving Ability - was defined as the ability to diagnose and dissect into mathematical tasks, see through their solution and solve the problem.
The important test was Problem Solving Test (Wilson, et al., 1954).

With the factors of Mathematical Ability isolated and operationalized, attempts have been made to examine the relationship between Mathematical Ability and Mathematical Achievement. This study adopted Wilson, et al. (1968) factors and tests.

2.3 Relationship Between Ability and Achievement in Mathematics.

After the isolation of the Mathematical

Ability factors it was found logical by the researchers to construct tests to measure each of the factors. The scores on these factored tests could then be used to predict performance in specific mathematics courses and also assist in the planning of instructional treatments most suitable for students having specific patterns of ability (Aiken, 1973). It could also prove the view that Mathematical Achievement was influenced by a composite of specific abilities in Mathematics (Guilford, Hoepfner and Peterson, 1965; Hills, 1957). Mathematical Achievement was taken to refer to the skills acquired in Mathematics as a result of instruction and experience at school.

As observation made in some studies indicated children who excel in Mathematics tended to score high on tests of general intelligence (Duncan, 1961; Kennedy and Walsh, 1965; Geng and Mehl, 1969). The studies attempted to establish whether general intelligence or Mathematical Ability was more important to Mathematical Achievement. Evans (1965) in a separate study found that above average intelligence was necessary but not sufficient for high performance on tests of Mathematical Ability and Mathematical Creativity. This implied that Mathematical Ability was unique in itself. Fox (1976) supported this idea by saying that, knowing that a student had an Intelligence Quotient (I.Q.) of [illegible] was not adequate information for deciding whether or not [illegible]

(IQ) of 160 was not adequate information for deciding whether or not the student was ready for a college course in science or mathematics. There was need to know the pupils pattern of ability, his level of achievement and interest. IQ just showed the learning potential of a pupil.

Predicting pupils' Mathematical Achievement has been a very tricky problem at every level of education yet a very important one. Basically it entails identifying factors that relate significantly with Mathematical Achievement.

Wick (1965) carried out a correlation study between Mathematical Achievement and scores of factored tests of Mathematical Ability and his results indicated very low correlations. His main concern was to identify factors associated with success in first year college mathematics. Though the result appeared opposite of what would be expected it was possible that there were other factors influencing the outcome. Aiken (1973) reported that results from many other investigations had shown that previous mathematics grades were the best predictors of Mathematical Achievement.

Considering the fact that the subjects for this study were of primary level of education, reviews of studies at a similar level would be most desirable. Dayo Adejumo (1977) carried out a predictive study on Mathematical Achievement of some Nigerian Children. He used Modified Halls Matrices (MHM), a test of Mathematical Reasoning Ability. With 180 subjects of 7 and 8 years old, the predictive power of the MHM for Mathematical Ability of young children in Nigerian schools was found to be satisfactory and acceptable. The high correlations found between MHM and Mathematical Achievement showed that MHM could be used to detect children with possible deficiencies in logical operations and computational ability.

Studies on the relationship between ability and achievement in mathematics were geared at predicting future achievement in mathematics. The studies have normally used only single factors of Mathematical Ability.

Sherman (1979) attempted to predict mathematics performance in high school girls and boys. She used ninth-grade (standard) scores for 157 females and 148 males for cognitive tests (Test of Academic Progress, Quick Word Test, (Space Relations, Test for Differential Aptitude) and Eight Fennema Sherman Mathematics Attitude scales to predict Mathematics Performance. Using multiple regression, ninth-grade scores significantly predicted mathematics performance

1 - 3 years later. Spatial visualization significantly predicted geometry grade for girls but not for boys. She also found that aside from Mathematical Achievement, Spatial Visualization was the only other variable with significant weight in predicting mathematical problem solving scores for girls over a three year period. Apart from the other findings it noted the importance of spatial ability as a factor of Mathematical Ability.

Guay and McDaniel (1977) had earlier studied the relationship between Mathematical Achievement and Spatial Ability among elementary school children. In their study, four Spatial Ability Tests were administered to 90 children enrolled in grade (standard) 2 through grade (standard) 7. Two tests measured simple spatial ability, that is, visualizing two dimensional configurations, the other two measured complex spatial ability, that is visualizing and mentally rotating three dimensional configurations. Scores on the Iowa Test of Basic Skills were used to classify children as High and Low Achievers. The results indicated that High Mathematical Achievers scored significantly higher than Low Mathematical Achievers in all the four Spatial Tests ($p < .05$). Additionally males scored significantly higher than females in the two tests measuring complex spatial ability ($p < .05$). The findings suggested that among elementary school children, high Mathematical Achievers have greater Spatial Ability than Low Mathematical Achievers.

El Abd (1971) carried out a study on the relationship between ability and achievement in mathematics of college students in East Africa. He gave out 13 tests based on the four factors of Mathematical Ability, that is, Mathematical Reasoning Ability, Spatial Ability, Computation Ability and Problem Solving Ability to the students. He analysed the relationship between the 13 tests and their performance in Mathematics and English tests. He also analysed the group factors of Mathematical Ability and did a factor analysis of the Mathematical Ability tests. His findings were as follows:

(a) He found significant correlations between Tests of Arithmetic Reasoning and marks from teachers examination in English and Mathematics.

(b) From the analysis of the group factors of Mathematical Ability he found numerical factor and Mathematical Reasoning factor to be the factors which related to Mathematical Achievement.

(c) A factor analysis of the thirteen tests and the mathematics examination marks were found to relate to the Numerical Facility Factor, the Deductive Reasoning Factor and Spatial Visualization Factor.

El Abd's finding showed that there was always some connection between the factors of Mathematical Ability and Mathematical Achievement.

Eshiwani (1974) attempted to predict the performance of some Form Two male and female Kenyan students studying a Unit on Probability. His tests were based on:

(a) Computation Ability
(b) Mathematical Reasoning Ability
(c) Comprehension of Mathematical Terms
(d) Comprehension of Scientific Terms
(e) Attitude toward Mathematics.

His findings were as follows:

Mathematical Ability (Five Dots Test) and Mathematical Reasoning Ability (Arithmetic Reasoning Test) were found to be statistically significant predictors of achivement for boys ($p < .05$) while comprehension of Mathematical Terms and Mathematical Resoning Ability were found to be statistically significant predictors for girls ($p < .05$).

Further attempt to establish the relationship between Mathematical Achievement and other factors of Mathematical Ability has been through the following studies. Westbrook, et, al., (1965), and Leton and Kim (1966) correlated various intellectual abilities and Mathematical Achievement. Factor analysis (at ages 4, 5 and 6 in the Westbrook et, al.'s study and at grade (standard) 9 in Leton and Kim's study) revealed numerical reasoning and ability to discern verbal meaning to be highly correlated with achievement in Mathematics. Success in solving word problems in Mathematics was found to depend upon skills in reading and computation, but the relative contribution of these skills was not clear.

Martin (1963) found that each of the factors of reading comprehension, computation, abstract verbal reasoning and arithmetic concepts was correlated with problem solving as measured by the Arithmetic problem solving test of the Iowa Test of Basic Skills given to fourth and eighth graders. The partial correlation between reading and problem solving with computation held constant (about .50) was higher at both grade levels than the partial correlation between computation and problem solving with reading held constant (about .40). As Martin suggested, the relationship between problem solving ability and its underlying skills particularly higher order verbal skills was probably more complex than has been supposed.

In a synthesis of two factor analytic studies of problem solving in Mathematics by Werdelin (1966) the two factor matrices were rotated to a congruent structure. He found that the loadings on the five factors isolated in each study were virtually identical tests of problem solving and they loaded strongly on a general reasoning factor and to a lesser extent on a deductive reasoning and numerical factor. The other factors, space and verbal comprehension were unrelated to problem solving.

Still on the same issue of problem solving ability Thompson (1967) reported that the effects of readability and mental ability on arithmetic problem solving performance were interactive. Although ease of reading was associated with higher performance at both high and low levels of mental ability, the effect was much greater with subjects of low mental ability. Thompson concluded that there was a close relationship between problem solving ability and mental ability. On memory and cognitive structure Bentley (1966) stated that tests of intelligence and achievement favoured memory and cognitive structure.

Concerned about pupil Mathematical Achievement Davison (1963) prepared a review with a view toward developing a "reasoning" test for predicting achievement in modern mathematics classes, but which would not predict achievement in conventional classes. A number of hypotheses were developed and specific set of studies prepared. Some of these studies were carried out and reported by Davison (September 1, 1963; September 30, 1963), . He found considerable support for using the Hidden Figures Test as differential predictor of Mathematical Achievement and evidence that the test could be handled in grades 8 and 11.

The review presented here shows that while researchers have tried to study the relationship between ability and achievement in mathematics, very few have considered all the factors of Mathematical Ability together . Wick (1965) who did this found very low correlations between factored tests of Mathematical Ability and Mathematical Achievement. In studies where single factors of Mathematical Ability were considered the results revealed strong correlations with Mathematical Achievement and this did not depend on the level of education of the subjects.

Though Mathematical Ability has been found to relate to Mathematical Achievement, the influence of Language used in instruction must not be underestimated.

2.4 Mathematical Achievement and Language:

The language used for communication and for instruction in schools forms an important part of the process of education. Where the language used is a second language to the pupils and to some teachers it becomes a very sensitive issue. It would therefore be important to determine the level of proficiency in the language of the pupils and how it would influence their performance in the subject matter areas. The importance of language to learning was inferred from the finding of Vygotsky (1962). He found that language was very important for concept formation.

Mathematics being a subject conceived of as only concerned with numbers and their calculations could be assumed to have nothing to do with language. The connection between Language and Mathematics has been researched.

Trying to get the connection between language and learning of mathematics, Skemp (1977) referred to the qualities of some of the great mathematicians and reported that mathematicians were often poor practitioners with words. His views over language and mathematics were similar to earlier views that verbal and mathematical intelligence would not go together, and that many mathematicians had been noted for their verbal fluency (krutetskii, 1969; Smith, 1964).

According to Aiken (1972, p. 359) "it is generally recognized that not only do linguistic abilities affect performance in mathematics but that mathematics itself is specialized language." Aiken also quoted that several investigations on intermediate grades (children) have yelded correlations between Reading Ability and Mathematical Achievement ranging between r = .40 and r = .86. Though reading ability is a different case, it showed the range of factors that could influence Mathematical Achievement.

Aiken's study supported earlier finding by Rose and Rose (1961) which also observed that childhood training in precise language was essential for performing well in mathematics.

Wrigley (1958) in his study of factors that influence success in mathematics, concluded that "high general intelligence was the first requirement for success in mathematics and that the positive correlations between measures of verbal and Mathematical Abilities could be explained by the joint relationship of these two variables to general intelligence."

Aiken (1972) argued differently on the finding saying that general intelligence could account for a substantial portion of the variability shared by Verbal and Mathematical Ability, but a significant degree of overlap between the first two variables remained unexplained.

Linville (1970) in a short study with 408 fourth grade students from 12 schools, attempted to find the connection between syntactic structures, vocabulary level, and Mathematical Achievement. The analysis of viariance of the results revealed significant main effects in favour of both the difficult and simple vocabulary tests. He concluded that both syntactic structure and vocabulary levels, with vocabulary level being more crucial, were important variables in solving verbal arithmetic problems. He also found that regardless of treatment condition, pupils of higher general ability and/or higher reading ability made significant higher scores on the arithmetic problems than pupils of lower ability.

In their observation Olander and Ehmer (1971) suggested that understanding of mathematical terms on the part of the elementary school pupils was highly interfered with by difficult vocabulary and syntax. Right from the early times this fact had been realized, thus according to Hansen (1944), knowledge of vocabulary was important in solving mathematical problems and consequently should be a goal of mathematical instruction.

Retzer (1969) in a study with grade (standard) 8 found that teaching certain concepts of logic not only had differential effects on eighth graders' abilities to verbalize mathematical generalizations, but that students with high verbalization abilities could better transfer learned mathematical generalizations. However, those results could partly be accounted for by other intellectual abilities related to verbalization ability.

While the view maintained by a number of researchers was that language positively influenced Mathematical Achievement, Ahlfor *et al.*, (1962) Wirtz (1971) maintained that language was frequently an obstacle rather than a obstacle help in understanding mathematics. Their explanation was that perhaps children with higher verbal abilities would learn mathematics more easily if the verbal aspects were emphasized. On the other hand, students with poor verbal (language) backgrounds and abilities could find a non-verbal approach more rewarding.

Still on mathematical learning and language, Madden (1966), Ausubel and Robinson (1969), Cooper (1971) and other educational researchers pointed out that mathematics itself was a special formalized language and should therefore be taught as such. Munroe (1963) referred to the language of mathematics as "Mathese" and indicated that it could be easier for the student to understand occidental mathese than other languages. Munroe also noted that because of the inconsistency of notation in mathematics and variations in the interpretations of symbols (especially x and y), it was impossible to construct a complete Mathese - to - English dictionary. Furthermore the majority of mathematicians were apparently not interested in attempting to devise or agree upon a completely inconsistent descriptive set of mathematical notations.

Although there was no one-to-one correspondence between the concepts and rules of mathematics and those of native languages, there were many similarities between verbal and mathematical languages.

The importance of language development to Mathematical Ability had been considered by many psychologists foremost among whom were Piaget (1954), Bruner (1966) and Galperin (See Lovel, 1971). Piaget maintained that growth in Linguistic ability followed the development of concrete operational thought rather than preceed it, although language was important in the completion of such cognitive structures. In contrast Bruner and his associates (1966) maintained that the development of adequate terminology was essential to cognitive growth. It had been noted that one area of difficulty in problem solving was that of translating the verbal information into symbolic manipulative form. These confirmed the importance of language to learning mathematics.

The review has brought important points about language and mathematics performance. The vocabulary and terminology in mathematics are very important for learning and understanding of mathematics. The symbols used for representation of ideas in mathematics in addition to proficiency in the language are very important too.

2.5 Mathematical Achievement and Sex of Pupil.

A considerable amount of data attest to the dislike for mathematics and as a result under-achievement in mathematics by women. This pattern was evident among school children and continued into adulthood and employment where women were under-represented in mathematics-related fields (Ernest, 1976). Dougherty (1975) reported that this phenomenon had generally been explained on the basis of women's mathematics anxiety, "an unspecified fear based on a projected feeling of inadequacy vis-a-vis some contemplated experience with mathematics" (p. 1).

While no completely satisfactory explanations have been proposed for discrepancies in Mathematical Achievement between males and females, several factors appear related. Studies of attitudes towards mathematics have indicated a reciprocal and mutually reinforcing relationship between attitudes and achievement. It has been observed and data suggest that parental attitudes influence children's attitude and that parents perceive mathematics as more appropriate for boys than for girls (Fennema and Sherman, 1977). Starting in the early grades and continuing through high school, fathers were perceived as the family authority in mathematics and females therefore started being socialized to the image that mathematics was for males (Ernest, 1976). The process often extended to the schools, where teachers and guidance personnel fostered for the attitude that females were less capable in mathematics (Casserly, 1975; Dutton, 1962).

Generally, the existence of sex differences in Mathomatical Ability had led to considerable speculation concerning the relative roles of heredity and environment in determining these abilities.

Research results showed that on the average, girls tended to score higher than boys on tests of verbal fluency, arithmetic fundamentals, and rote memory whereas boys were superior in spatial ability, arithmetic reasoning and problem solving (Aiken, 1971; Werdelin, 1961). But Aiken (1973) added that sex differences in abilities were less pronounced in the early grades and there was a general differentiation of abilities with age and experience.

Sherman (1967) trying to explain the importance of spatial ability said that this ability could partially explain the commonly observed sex differences in mathematical performance. Women typically scored lower than men on tests of spatial ability and also showed less interest and proficiency than did men in mathematically based tasks. Evidence supporting Sherman's hypothesis had been reported in several recent studies (Burnett, Lane and Draft, 1979; Hyde, Geiringer and Yen, 1975). Sherman had also suggested that the observed sex differences in spatial skills were to a great extent culturally determined, a contention that had received both support (Garai and Scheinfield, 1968) and contradiction (Maccoby and Jacklin, 1974) from subsequent research. Based on data from twin studies Vardenberg (1968) concluded that spatial ability seemed to be less influenced by educational and cultural factors than did verbal ability.

In a later study, Fennema and Sherman (1978) attempted to establish sex differences in Mathematical Achievement and related factors. The relationships were investigated between mathematical learning, verbal ability, spatial visualization and eight affective variables. Subjects were 1320 sixth through eighth graders. No sex-related differences over all schools were found for any cognitive variable. Females were significantly less confident of themselves in mathematics, and males stereotyped mathematics as a male domain higher than did females. Fennema and Sherman synthesized the results with those obtained at high school level and found sex related differences in high school areas but not in the same middle schools areas. Where significant differences in achievement were found at both levels, they were accompanied by significant differences in many affective variables. The correlations between Mathematical Achievement and Spatial Visualization in the high school study were .45 for females and .51 for males. In the middle school study the correlations ranged from .51 to .60 between the various variables and spatial visualization with little differences between males and females.

In earlier reviews Fennema (1974) and Maccoby and Jacklin (1974) cited numerous studies in which males performed better than females on tests of Mathematical Achievement and Spatial Ability. The sex differences were reported to occur starting in early adolescence and continuing into adulthood. In Smith's (1964) analysis of spatial ability studies, he concluded that spatial ability was positively related to high level mathematical conceptualization that is, people who could solve high level mathematics generally had greater spatial ability than people who could not solve those problems. Smith's assertion offered an explanation of why sex differences favouring males were often found concurrently on tests of Mathematical Achievement.

According to Maccoby (1966) sex differences upto the elementary school age were slight but the trend was for the differences, if found, to be in favour of girls. On number concept among pre-school children Maccoby's review on Mathematical Ability showed no sex differences on performance on number conservation tasks or on numeration. During the early school years as well, no sex differences were found in the mastery of numerical operation and mathematical concepts.

In the age range from nine to thirteen, Maccoby's review found that sex differences, when found were usually in favour of boys. After the age of thirteen, the result of most studies became more consistent in their findings and boys were almost invariably found to be superior. However, Maccoby pointed out that the situation regarding variability between performance of boys and girls varied considerably from study to study. Figures between two-thirds of a standard deviation to less than a fifth of a standard deviation to no significant difference between viariability of girls and boys performances were also quoted by Maccoby. He then concluded that there was little sex difference in variability prior to adulthood.

Making their final comments on the study they conducted to establish sex differences in spatial ability, Maccoby and Jacklin (1974) stated that;

> "it was resonable to expect that if the deficit in spatial ability of females resulted from a lack of training, they could begin differing in underlying 'ability', however males could profit more from training than females. At present the issue was simply unresolved" (pp 128 - 129).

In a similar study to investigate the relationship between Mathematical Achievement and Spatial Abilities among elementary school children, Guay and McDaniel (1977) found that with regard to sex differences in spatial abilities the data suggested that among elementary school children, males had higher level spatial ability than females, and males and females had similar low level spatial ability. The scores on the spatial tests requiring low level spatial ability were observed independent of the subject's sex. In contrast, male performance on the high level spatial tasks was found to be significantly better than females. The significant sex differences were not found to be a function of any variation. These observations were consistent with literature review by (Maccoby and Jacklin, 1974) indicating sex differences favouring males but inconsistent with that portion of the reviews suggesting that sex differences become evident only during early adolescence.

In a study by Eshiwani (1974) to establish if there were any sex differences in the learning of mathematics among Kenyan high school students, the major purpose was to determine whether there was a significant difference in achievement and retention in mathematics among boys and girls in high schools in Kenya. He used a sample of form two girls and boys. In general he found that the boys achieved higher than girls and had a more positive attitude towards mathematics than girls and that boys scorod higher on tests of mathematical reasoning, computation and comprehension of mathomatical and scientific terms.

The results of the regression analysis showed that arithmetic reasoning was a valid predictive variable for boys as well as for girls. However, for girls it seemed that comprehension of mathematical terms and computation ability were important factors in mathematical performance and also valid for use in prediction of future Mathematical Achievement.

On the other hand Wamani (1980) in his study of Mathematical Ability among the primary school children in Nyeri, Kenya had contradictory findings that there were no sex differences in Mathematical Ability. Wamani's study contradicted a number of other studies which had noted sex differences in Mathematical abilities.

2.5.1 Sex Differences - Psychoanalytic Viewpoint

About three decades ago, Plank and Plank (1954) interpreted the existence of sex differences in mathematical performance from a psychoanalytic view point. They called it the "masculine identification hypothesis." These writers claimed that, since a high level of controlled aggression was necessary for mathematical activity, mathematics was primarily a masculine enterprise. It was maintained that, since mathematics was "masculine", women who liked mathematics tended to identify with a strong male figure.

A sprinkling of both negative and postive results had also been obtained in studies designed to test the masculine identification hypothesis. Lambert (1960) found no correlation between mathematical proficiency and masculinity of interest in either sex. In actual fact, the female mathematics majors in Lambert's study showed up as more ""feminine" on the MMPI than non-mathematics majors. But Elton and Rose (1967) reported that college girls who were average in English but high in mathematics on the American College Tests had higher theoretical and lower aesthetic interests (that is, more 'masculine' interests) than girls who were high in English but average in mathematical achievement. Consequently these writers concluded that "masculine role" was an important factor to consider in predicting differences in ability in English and Mathematics.

In a more recent study on sex related differences in mathematics by Fennema and Carpenter (1981) where a sample of 70,000, 9-, 13-, and 17 year olds were used, the two authors used assessment exercises measuring achievement which were categorized by mathematical content and cognitive level. Five content areas were assessed; number and numeration, variables and relations, geometry, measurement and other topics. Each content area was assessed at four cognitive levels; knowledge, skill, understanding and application. The scores for the sets of items representing the four cognitive levels are summarized in table 2.1. On each cluster of items the percentage of correct responses of males was subtracted from the percentage of correct responses of females. A positive score indicated that females scored higher than males, whereas a negative score indicated the reverse.

TABLE 2.1

DIFFERENCES BETWEEN FEMALE AND MALE ACHIEVEMENT

	DIFFERENCES BETWEEN FEMALE AND MALE AVERAGE PERCENT CORRECT		
COGNITIVE LEVEL	AGE 9	AGE 13	AGE 17
Knowledge	1.41	- 0.17	- 2.16
Skill	0.40	1.11	- 2.54
Understanding	- 0.07	- 0.29	- 3.61
Application	- 0.37	- 0.60	- 5.04

The results of the study showed that no clear pattern of differences in achievement was apparent at ages 9 or 13. The average scores for females on the knowledge and skills exercises tended to be slightly in favour of males. At age 17, males' average performance exceeded that of females at every cognitive level.

When they compared achievement of 17 - year old females and males who reported that they had been enrolled in the same mathematics courses, the results indicated that achievement differences still existed when course background was taken into account. For each course background category, male achievement exceeded that of females. It was also noted that the magnitude of the difference increased consistently in relation to the amount of mathematics courses taken. Another consistent trend observable in the 17 year old achievement results was that achievement differences between females and males increased with the cognitive level. There were smaller differences at the lower cognitive levels and larger differences at the higher levels.

Another observation was that within specific content areas, different patterns of performance emerged. Females scored higher on lower level number and

numeration skills at ages 9 and 13. Males scored higher on multi-step word problems in this content area at all ages. A different pattern of results was found on geometry and measurement exercises. At ages 9 and 13, there was a consistent pattern of lower averages for females on geometry and measurement exercises over all cognitive levels. For measurement these differences were often substantial.
To them a positive explanation for females' relatively poor performance on geometry and measurement exercises was that a substantial number of those exercises could have involved spatial visualization skills. As had been shown earlier, from about adolescence, females, performed at lower levels than males on items that measured the skill (Maccoby and Jacklin, 1974). As they noted, several geometry exercises in the assessment appeared to require a direct application of spatial visualization skills, and spatial visualization could have played a part in the solution of many other geometry and measurement exercises.

In a way of summary of the study, they found that the assessment results indicated that, on a nationwide basis, there was little difference between males and females in overall Mathematical Achievement at ages 9 and 13.

At age 17 however, females were not achieving at the same level in mathematics as were males. Even when females and males reported that they had been enrolled in the same courses, males' performance was higher than that of females, and that the differences were greatest on the more complex tasks.

2.5.2 Sex differences and Attitude toward Mathematics

Parkar (1974) carried out a study involving 219 students from six classes in two different schools. Although the study did not take sex as a major variable, comparisons were made between boys and girls on achievement and attitudes toward mathematics.

The study used intact Form One classes which were randomly assigned to two groups, a control group and an experimental group. The control group were taught the contents of School Mathematics of East Africa (SMEA) book I through the traditional chalk-talk, teacher-dominated approach while the experimental group learnt the contents of SMEA book one through what Parkar labelled "Programmed Work Cards". Three attitude scales were used in this study.

These were:

1. Attitude towards mathematics as a process.
2. Attitudes about difficulties of learning mathematics.
3. Attitudes towards the place of mathematics in society.

Three tests assessing achievement of the groups were given at the end of first, second and third terms of the school year. A summary of the findings were: Girls performed significantly better than boys in both the groups on the first tests of achievement. In the second test, girls were still significantly better than boys in the experimental group but not in the control group. In the third slight differences favoured the boys doing significatnly better than girls in both groups.

Only two attitudes toward mathematics scales were given to the pupils during the course of the study, one at the beginning and one at the end of the study. For the experimental group, girls had slightly more favourable attitudes on all the three scales, as well as on the total attitude scale. In the control group boys had more favourable attitudes on the "Place of Mathematics in Society Scale", and on the overall scores on the attitude scales. However none of the differences were significant for either group.

In a study by Sheikh (1976) on sex differences he studied some factors involved in the learning of mathematics among secondary Form three students in Kenya. The factors he considered for the study were, attitude towards mathematics, reading ability, motivation, educational and vocational aspirations. For his study he had about 600 subjects and gave out 17 tests. On cognitive abilities he had achievement tests testing the following abilities in mathematics: Knowledge, Comprehension, Application and Analysis.

The results of the study showed that the sexes differed significantly in their performance in mathematics. In general boys showed superiority at the higher cognitive levels while the differences between girls and boys were not significant at the lower level subtests on knowledge and comprehension. Overall boys did significatnly better than girls. This has been supported by a more recent study mentioned earlier of Fennema and Carpenter (1981). Sheikh felt that the poor performance of girls at the higher cognitive levels of thinking, that is application and analysis, was attributable to their lack of suitable background experiences which are necessary for higher order cognitive processes.

Another finding of the study was that girls had significantly more unfavourable attitudes toward mathematics on two of the three subscales used. Thus girls enjoy mathematics far less than boys. Boys intend for advanced level mathematics more than girls, and also aspire for technical jobs as opposed to girls. Finally evidence from regression analysis suggested that for boys, educational aspiration was the best non-cognitive variable for prediction on their achievement in Mathematics. This study confirmed the results of some of the earlier studies.

One of the very comprehensive studies on Mathematical Achievement was an international project which involved 12 different countries (Australia, Belgium, England, Finland, France, Germany, Israel, Japan, The Netherlands, Scotland, Sweden and United States and) edited by Husen (1967). In the study, a number of factors that influenced Mathematical Achievement were investigated. One of the important factors studied was, sex differences in Mathematical Achievement. In the words of the authors, the aims of studying sex differences were to determine:

> ..... the way in which cultural views of the role of men and women influenced not only the taking of mathematics courses but also achievement of boys and girls. --- whether sex differences were reflected in verbal as compared to computational problem. --------- and to understand how sex roles were related to interest in mathematics, plans to take further mathematics (Husen, 1967) p. 204.

In a way of summary, the findings of this large study were:

On total mathematics scores, significant differences were found in favour of boys in all four target populations. Boys showed greater variability in their achievement.

On verbal problems, clear differences in favour of boys were found in all populations with the exception of Israel, U.S.A. and Sweden.

On interest in mathematics, boys showed significantly greater interests than girls in all populations.

On a test on difficulty in learning mathematics, very few significant differences were found. The only significant case of girls finding mathematics easier than boys was Israel. In Finland and Netherlands boys found mathematics easier than girls.

Studying single-sex schools, boys were significantly better than girls in all populations on achievement in mathematics. No significant differences between boys and girls on interest was found in mathematics. Only in Australia and Israel were girls superior to boys in the single sex schools.

Summarising a number of researches, Hochchild (1973) explained that,

> "the sexes differ in the way they think (Maccoby, 1966), perceived (Bieri, et, al., 1958) aspire (Horner, 1968; Turner, 1964), experience anxiety (Sinnick, 1956), day dream (Singer, 1958) and play competitive games (Vesugi and Vinachke, 1963). Men tend to have an exploitative strategy, women an accommodative one, which even win some games" p. 253.

From the review it can be seen that the issue of sex differences in mathematical performance is not yet resolved. The explanations for sex differences in mathematics have involved social, psychoanalytic, affective domains of human life.

In summary the findings of the studies reviewed indicated that Mathematical Ability was composed of specific ability factors, that is, Mathematical Reasoning Ability, Spatial (Visualization) Ability, Numerical (Computational) Ability and Problem Solving Ability. These factors were also defined in operational terms.

Studies attempting to relate factors of Mathematical Ability to Mathematical Achievement were also reported. These studies were reported on different levels of education, that is elementary school level, high school level and college level. Most of the studies concentrated on the relationship between spatial ability and mathematical performance. In general positive relationships were found between individual factors of Mathematical Ability and Mathematical Achievement, though in some cases low correlations were reported.

The importance of language used for instruction in Mathematics and Vocabulary of Mathematical terms to learning mathematics was also shown.

Sex differences in mathematics were found consistently in many aspects of mathematics. The explanations for such differences were hypothesized to originate from the females' negative attitudes and female role identification. Generally the issue on sex differences was not fully resolved.

Regarding the Kenyan primary school pupils, mainly the ones in standard seven who face the C.P.E. examination it would be important to find some information about their performance and factors influencing their performance. According to this review, Mathematics would be an important subject for such a study. The focus for this study derived from the fact that in Kenya pupils attend different school types and have English Language as medium of instruction which is their second language. Further, was the consistent sex differences found in mathematical performance of the pupils. The most important is the fact that standard seven level of education is basically the terminal level of primary education. Success in C.P.E. examinations is crucial to consideration for secondary education.

In this study therefore, four hypotheses were advanced. The hypotheses were stated in null form.

2.6 Hypotheses

Null Hypothesis I

(i) There is no significant relationship between scores on Mathematical Achievement test and scores on Mathematical Ability tests of the pupils.

(ii) There is no significant relationship between scores on Mathematical Achievement tests and scores on Mathematical Vocabulary test of the pupils.

(iii) There is no significant relationship between scores on Mathematical Achievement test and English Language Proficiency test of the pupils.

Null Hypothesis II

There is no significant difference between scores of pupils attending Low Cost, Medium cost and High-Cost schools in;

(i) Mathematical Achievement Test
(ii) Arithmetic Reasoning Test
(iii) Computation Test
(iv) Whole Number Comprehension Test
(v) Hidden Figures Test
(vi) Foarm Board Test

(vii) Five Dots Test

(viii) Problem Solving Test

(ix) Mathematical Ability Total

(x) Mathematical Vocabulary Test

(xi) English Language Proficiency Test

Null Hypothesis III

There is no significant difference between the scores of male and female pupils in;

(i) Mathematical Achievement Test

(ii) Arithmetic Reasoning Test

(iii) Computation Test

(iv) Whole Number Comprehension Test

(v) Hidden Figures Test

(vi) Foarm Board Test

(vii) Five Dots Test

(viii) Problem Solving Test

(ix) Mathematical Ability Total

(x) Mathematical Vocabulary Test

(xi) English Language Proficiency Test

Null Hypothesis IV

The variation in Mathematical Achievement test scores will not be fully accounted for by the Mathematical Ability, Mathematical Vocabulary, English Language Proficiency, Type of school, Sex of pupil, Age, Class repetition, After-school coaching in Mathematics and After-school coaching in English.

7 Basic Assumption

This study assumed that there existed individual differences in Mathematical Ability. Ability in Mathematics was therefore normally distributed among the pupils, following individual differences. Having reviewed researches related to this study, chapter three will present the methodology of the study. This will involve sampling of subjects, and data collection (testing) procedures.

CHAPTER THREE

METHODS AND INSTRUMENTS

3.1 Introduction

In this chapter attempt is made to describe the sample chosen for the study, procedures and instruments used in gathering data to test the hypotheses.

3.2 The Sample

The number of primary schools in Kenya are in the tens of thousands. To be able to get a sample which would be representative and meaningful was difficult and beyond the scope of this study. In this study, the sample of schools were drawn from Kisumu town and its periphery within a radius of 10 kilometres. This region contained a total of 45 primary schools. The importance of choosing this area was mainly because it consisted of schools which distinctly differed from one another in terms of general costs and maintenance. This phenomenon was found common with Primary Schools in other parts of the Republic of Kenya. Basically the schools found in this area were of three types, that is Low Cost, Medium Cost, and High Cost schools. The three types of schools are described below.

Low-Cost Primary Schools

These were the schools mainly found in peri-urban and rural areas. They were partly maintained by the government, though much of the funds came from contributions by the local people of the area. The school buildings were quite poor (most of them semi-permanent) and not well maintained. The schools lacked alot of school equipment and stationery. Enrolment of pupils per class was very high about 50. The majority of teachers were untrained. The pupils paid no school fees except at times some contributions towards schools funds.

Medium-Cost Primary Schools.

These were the Municipal Schools. The schools were funded and maintained by the Municipality through government grant. The buildings were permanent with amenities such as light and water. The schools had some equipment and stationery. The enrolment of pupils per class was on the average 40. The teaching staff were all trained though not particularly with high grades. There were also some subordinate staff. The school fees were reduced to school funds.

High-Cost Primary Schools.

These schools were found within the urban areas. They were private community maintained schools. The communities that funded such schools included Ismalia, Hindu, Goan, etc. The school buildings were permanent with all the amenities in a well kept compound. The schools had all the necessary equipment and stationery, text books, etc. The enrolment of pupils per class was on the average 30. The teaching staff were all highly qualified. The schools were also fully staffed with both teaching staff and subordinate staff. School fees were paid in these schools.

The study involved a sample of 634 pupils in standard seven from some fifteen primary schools. The selection of the schools according to type was done by the stratified-random sampling technique. Five Low Cost, Six Medium Cost and Four High-Cost schools were sampled. The type of schools sampled varied in number. This was because these schools were not equal in numbers in the area chosen for study and the intention was to have fair representation. In every school the pupils varied in sex, age, class repetition and after-school coaching in Mathematical and in English.

Table 3.1 presents the distribution of pupils attending Low Cost, Medium Cost and High Cost schools by their sex, age, class repetition, after-school coaching in Mathematics, and in English.

TABLE 3.1

DISTRIBUTION OF PUPILS ATTENDING LOW COST, MEDIUM COST, AND HIGH-COST SCHOOLS BY THEIR SEX, AGE, REPEATER, AFTER-SCHOOL COACHING IN MATHEMATICS AND AFTER-SCHOOL COACHING IN ENGLISH.

	LOW COST SCHOOLS	MEDIUM COST SCHOOLS	HIGH COST SCHOOLS
N	242(38.1%)	264(41.7%)	128(20.2%)
SEX			
Males	161(66.5%)	131(49.4%)	70(54.7%)
Females	81(33.5%)	134(50.6%)	58(45.3%)
AGE			
11.5-13.0 Years	22(9.1%)	70(26.4%)	81(63.3%)
13.1-14.5 Years	71(29.3%)	105(39.6%)	38(29.7%)
14.6-16.0 Years	71(29.3%)	68(25.7%)	8(6.2%)
16.1--+++ Years	78(32.2%)	22(8.3%)	1(0.8%)
IF REPEATER			
Yes	181(74.8%)	179(67.5%)	43(33.6%)
No	61(25.2%)	86(32.5%)	85(66.4%)
IF COACHING IN MATHS			
Yes	113(46.7%)	190(71.7%)	80(62.5%)
No	129(58.3%)	75(28.3%)	48(37.5%)
IF COACHING IN ENGLISH			
Yes	104(42.6%)	161(60.8%)	78(60.9%)
No	138(57.4%)	104(39.2%)	50(39.1%)

The analysis of the pupils' age showed that their ages ranged from 11 to 21 years. About 40 percent of the sample were above 14½ years of age, 16 percent were above 16 years of age. The modal age was 14 years instead of the expected 13++ (6 + 7) years, since children were enrolled at about 6 years of age in standard one and they take 7 years in primary education. The majority of the pupils were males (57%) as compared to females (43%). About two in every three pupils were repeaters. Repetition was considered in any class during the primary school and could be more than once.

Taking children to private tutors for after-school coaching (private tutoring) in their weaker subject areas was a widespread practice among many parents. Normally parents hired a teacher or teachers to drill their children during after-school times and weekends at certain payments. This practice was normally at its peak when pupils were in standard seven. The idea was to get the child to pass C.P.E., a gateway to secondary education. It was found that 60 percent of the pupils went for a after-school coaching in Mathematics and 54 percent in English.

3.2.1 Selection of Subjects.

Permission to carry out the research was granted by Kenyan Office of the President in February, 1981. The decision to obtain a sample from schools in Kisumu District was prompted by the investigator's considerable familiarity with many areas in the district. This decision was useful because the time and funds available to collect the data were limited.

The primary schools have three terms with approximately one month holiday between the terms. Each term is approximately three months. The testing of the subjects was carried out in the first term between February and March, 1981. Subjects for the study were selected by the stratified-random sampling technique. The testing took one day per school. The number of pupils in standard seven in these schools varied. The mean class size was 42 with a standard deviation of about 4 and a range from 30 to 51. 40 percent of the schools had between 30 to 40 pupils per class and 60 percent of schools had between 41 to 51 pupils per class. Since all the schools had more than one standard seven class, only one class was considered and its choice was random.

3.3 Variables Selected for the Study

The dependent variable for this study was Mathematical Achievement. Mathematical Achievement was viewed broadly to be related to different environmental and ability variables. The main independent variables for the study were Mathematical Ability, Mathematical Vocabulary, English Language Proficiency, Type of school, and Sex of pupil. The independent variables were chosen on the assumption that they influence Mathematical Achievement. Under normal circumstances what one achieves is presumed to depend on his ability in that area. Given the environmental variations other factors could become significant in influencing what one achieves. It was also viewed that the language used in instruction and testing for what one knows, and knowledge of key terms in a particular discipline such as Mathematics can influence his performance in that discipline. The language used for instruction was particulary important in this study because for too many pupils English Language was their second language. Sex differences in Mathematical performance had been observed and deserved further scrutiny. Finally, based on differences among the type of schools it was possible that pupils' Mathematical Achievement would be influenced.

This was because it was possible that the teaching and learning experiences differed with the schools and therefore for the pupils. The variables are discussed in detail in the following section.

3.3.1 Mathematical Achievement.

Mathematical Achievement was the dependent variable for the study. To assess the level of achievement in Mathematicis for the pupils, a Mathematical Achievement Test was set by the researcher and pretested. The reliability coefficient was 0.78. The test was based on the Kenya Primary Mathematics Syllabus and was set to standard seven level. The questions were based on C.P.E. format with similar level of difficulty. The main skills tested for were knowledge of facts, understanding comprehension, application and analysis. The topics covered in the test included:

(a) Sets
(b) Number and Numeral
(c) Operation and Properties
(d) Geometry and Measurement
(e) Fractions and Decimals
(f) Integers

g) Mathematical Statements (Algebra), and

(h) Statistics.

The number of test items testing each skill was carefully prepared through a test blue print. There were a total of 24 items, 18 of which were multiple choice items while six were problem type. For each multiple choice item one mark was awarded for a correct response. For the problem type items, two marks were awarded for correct statement and correct answer, and either of the two awarded one mark. No mark was awarded for both wrong statement and wrong answer. A maximum of 30 marks and a minimum of zero marks were possible. The test was for 45 minutes.

3.3.2 Mathematical Ability

As already mentioned, what one achieves in a given subject discipline was viewed to be a reflection of his potential capacity in that area. For Mathematics, there was Mathematical Ability. Mathematical Ability was found to be composed of the following factors:

(a) Mathematical Reasoning Ability

(b) Spatial - Perceptual (Visualization) Ability

(c) Numerical (Computational) Ability

(d) Problem Solving Ability.

Each of these factors as discussed in Chapter Two were testable through the following tests:

(i) Arithmetic Reasoning Test (15)*

(ii) Five Dots Test (19)

(iii) Hidden Figures Test (8)

(iv) Foarm Board Test (12)

(v) Computation Test (15)

(vi) Whole Number Comprehension Test (12)

(vii) Problem Solving Test (10)

The tests were constructed and validated by the School Mathematics Study Group (SMSG, 1968). The tests were also shown to have reliability coefficients between 0.68 and 0.84. The total number of items in these tests were 81 and each correct response to an item was awarded one mark, and incorrect response no mark. In all the tests the items were multiple choice type except in computation test where actual answers had to be filled in a space provided. A maximum of 81 marks were tenable with a minimum of zero. Each test was timed. The time in minutes for each test was

*In bracket are the number of test items in each test.

Arithmetic Reasoning (15), Five Dots (20), Hidden Figures (10), Foarm Board (15), Computation (15), Whole Number Comprehension (15) and Problem Solving (10).

3.3.3 Mathematical Vocabulary

This was the ability to understand and comprehend the meaning of certain mathematical terms in common use in the Kenya Primary Mathematics Syllabus.

Mathematical Vocabulary test was constructed by the researcher based on the common mathematical terms and vocabulary in Primary Mathematics Syllabus. It was pretested and the reliability coefficient was found to be 0.61. The main task in this test was to provide meaning and application of some mathematical terms. It was viewed that knowledge of Mathematical Vocabulary would aid in the understanding of verbal problems in mathematics. There were 8 items in the test, each awarded one mark. The test was for 10 minutes.

3.3.4 English Language Proficiency.

The language used for instruction and its use in examinations and tests for assessing the pupils' progress in mathematics is an important aspect of the learning process. To understand what was taught and what a question demands require some proficiency in the language used. It might therefore be possible to explain in some ways the variations in Mathematical Achievement by level of proficiency in English Language.

Proficiency in English Language constituted the ability to make correct sentence constructions in English, give correct meaning to English words, correct word simile and an ability to discern correct information form a given passage.

The English Language Proficiency Test was constructed and pretested by the researcher with the help of a language specialist, The reliability coefficient of the test was 0.67. The test items were on grammar, vocabulary, similar words (synonyms) and comprehension. There were a total of 20 test items. A correct response to an item earned one mark and incorrect response no mark. A maximum of 20 marks with a minimum of zero marks were possible. The test was for 20 minutes. The level of performance on this test reflected the degree of understanding of English Language.

The importance of this test lay in detecting how performance in Mathematics was influenced by proficiency in English Language. This was because for the majority of the pupils, their mother tongue was not English so the degree of competence in the language varied from one pupil to another, depending on the language adopted in the home and speed of learning the language.

The other variables, sex of pupils and type of school had been dealt with in the previous sections.

3.4 Data Collection and Instruments.

The data for this study were obtained through test administration which included a detailed pupil identification form. The procedures were as follows:

3.4.1 Test Administration

A testing programme was sent to the school headmasters in advance showing the tests timetable and requirements. To take the tests, the pupils were required to have a pencil, rubber and rough paper. Below is the list of the tests taken by the pupils in that order:

(a) Mathematical Ability Test (Seven sub-tests)

(i) Arithmetic Reasoning Test
(ii) Computation Test
(iii) Whole Number Comprehension Test
(iv) Hidden Figures Test
(v) Foarm Board Test
(vi) Five Dots Test
(vii) Problem Solving Test

(b) Mathematical Achievement Test

(c) Mathematical Vocabulary Test

(d) English Language Proficiency Test.

Each of the tests had an answer sheet where pupils were expected to write the answers. The items involved multiple choice and structured type questions. A detailed pupil identification questionnaire was attached to the answer sheet of Mathematical Ability Test. The questionnaire required information mainly on pupil's age, sex, class repetition and after-school coaching in Mathematics and or English. The classes were kept intact.

Since the pupils had normally had a testing experience, it was assumed that it was not a surprise to them.

The instructions given before the tests were as follows:

> You are going to take a test
> The tests are for research puposes
> The test will not reflect on your
> examination results . Feel free and do
> your level best. You have a specific
> time for each test. Work fast but
> try to be accurate. Choose the answer
> you think is correct and put a tick
> or a cross and where indicated, provide
> the solution.

The whole testing programme took one day per school.

3.4.2 Scoring of Test

The main research instruments for this study were the tests. After the test administration the scoring was done by the researcher. The marks for each test were then summed up. The total scores for the tests for the pupils were then analysed using different techniques of statistical analysis.

3.4.3 Analysis of Data

The statistical techniques deemed appropriate for this analysis were correlation analysis (matrix), t-test, one way analysis of variance (ANOVA), and step-wise multiple regression analysis.

Such an analysis would be very complex and tedious if done manually, so the services of a computer were utilized. A statistical package for social science (SPSS) was used to set a programme for the computer.

With the data ready, the next chapter presents the results of data analysis and then a discussion of the findings.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results of data analysis. The results are also interpreted and discussed to provide possible explanation for the findings of the study.

4.2 Statistical Procedures

To analyse the data the services of a computer were used. All the analyses were performed using the statistical Package for Social Sciences (SPSS) version 600 program (Nie, et. al., 1975).

The statistical tools used in data analysis were the Pearson Product- Moment Correlation, t-test, one way analysis of variance, and step-wise multiple regression analysis. To test the hypotheses, each of the statistical methods was used. An answer to the question "Is there any relationship between the scores of pupils in Mathematical Achievement test and Mathematical Ability tests?" was provided by the use of Pearson Product-moment Correlation method.

This method gave an indication of the strength and direction of the relationship between the two variables. To test if pupils attending Low Cost, Medium Cost, and High Cost Schools differed significantly in their test scores, one way analysis of variance (ANOVA) was used. Similarly sex - differences in the performance of pupils on the tests were determined by the t-test method. Finally to determine the factors which explained the variation in Mathematical Achievement, step-wise multiple regression analysis was used.

4.2 Results and Interpretation.

In this section statements of hypotheses in null form will be presented. These will be followed by the results of data analysis based on the hypotheses and on the interpretation of the results.

4.3.1 Relationship between Achievement and Ability in Mathematics and Language Factors.

Null Hpothesis I

(i) There is no significant relationship between scores on Mathematical Achievement test and scores on Mathematical Ability tests of the pupils.

(ii) There is no significant relationship between scores on Mathematical Achievement test and scores on Mathematical Vocabulary test of the pupils.

(iii) There is no significant relationship between scores on Mathematical Achievement test and English Language Proficiency test of the pupils.

TABLE 4.1

INTERCORRELATIONS OF MATHEMATICAL ACHIEVEMENT TEST SCORES WITH MATHEMATICAL ABILITY, MATHEMATICAL VOCABULARY AND ENGLISH LANGUAGE PROFICIENCY TESTS SCORES FOR ALL PUPILS

(N = 634)

	1	2	3	4	5	6	7	8	9	10	11
1. Mathematical Achievement		.49**	.60**	.63**	.18*	.48**	.49**	.55**	.73**	.56**	.49**
2. Arithmetic Reasoning			.38**	.43**	.15	.35**	.40**	.42**	.65**	.36**	.36**
3. Computation				.52**	.17*	.32**	.37**	.48**	.67**	.46**	.35**
4. Whole Number Comprehension					.18*	.42**	.46**	.52**	.73**	.46**	.44**
5. Hidden Figures						.30**	.27**	.17*	.43**	.11	.18*
6. Foarm Board							.42**	.42**	.68**	.32**	.34**
7. Five Dots								.44**	.78**	.40**	.40**
8. Problem Solving									.69**	.42**	.48**
9. Mathematical Ability Total										.54**	.54**
10 Mathematical Vocabulary											.46**
11 English Language Proficiency											-

* $p < .05$ ** $p < .01$

The results of correlation analysis for all the pupils presented in table 4.1 indicate significant relationship between Mathematical Achievement test scores and Mathematical Ability test scores at a significance level of $p < .01$, except with hidden figures test scores where the correlation was significant at $p < .05$. These result suggest that the higher the scores in Mathematical Ability tests, the higher the scores in Mathematical Achievement test . The implication here was that the pupils' Mathematical Achievement was influenced by their ability in mathematics such that what a pupil achieved in mathematics was a result of his Mathematical Ability.

The relationship between Mathematical Achievement test scores and Mathematical Vocabulary test scores was also found to be significant at $p < .01$. Significant relationship was also found between Mathematical Achievement test scores and English Language Proficiency test scores. This showed that higher scores in Mathematical Achievement test were associated with higher scores in Mathematical Vocabulary test and also with higher scores in English Language Proficiency test. In other words the result suggests that knowledge of Mathematical Vocabulary and the level of proficiency in English Language is important and influences pupil Mathematical Achievement.

From the results presented on table 4.1, the null hypothesis I was rejected. The result proved that performance in Mathematical Achievement test was linked with pupils Ability in Mathematics, his knowledge in Mathematical Vocabulary and his level of proficiency in English Language.

4.3.2 Relationship between type of school and test performance.

This section deals with the following question, "Does attending a given school type cause a difference in the performance of pupils in the tests". Below is the null hypothesis related to the question.

Null Hypothesis II

There is no significant difference between scores of pupils attending Low Cost, Medium Cost and High Cost schools in;

(i) Mathematical Achievement Test

(ii) Arithmetic Reasoning Test

(iii) Computation Test

(iv) Whole Number Comprehension Test.

(v) Hidden Figures Test.

(vi) Foarm Board Test

(vii) Five Dots Test

(viii) Problem Solving Test

(ix) Mathematical Ability Total

(x) Mathematical Vocabulary Test

(xi) English Language Proficiency Test.

To test this hypothesis the mean scores for pupils attending the three school types were compared using the One-Way Analysis of Variance (ANOVA) technique. Table 4.2 presents the mean and standard deviation of test scores for pupils attending the three school types.

TABLE 4.2

MEAN AND STANDARD DEVIATION OF MATHEMATICAL ACHIEVEMENT TEST, MATHEMATICAL ABILITY TEST, MATHEMATICAL VOCABULARY TEST AND ENGLISH LANGUAGE PROFICIENCY TEST FOR LOW-COST, MEDIUM COST AND HIGH COST SCHOOLS

TEST	LOW-COST SCHOOLS (N =242)		MEDIUM-COST SCHOOLS (N =264)		HIGH-COST SCHOOLS (N = 128)	
	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
Mathematical Achievement	12.9	6.2	11.3	5.2	17.9	4.5
Arithmetic Reasoning	5.9	2.2	5.5	2.2	7.1	2.2
Computation	12.6	2.2	11.9	2.3	13.9	1.5
Whole No. Comprehension	5.3	2.3	4.9	2.1	7.0	1.9
Hidden Figures	3.1	1.8	3.0	1.9	3.6	2.0
Foarm Board	2.9	2.5	3.3	2.5	4.6	2.7
Five Dots	6.0	3.8	5.9	3.5	8.7	4.7
Problem Solving	4.4	2.0	4.5	1.9	6.2	1.5
Mathematical Ability-Total	40.3	11.5	38.8	10.5	51.0	11.1
Mathematical Vocabulary	4.6	1.9	4.5	1.8	6.0	1.6
English Language Proficiency	8.1	3.4	9.8	3.0	13.5	2.6

An observation of the mean test scores for these three school types show that the mean test scores for pupils in High-Cost schools were higher as compared to the other two school types. Between Low Cost and Medium Cost schools the differences could not be clearly discerned. As already indicated above One-Way ANOVA technique was used to establish the differences. The tables below show the summary of the One-Way ANOVA technique for the tests.

TABLE 4.3

SUMMARY OF ONE-WAY ANOVA FOR MATHEMATICAL ACHIEVMENT TEST

SOURCE	SS	MS	df	F	P
Between School types	3867.4	1933.7	2	64.1	.001
Within a School type	19057.8	30.2	632		
Total	22925.2		634		

TABLE 4.4

SUMMARY OF ONE-WAY ANOVA FOR ARITHMETIC REASONING TEST

SOURCE	SS	MS	df	F	P
Between schools types	215.4	107.7	2	23.1	.001
Within a school type	2946.8	4.7	632		
Total	3162.2		634		

TABLE 4.5

SUMMARY OF ONE-WAY ANOVA FOR COMPUTATION

SOURCE	SS	MS	df	F	P
Between schools types	330.8	165.4	2	35.6	.001
Within a school type	2936.5	4.6	632		
Total	3267.4		634		

TABLE 4.6

SUMMARY OF ONE-WAY ANOVA FOR WHOLE NUMBER COMPREHENSION TEST

SOURCE	SS	MS	df	F	P
Between school types	412.2	206.1	2	44.9	.001
Within a school type	2898.5	4.6	632		
Total	3310.7		634		

TABLE 4.7

SUMMARY OF ONE-WAY ANOVA FOR HIDDEN FIGURES TEST

SOURCE	SS	MS	df	F	P
Between school types	42.6	21.3	2	5.99	.001
Within a school type	2246.3	3.55	632		
Total	2288.9		634		

TABLE 4.8

SUMMARY OF ONE-WAY ANOVA FOR FOARM BOARD TEST

SOURCE	SS	MS	df	F	P
Between school types	255.4	127.7	2	19.6	.001
Within a school type	4127.0	6.5	632		
Total	4382.4		634		

TABLE 4.9

SUMMARY OF ONE-WAY ANOVA FOR FIVE DOTS TEST

SOURCE	SS	MS	df	F	P
Between school types	744.1	372.0	2	24.5	.001
Within a school type	9580.4	15.2	632		
Total	10324.5		634		

TABLE 4.10

SUMMARY OF ONE-WAY ANOVA FOR PROBLEM SOLVING TEST

SOURCE	SS	MS	df	F	P
Between school types	306.5	153.2	2	45.0	.001
Within a school type	2152.3	3.4	632		
Total	2458.8		634		

TABLE 4.11

SUMMARY OF ONE-WAY ANOVA FOR MATHEMATICAL ABILITY - TOTAL

SOURCE	SS	MS	df	F	P
Between school types	13815.0	6907.5	2	56.9	.001
Within a school type	76735.2	121.4	632		
Total	90550.2		634		

TABLE 4.12

SUMMARY OF ONE-WAY ANOVA FOR MATHEMATICAL VOCABULARY TEST

SOURCE	SS	MS	df	F	P
Between schools types	207.5	103.7	2	31.7	.001
Within a school type	2069.5	3.3	632		
Total	2277.0		634		

TABLE 4.13

SUMMARY OF ONE-WAY ANOVA FOR ENGLISH LANGUAGE PROFICIENCY TEST

SOURCE	SS	MS	df	F	P
Between school types	2388.7	1194.3	2	125.0	.001
Within a school type	6040.8	9.6	632		
Total	8429		634		

The results of One-Way ANOVA show that the scores of the pupils attending the three school types differed significantly at $p < .001$. The differences were clearly in favour of the pupils attending High Cost schools. This was by judging from the fact that on the average the pupils of High Cost schools consistently scored higher marks in Mathematical Achievement test, Mathematical Ability tests, Mathematical Vocabulary test and English Language Proficiency test as compared to the pupils of Medium Cost and Low Cost schools. This result led to the rejection of the hypothesis of no differences between the scores of pupils attending the three school types. On further scrutiny of this finding, t-test was applied to two school types at a time. The results of this test presented in tables 4.14, 4.15 and 4.16 show that between pupils in High Cost and Medium Cost schools, and between pupils of High Cost and Low Cost schools, in all the tests, the differences in the scores were statistically significant at $p < .001$, in favour of pupuls in High Cost schools. This result justified the fact that all the differences found earlier were in favour of pupils in High Cost schools. However, between pupils of Low Cost and Medium Cost schools significant differences were found only in some tests. There were differences in Computation test ($p < .001$) and Whole Number Comprehension test ($p < .02$).

Both these two tests were a part of Mathematical Ability tests. Other tests were Mathematical Achievement tests ($p < .001$) and English Language Proficiency test ($p < .001$). Interesting enough the differences in Mathematical Achievement test scores and in the two Mathematical Ability test scores were in favour of pupils of Low Cost schools while for English Language Proficiency test the differences were in favour of pupils in Medium Cost schools. This implies that pupils in Medium Cost schools had on the average a higher level of proficiency in English Language over pupils from Low Cost schools, while pupils in Low Cost schools were better in Mathematics. This could be explained by considering the fact that proficiency in English Language is not as important to Mathematical Achievement as Vocabulary of Mathematical terms. Knowledge of Mathematical terminology has been shown to influence Mathematical performance (Aiken, 1971; Eshiwani, 1974). On the other hand since Medium Cost schools were found in the urban areas,it is possible that the pupils attending the schools were more used to communicating in English as they did not have a common mother tongue and therefore were proficient in English Language use as opposed to pupils in Low Cost schools who are in the rural areas and normally have a common mother tongue.

TABLE 4.14

MEAN DIFFERENCES IN TEST SCORES FOR LOW COST AND HIGH COST SCHOOLS.

TESTS	MEAN SCORE FOR LOW COST	MEAN SCORES FOR HIGH COST	*t*-TEST
Mathematical Achievement.	12.9	17.9	$p < .001$
Arithmotic Roasoning	5.9	7.1	$p < .001$
Computation	12.6	13.9	$p < .001$
Whole Number Comprehension	5.3	7.0	$p < .001$
Hidden Figures	3.1	3.6	$p < .001$
Foarm Board	2.9	4.6	$p < .001$
Five Dots	6.0	8.7	$p < .001$
Problem Solving	4.4	6.2	$p < .001$
Mathematical Ability Total	40.3	51.0	$p < .001$
Mathematical Vocabulary	4.6	6.0	$p < .001$
English Language Proficiency	8.1	13.5	$p < .001$

TABLE 4.15

MEAN DIFFERENCES IN TEST SCORES FOR MEDIUM AND HIGH COST SCHOOLS

TEST	MEAN SCORE FOR MEDIUM COST	MEAN SCORE FOR HIGH COST	t-TEST
Mathematical Achievement.	11.3	17.9	$p<.001$
Arithmetic Reasoning	5.5	7.1	$p<.001$
Computation	11.9	13.9	$p<.001$
Whole Number Comprehension	4.9	7.0	$p<.001$
Hidden Figures	3.0	3.6	$p<.001$
Foarm Board	3.3	4.6	$p<.001$
Five Dots	5.9	8.7	$p<.001$
Problem Solving	4.5	6.2	$p<.001$
Mathematical Ability Total	38.8	51.0	$p<.001$
Mathematical Vocabulary	4.5	6.0	$p<.001$
English Language Proficiency	9.8	13.5	$p<.001$

TABLE 4.16

MEAN DIFFERENCES IN TEST SCORES FOR LOW COST AND MEDIUM COST SCHOOLS

TEST	MEAN SCORE FOR LOW COST	MEAN SCORES FOR MEDIUM	t-TEST
Mathematical Achievement	12.9	11.3	$p < .001$
Arithmetic Reasoning	5.9	5.5	ns
Computation	12.6	11.9	$p < .001$
Whole Number Comprension	5.3	4.9	$p < .001$
Hidden Figures	3.1	3.0	ns
Foarm Board	2.9	3.3	ns
Five Dots	6.0	5.9	ns
Problem Solving	4.4	4.5	ns
Mathematical Ability Total	40.3	38.8	ns
Mathematical Vocabulary	4.6	4.5	ns
English Language Proficiency	8.1	9.8	$p < .001$

In general when the scores in Mathematical Ability tests were summed up, no significant difference was found between pupils in Low-Cost and Medium-Cost schools. No significant difference was found in the scores on Mathematical Vocabulary test as well. Significant differences only occurred in Mathematical Achievement test scores and English Language Proficiency test scores.

It is therefore clear from this analysis that the performance of pupils attending High Cost schools was better than that of pupils attending Medium-Cost and Low-Cost schools in the areas they were tested in. The situation was found to be slightly different when pupils from Low-Cost and Medium-Cost schools were compared. While in some areas no difference was registered in other areas the pupils' scores were found to differ. In general the pupils in High Cost schools can be viewed to have developed their abilities in mathematics to a high level and therefore had a higher potential in mathematics. Their level of proficiency in English Language and knowledge of Mathematical terms were also higher as compared to the other pupils, and as a result they achieved higher in mathematics. On the other hand it must be made clear that pupils attending High-Cost schools were from homes where parents were educated and were professionals. So the children grew up in very stimulating environments, which is not the case for pupils attending Low-Cost and Medium-Cost schools. At the same time it should be understood that ability tests are very difficult to construct such that the ones used here though constructed by professionals could not tap fully a pupil's ability in mathematics. It is possible therefore that the ability tests to some degree acted as achievement test, thus ability tests could be viewed as influenced by the environmental factors.

The results also showed that the pupils in Low Cost and Medium Cost schools had equivalent ability in Mathematics and knowledge of Mathematical terms, although pupils in Medium-Cost schools were better than those in Low-Cost schools in proficiency in English Language. Pupils in Low Cost schools performed better than pupils in Medium-Cost schools in Mathematics. An important point to note here is how the pupils get to these types of schools. As Medium-Cost and High-Cost schools are found in the urban areas, it is possible that through the Nursery Schools the first selection of the top pupils are taken by the High Cost schools and the rest find their ways in the Medium Cost schools. In the rural areas since it is only Low-Cost schools that are around, basically all pupils go to that type of schools. It therefore seems as if in the urban areas High-Cost schools have the top echelon of talent of pupils, while Medium-Cost schools have the lower talent of pupils.

In the Low-Cost schools pupils of all levels of talent are found, and the only problem is with the development of these talents. Therefore in a case where pupils attending Low-Cost and Medium-Cost schools are compared in very strict terms, pupils of Low-Cost schools are most likely to be found smarter. This could explain why pupils in Medium-Cost schools had a higher level of proficiency in English Language than pupils of Low-Cost schools, when pupils of Low-Cost schools turned out better than pupils of Medium Cost schools in Mathematical Achievement. This was likely because pupils in Medium-Cost schools both outside and within the school communicate more in English as compared to pupils in Low-Cost schools.

4.3.3 Relationship between sex of pupil and test performance.

The question to be answered here is "Do male and female pupils differ in their scores on the test?" Below is the statement of null hypothesis based on the question.

Null Hypothesis III

There is no significant difference between the scores of male and female pupils in

(i) Mathematical Achievement Test

(ii) Arithmetic Reasoning

(iii) Computation Test

(iv) Whole Number Comprehension Test

(v) Hidden Figures Test

(vi) Foarm Board Test

(vii) Five Dots Test

(viii) Problem Solving Test

(ix) Mathematical Ability Total

(x) Mathematical Vocabulary Test

(xi) English Language Proficiency Test

Table 4.17 presents results of t-test to prove the hypothesis.

TABLE 4.17

MEAN DIFFERENCES ON MATHEMATICAL ACHIEVEMENT TEST, MATHEMATICAL ABILITY TESTS, MATHEMATICAL VOCABULARY TEST AND ENGLISH LANGUAGE PROFICIENCY TEST FOR MALE AND FEMALE PUPILS

TESTS	MALES (N = 362)		FEMALES (N = 272)		t - TEST	
	MEAN	S.D	MEAN	S.D.	T VALUE	p
Mathematical Achievement	14.7	5.9	11.4	5.7	7.10	.001
Arithmetic Reasoning	6.3	2.2	5.6	2.2	3.89	.001
Computation	12.9	2.0	12.1	2.5	4.86	.001
Whole Number Comprehension	5.9	2.2	4.9	2.3	5.60	.001
Hidden Figures	3.3	2.0	3.0	1.7	2.03	.05
Foarm Board	3.9	2.7	2.8	2.5	4.90	.001
Five Dots	7.0	4.2	5.9	3.8	3.32	.001
Problem Solving	5.1	1.9	4.4	2.0	4.40	.001
Mathematical Ability Total	44.3	11.2	38.6	12.1	6.11	.001
Mathematical Vocabulary	5.1	1.9	4.5	1.8	3.46	.001
English Language Proficiency	10.1	3.7	9.7	3.6	1.33	ns

Theoretical value considered for t = 1.56, t values greater than this significant at levels $p < .05$.

The results of the t-test for mean score differences in the tests for male and female pupils indicate significant differences at $p < .001$ except in the test of English Language Proficiency. All the differences were in favour of the male pupils. The male pupils consistently scored higher marks in all the Mathematical Ability tests, Mathematical Achievement test and Mathematical Vocabulary test. These results suggest that male pupils were better than the female pupils in mathematics.

The finding that no significant differences existed between male and female pupils in the test on proficiency in English Language suggests that sex of pupil did not influence their level of proficiency in English Language. All the pupils male or female had an equal chance of scoring high marks in this test. On the average the male and female pupils had similar level of proficiency in English Language.

Although significant correlations were found between Mathematical Achievement test and English Language Proficiency test (See page 81), this did not help much when it came to explaining sex differences found in Mathematical Achievement test scores, Mathematical Ability tests scores and Mathematical Vocabulary test scores.

This was mainly so because both males and females were found to be equivalent in their level of English Language Proficiency. In a way level of proficiency in English Language is not a significant factor in Mathematical Performance. Actually if proficiency in English Language was significant to Mathematical Performance then the male pupils would still perform better in it as they did in Mathematical Performance. However, the fact that the Mathematical Vocabulary of girls was lower than that of boys confirms the importance of Mathematical Vocabulary to Mathematical Performance. This implies that proficiency in English Language did not have a significant influence on Mathematical Performance.

4.3.4 Factors responsible for the variation in Mathematical Achievement.

The proposition here sought to establish which factors are responsible for the variation in Mathematical Achievement test scores.

Null Hypothesis IV

The variation in Mathematical Achievement test scores will not be fully accounted for by the Variables, Mathematical Ability, Mathematical Vocabulary, English Language Proficiency, Type of School, Sex of Pupil, Age, Class Repetition, After-School Coaching in Mathematics, and After-School Coaching in English, taken singly or taken all of them together.

The statistical procedure used in testing this hypothesis was the step-wise multiple regression analysis. This method identified which factor or factors were important to Mathematical Achievement. The factors found to be reponsible for the variation in Mathematical Achievement test scores would be the best predictors of Mathematical Achievement. Table 4.18 is a summary of the step-wise Multiple Regression Analysis. The table presents the results in order of the factors entered in the regression equation. The Multiple R and R^2 give the proportion of variance accounted for by the factor in question or a joint effect of two or more factors in the order they are entered in the regression equation.

TABLE 4.18

SUMMARY OF STEP-WISE MULTIPLE REGRESSION ANALYSIS ON MATHEMATICAL ACHIEVEMENT TEST.

FACTORS IN THE ORDER ENTERED	MULTIPLE R	R^2	BETA
Whole Number Comprehension Test	.62883	.39543	.20767
Computation Test	.70350	.49491	.21168
Mathematical Vocabulary Test	.73877	.54578	.16861
Foarm Board Test	.75780	.57426	.11921
Arithmetic Reasoning Test	.76760	.58921	.09963
Sex of Pupil	.77238	.59657	-.08494
English Language Proficiency Test	.77795	.60520	.09362
Coaching in English	.78127	.61038	.08000
Five Dots Test	.78389	.61449	.07647
Problem Solving Test	.78588	.61761	.07389
Hidden Figures	.78613	.61800	-.02064
Coaching in Maths	.78633	.61832	-.01690
Type of School	.78646	.61852	-.02319
Pupil's Age	.78661	.61876	.02044
If Repeater	.78664	.61880	.00745

Results of step-wise multiple regression analysis indicate that all the factors considered together accounted for 61.9 percent of the variation in Mathematical Achievement test scores. The first important single factor was Whole Number Comprehension test (39.5%). Subsequently the next significant factors acting jointly in order of preceeding factors were Computation test, Mathematical Vocabulary test, Foarm Board test, Arithmetic Reasoning test, Sex of pupil, English Language Proficiency test and After-School Coaching in English. All these eight factors were found together to account for 61 percent of the variation in Mathematical Achievement. The remaining factors including Five Dots test, Problem Solving test, Hidden Figures test, After-School Coaching in Mathematics, Pupil's Age and Class Repetition did not appear to have any significant contribution to performance in Mathematical Achievement test. While this was so, it should be noted that about 38 percent of the variation in Mathematical Achievement test was still unaccounted for.

4.3.5 Summary of Findings

By way of summary the analysis carried out here revealed the following results:

1. Mathematical Achievement test scores were found to correlate significantly with Mathematical Ability test scores, Mathematical Vocabulary test scores and English Language Proficiency test scores.

2. Concerning the comparision of pupils attending the different school types one-way ANOVA results indicated statistically significant differences in performance between these pupils, with the differences being in favour of pupils in High-Cost schools. An important point to mention here is that pupils attending Low-Cost and Medium-Cost schools were found to differ significantly only in some tests but not in others.

3. When Male and Female pupils were compared in their performance in the tests by use of t-tests, statistically significant differences were revealed in all the tests except for a test on English Language Proficiency. This result showed that on the average Male and Female pupils have the same level of proficiency in English Language.

4. Finally it was found that 61.9% of the variation in Mathematical Achievement test scores was explainable by all the factors considered in the study. Out of these factors some had significant loading in Mathematical Achievement test scores than others. Effectively 61% of the variation was accounted for by the first eight factors in table 4.18. Clearly in this study 38% of the variation in Mathematical Achievement test scores were as yet unaccounted for.

4.4 Discussion

The statistical techniques used in the analysis of data were very useful in proving the hypothesis and hence the findings. The main focus for this study was on pupil's Mathematical Achievement. It would be reasonable to expect that what a pupil achieves in Mathematics after a given period of instruction would depend on a number of cognitive and environmental factors. In this context, the school influences on pupil Mathematical Achievement were investigated in an attempt to identify areas where pupils attending different types of schools would differ or be similar.

Studies in Mathematical Ability have revealed that Mathematical Ability is composed of single factors which together in certain amounts reside in the Human brain (Werdelin, 1958). It would therefore be reasonable to expect a very close link between pupil Mathematical Achievement and Pupil Mathematical Ability (Aiken, 1973). Wick (1965) attempted to establish the the relationship between the factored tests of Mathematical Ability and Mathematical Performance. His results indicated very low correlations showing that there was no correlation between Ability and Mathematical Achievement. The findings of this study demonstrated that the relationship between pupil Mathematical Ability and Pupil Mathematical Achievement was significant. Ability is a potential and therefore this strong relationship between pupil Ability and Achievement in Mathematics clearly shows that the pupils did achieve to their potential in Mathematics. It did not matter which type of school a pupil went to, or whether a pupil was male or female, what he or she achieved in mathematics was a reflection of his/her potential in Mathematics. As all pupils were not expected to score the same, any differences among the pupils would be attributed to individual differences. This is based on the assumption that a potential in Mathematics is normally distributed among the pupils.

When dealing with Mathematical Achievement of pupils the influence of the terms specific to Mathematics, that is Mathematical Vocabulary, need to be considered. Likewise in a situation where the medium of instruction is a second language to the pupils and in most cases to the teachers as well, the effects of proficiency in English Language on pupil Mathematical Achievement must be looked into. The results of the relationship between pupil Mathematical Achievement and Mathematical Vocabulary were in all cases found to be significant. Similar result was found for the relationship between Mathematical Achievement and Proficiency in English Language. These findings show that sound knowledge in Mathematical terms is important in aiding the understanding of the subject and therefore little knowledge of these terms could possibly contribute to poor performance in Mathematical Achievement tests. Along the same lines the degree of proficiency in the language used for instruction appears important. Although significant correlations were found between Mathematical Achievement tests and English Language Proficiency test, it was also found that vocabulary in mathematical terms was more important to Mathematical Performance. Competence in the language here should be biased to Mathematics since mathematics is composed of special terminology. Nevertheless the importance of the proficiency in English Language cannot be underestimated. The strong relationship between Mathematical Achievement tests scores and English Language Proficiency test score found in this study confirms the importance. For pupils in Primary Schools who learn the English Language and are taught other subjects through English medium, it would be important to have a sound understanding of the English Language if they have to achieve well in the other subjects. It is possible that a low competence in English Language could handicap the level of performance and the amount of work one could do in a given subject. At the same time a high level of competency in English Language would serve as an advantage and an aid in understanding whatever is required in the course, given that the pupil is of average intelligence. The importance of Language to learning was realized when Vygotsky (1962) found that Language was important in concept formation. On Mathematics Aiken (1972) found that apart from being a Language on its own there was a close relationship between Mathematics and Language used in instruction. Hence the evidence revealed from the findings of this study points out that pupils who had relatively high scores on Mathematical Vocabulary test and English Language Proficiency test tended to have high scores on Mathematical Achievement test. However,Mathematical Vocabulary appeared more important than English Language Proficiency.

Although significant correlations were registered between Mathematical Achievement and Mathematical Ability; Mathematical Achievement and Mathematical Vocabulary; Mathematical Achievement and English Language Proficiency over all the pupils, this finding did not provide enough information on how the school types, Low-Cost, Medium-Cost, and High-Cost schools compared and how the male and female pupils compared in terms of the magnitude of the test scores. An important objective in this study was to establish whether attending a given type of school would have an influence on the pupils' performance in Mathematics.

The study considered the three types of schools and carried out tests to establish if the pupils attending the three school types differed significantly in their performance in the tests. The results showed that the scores on all the tests, differed significantly among pupils attending the three types of school. Pupils in High-Cost schools had the highest scores compared to pupils in Medium-Cost and Low-Cost schools. But the scores of pupils in Low-Cost and Medium-Cost schools when compared only differed significantly in some tests. The direct implication here was that pupils attending High-Cost schools were better than the other pupils in Low-Cost and Medium-Cost schools. This fact though generally observed in the past examination results it has never been established and as to which areas the differences occur has never been established as well. Somerset (1974) found that pupils in High-Cost schools tended to achieve higher than pupils in Low-Cost schools particularly in Mathematics. His explanation to this difference resulted from an item analysis of C.P.E. 1971 Mathematics Paper where he found that most of the questions in the paper tended to favour pupils from High-Cost schools. Similarly summary of examination results compiled every year by the Examination Council consistently show high average scores in Mathematics from High-Cost schools. It should be noted that the terms Low-Cost, Medium-Cost and High-Cost schools do not necessarily refer to cost incurred by parents but more on cost of facilities in the school. The area which has not been investigated by the researchers in this field is the one concerned with identifying the cause of the differences, and whether the pupil performanceswere true reflection of pupils' ability.

The finding of statistically significant differences in scores of pupils from Low-Cost, Medium-Cost and High-Cost schools particularly in all the seven Mathematical Ability tests was striking. On the average pupils from High-Cost schools had higher scores. It would be expected that pupil potential in Mathematics would remain relatively constant over the whole range of school types, but the results indicated that pupils attending High-Cost schools had their Mathematical Ability more developed than the others. This result contradicts the view held by many researchers in this field that ability is an innate potential which develops naturally with time but has a ceiling which varied from one individual to another.

This fact presumes that

1. Mathematical Ability is normally distributed .
2. After seven years of schooling the level of development of ability in the three school types may reach the same point.

However, this is not so in this study. Although the subjects of this study were from a random sample of schools, the differences among the pupils occurred because;

1. The school environments did not provide the learning conditions to enable development of ability to full potential for some pupils. Given the fact that the schools differed in the quality of staff, school equipment, class amenities, teacher-pupil ratio, conditions of admission, age at enrolment, seating arrange-

ment, etc.

2. Some pupils were pre-selected from nursery schools for the best schools.

Though the pupils attending these schools could have natural similarity in their abilities the environment through which they operate was bound to have an influence. Regarding Mathematical Ability of school children, Krutetskii (1976) and Werllelin (1958) observed that the development of Mathematical Ability was influenced by classroom instruction, Mathematical games and out of class experiences involving mathematically related tasks. An interpretation of this view would imply that pupil potential in Mathematics would only be realized fully if the conditions within school environment are favourable, otherwise this potential will remain dormant. Thus pupils who attended schools which did not have all the necessary requirements lacked some of the experiences which would help them develop their Mathematical Ability and therefore they underachieved. In actual fact this latent ability would remain dormant completely until a favourable atmosphere avails itself. Wamani (1980) had similar findings although his subjects were of standard 3 - 5 level.

The results indicating that pupils from High-Cost schools on the average performed better than pupils in Low-Cost and Medium-Cost schools in all the tests deserve some scrutiny. An explanation of these differences would call for a critical analysis of the quality of the schools, the learning environment, pupils home background (Socio-economic status). Facts from studies on intelligence indicate that the intelligence quotient (IQ) is normally distributed among people. This would imply that if admission into these three school types is not based on a test of mental ability then no significant differences would be expected among the scores of pupils. The results of this study have revealed significant differences in the scores of pupils in these categories of schools. A similar result was found by Wamani (1980) who observed that some schools in Nyeri Distirct consistently out scored others every year in C.P.E. results. An explanation to such differences could be sought in terms of school characteristics and pupil home background. The majority of the pupils who attend High-Cost schools are from homes where parents are literate, well to do and are ready to pay fees for the education of their children. Such parents value education and therefore provide their children with books, proper study places and also take keen interest on the progress of their children.

The schools where they take their children are the ones which are fully established and provide enough of what is required for proper learning. In these schools, admission is granted under very strict conditions. The pupils must have passed through a prominent nursery school and must be about six years of age. The school itself is equipped with highly qualified staff, teaching aids, books and stationery and well-planned classrooms with proper seating arrangement. The teacher-pupil ratio is on the average one to 35. This kind of environment is very suitable for any learning process and the pupils are able to develop as fast as they possibly can. Such an atmosphere would itself be very motivating to the pupils as well as the teachers.

On the other extreme the pupils attending Low-Cost schools come from very poor home backgrounds where many parents are illiterate or semi-literate. These parents are predominantly agrarian and show very little interest in the education of their children. All that these parents do is to allow their children to go to school but with frequent interruptions when their services are required at home. Much to do with the education of the children is between the pupils and the school. With no proper study places at home, the pupils have no motivation to study. On the other hand the school is very poorly equipped, very few books, majority of staff unqualified, etc.

The classrooms are congested on the average 50 pupils per class and on very few desks. The pupils on admission to the school need not have passed through a nursery school and the pupil's age at admission is not taken seriously. Thus adding to the fact that these pupils also attend school on and off, by the time they come to standard seven they are of varied ages. An analysis of our study sample presented on table 3.1 revealed that by standard seven 93% of pupils in High-Cost schools were of age less than 14.5 years while in Medium-Cost schools 66% and Low-Cost schools 38% were below that age. Much of the age range in Low-Cost schools is also contributed by the fact that so many pupils repeat classes, often more than once. In table 3.1 it is also shown that in High-Cost schools, 33.6% of the pupils had repeated at least a class, compared to 68% in Medium-Cost schools and 75% in Low-Cost schools.

Generally if considerations are given to the school and the pupils home background then what clearly comes out is that some pupils are at an advantage over others. This fact is very clear from the sharp differences that exist between the school types and the home backgrounds of pupils attending the schools.

These two main factors considered here are bound to affect and influence what the pupils achieve in the various subjects. Even by considering the language for communication, the pupils from the rich backgrounds through experience at home and in the nursery school will have attained some degree of proficiency in English as opposed to the other pupils who will be in the process of learning the language. This could actually affect how they understand the subjects. Moreover teaching methods vary with level of training. The main struggle by the school types is for academic excellence in the National Examination (C.P.E.) which is the determinant of an upward mobility in education (ILO, 1972), that is, proceeding to secondary education.

Although the child from the rich home has better chances of success, there is no guarantee to the success. Many parents especially the literate ones pay extra fees for private after-school coaching of their children. The figures presented on table 3.1 show that on the average 62% of pupils in High-Cost schools go for after-school coaching as compared to 37 percent in Medium-Cost and 43% in Low-Cost schools. Though the relationship between After-school coaching in Mathematics and Mathematical Achievement was not sought, it is however a clear indication that the literate parents do understand what education means and have a strong need for their children to proceed on with their education. In such a situation it would not be a simple matter to establish the view held by the poor parents as concerns education because they have certain limitations. In a way the arguments presented here suggest with alot of caution that if two pupils with the same potential are educated under these varied conditions one would achieve higher than the other. This however, would not mean that he/she is better than the other since if educated under similar conditions they could achieve the same. The differences registered in the scores of pupils in the school types are therefore not a reflection on differences in pupils' potential but rather a reflection on the quality differences in the learning environment and experience the schools provide.

Another area dealt with in this study was on the performance differences of male and female pupils in Mathematics. The result indicated that male pupils performed better than female pupils in Mathematical Ability Tests, Mathematical Achievement Tests and Mathematical Vocabulary Tests. But in English Language Proficiency there were no such differences. This result is similar to the earlier research findings by many researchers which also revealed such sex differences. The fact that differences still occurred in Mathematical performance even when the level of proficiency in English Language was similar between male and female pupils served to strengthen the belief in sex differences in Mathematics. Attempt to explain the sex differences in Mathematical performance has been made by many researchers. Explanations have covered a variety of areas involving personality, masculine interest and scientific career interest (Aiken, 1970; Astin, 1974; Maritim, 1970; Carey, 1958; Milton, 1957). Other explanations have centered on attitudes toward mathematics (Eshiwani, 1974; Sheikh, 1976). By considering the methods of teaching Mathematics Eshiwani (1974) also found that when females are taught Mathematics through programmed instruction they tended to have scores comparable to the males. The issue of sex-differences in general has also been tackled by researchers such as Maccoby (1974), Fennema (1978, 1981).

In this study, the correlation analysis showed that for all pupils the relationship between Mathematical Achievement test scores and Mathematical Ability test scores were significant. This indicated that whatever the male and female pupils achieved in Mathematics was mainly a result of their ability. The school environments in which both the female and male students were operating were quite similar. Both the sexes were almost in the same proportion in each of the school types see table 3.1.

Maritim (1979) explained such gap in school performance between boys and girls to lie in their differences in academic self perception. His explanation appeared to be closely linked with the one of attitude towards mathematics. Here the females view themselves as being incapable of doing mathematics and therefore form a very negative attitude towards the subject. This study as already mentioned found that even in Mathematical Ability tests the boys still performed better. It would therefore appear that without even making serious attempts the majority of females have learnt to give up at the slightest difficulty encountered in solving a Mathematical problem. Therefore however much the males excel females in mathematics it should not be viewed as an indication of inferiority on females. The guidance provided by roles and norms could also have an influence on the female pupil performance in mathematics. The types of roles expected of females do not rigidly require mathematics as a prerequisite as do those of males. On such grounds the females give up and work hard in subjects related to their future roles such as Domestic Science and the Arts Subjects.

Along with the above explanation importance must be attached to the teachers as well as single sex or co-educational schools. The attitudes held against the girls as concerns Mathematics by the teachers are bound to influence the kind of interaction between the female pupils and the teachers. Maritim (1979) found that where girls had low academic self perception of their abilities, in corresponding areas the teachers had low perception of girls' abilities. The extent of this association could be strengthened by the sex of the mathematics teacher. The kind of interaction between a male teacher and a female pupil might be different from that between a female teacher and a female pupil. At the same time the kind of classroom situation where the pupils sit to be taught might have some influence depending on whether the school is co-educational or single sex. When girls sit in class with boys, there is a possibility of girls giving up to the boys on Mathematics and therefore achieving lower than them. Observations show that girls learning in single sex schools are almost comparable to boys in Mathematical Performance (Eshiwani, 1974).

Another important point in explaining the differences is to do with the stage of development. According to Brown (1957) and Rabban (1950), roles become more clear with age and this ends the rigour in doing subjects that are thought to be male dominant by females. At puberty the girl becomes fully aware of herself as feminine person with a definite feminine role to adopt. If this role appears to include a rejection of Mathematics and to a lesser but potent extent scientific interests then she will react accordingly. The majority of pupils considered in this study were over 13 years of age which is puberty stage. Wamani (1980) found in his study that no sex differences in performance in Mathematics were observed from pupils of 11 years and below. Similar results have been reported in the past. These reasons provided here suggest that there is alternative explanation to the sex differences in Mathematical Performance. Therefore it would not be resonable to view such differences as females being inferior to males in Mathematics.

Mathematical Achievement in this study was viewed to depend on a number of factors. This meant that any variation in Mathematical Achievement could be explained in terms of the independent contributions of the factors considered. The factors that had significant contribution were Computation Ability, Mathematical Vocabulary, Spatial Ability, Arithmetic Reasoning Ability, Sex of pupil and Proficiency in English Language. These factors as already mentioned earlier accounted for 61% of the variation in Mathematical Achievement.

The other factors did contribute but not significantly; therefore any prediction equation would be composed of the factors mentioned above. This finding indicate that a sound knowledge in Computation, Mathematical Vocabulary, Spatial Orientation, Arithmetic Reasoning and Proficiency in English Language would make a pupil excel in addition to sex of pupil. The differences registered among High-Cost, Medium-Cost and Low-Cost schools could be explained in terms of sound development of such skills. It would appear therefore that these skills are far more developed in High-Cost schools than in the other schools, so that they consistently have high achievement in mathematics. It is possible the other pupils from Low-Cost and Medium-Cost schools could equally develop the skills if given the opportunity.

This discussion thus far presented can be summarised by pointing out that even though pupils in High Cost schools had better performance in all areas tested than pupils in Low-Cost and Medium-Cost schools, this was more to the schools than to the pupils. The three school types differed in many aspects which considered together could influence and promote whatever the pupils achieved. The poor maintenance in Low-Cost and to some extent in Medium-Cost schools as compared to the well established High-Cost schools could account for the differences in performance by the pupils.

To that extent pupils in Low-Cost and Medium-Cost could be viewed to have the potential which is not developed to the full. The results of sex differences in Mathematical performance and not significantly in other areas is an indication that there could be other reasons for it, not necessarily question of inability. Further research is required in this area.

In summary, the discussion of the findings revealed the following points.

1. Pupil performance was found to be influenced by the quality of teaching and learning environment. Both these depend on the level of training of the teachers and the facilities and equipment necessary for teaching and learning in the school.

2. Although achievement in Mathematics was found to depend on pupils' ability in Mathematics, it was also found that Mathematical Vocabulary was very important for the level of Achievement in Mathematics.

3. The ability to manipulate space was not well

developed in the pupils. The possible reason was that pupils lacked enough experience with tasks involving space.

4. Although some explanations for sex differences in Mathematical performance have been provided, they are not conclusive, so further research is still required.

Based on these points, a few recommendations will be made.

The next chapter will discuss the limitations, implications and recommendations of the study. It will also discuss the directions for future research and then a conclusion.

CHAPTER FIVE

LIMITATIONS, IMPLICATIONS, RECOMMENDATIONS

This chapter will present the limitations of the study, implications, recommendations and directions for future research.

5.1 Limitations of the study

In any social research there will undoubtedly be errors of various kinds in the data. There will also be the inevitable sampling errors which cannot be avoided easily.

One of the limitations in this study was the generalization of the results to other settings. The main point here was to do with the size of the sample considered as compared to the size of the population of all standard seven children in Kenya, which was in the tune of hundreds of thousands. If such a comparison was made then the study would not hold its worth. However, the results of such a study served as an indication to the state of events.

It was noted that a study relating to school achievements would need to cover all the curriculum areas to be able to discover factors influencing school achievement.

This study by nature and purpose, restricted itself to mathematics. However, it was recognized that a wider study covering all the areas would provide more concrete information on the determinants of school achievement.

2 Implications of the study.

The implications of the present results are fairly straightforward. The past researchers (King, 1974; Somerset, 1974) argued that the pupils' success and failure in C.P.E. depended on the quality of the school and the quality of the teachers. The main reason behind their argument was that the rural children were the victims of poor environment and poor teaching. These findings appeared quite realistic and acceptable. In addition this present study went further to investigate how pupils' achievement in mathematics related to their ability in mathematics and the nature of the differences that occurred among pupils attending the different schools. The results implied that poor environment and poor teaching retarded the development of pupils' abilities thus resulting in poor achivement.

Although there had been very few researchers probing into the qualities of staff and facilities in the schools in relation to student performance, it still appeared convincing that what the school had to offer to the pupils in terms of teaching and facilities to aid in learning and development of necessary skills did make a significant difference. It was clear from some studies, that teaching methods were very crucial to higher achievements in the related subjects (Eshiwani, 1974). As already mentioned, being in a school of high quality was to a great extent influenced by pupils' home background. This did imply that the pupil's home background was significant to his/her performance at school.

As for sex differences in Mathematical Performance many research findings have revealed that male students performed better than female students. Although girls on the average never do as well as boys in mathematics, it is possible that the problem is a psychological, social and cultural one and is not of a lack of ability or potential in mathematics. However, the poor performance in mathematics by females still deserves scrutiny to establish where it originates from, its causes and how it develops.

5.3 Recommendations

From the findings of this study the following recommendations are made.

5.3.1 Improvement of Learning Facilities and Environment in Medium and Low-Cost Schools.

Many schools were found to have the majority of the teaching staff unqualified. In these schools most of the school equipment was lacking as well. Since better learning requires conducive atmosphere with exposure to the necessary skills using best teaching methods, it would be important to uplift the schools by increasing the number of qualified teaching staff and the necessary school equipment including text books. It is a fact that teacher efficiency depends upon the training and the teaching aid-equipments. It is viewed that if the schools could have all the necessary school equipment, qualified teaching staff and improved tuition blocks to provide for conducive learning atmosphere, then the pupils could probably develop fully their abilities and achieve at higher levels.

5.3.2 Mathematical Vocabulary

The results of this study revealed that knowledge of the common mathematical terms was very important in the learning of mathematics. It is therefore recommended that when teachers are trained on the methodology of teaching mathematics, special emphasis should be laid on the common but important Mathematical Vocabulary and terms. This would be important since in teaching mathematics, if the pupils have to be clear in their minds about what is taught, then the mathematical concepts must be explained clearly. Formation of concepts can be further strengthened by using mathematical models, by giving wider opportunities of using and applying the concepts. Proficiency with mathematical terms was found to bear significant relationship with Mathematical Achievement.

5.3.3 Special Emphasis on Development of Spatial Ability.

This was the only one of the composites of Mathematical Ability which had insignificant correlation with Mathematical Achievement. This ability involved manipulation of space, including Three-Dimensional experience, Geometrical Constructions, Mathematical Models, Tangrams and other practical experiences involving space. It appeared that this aspect of mathematics has been given very little attention. It is therefore recommended that special emphasis should be put on space understanding and orientation (Geometry). Teachers should be well trained to be aware of this important aspect of mathematics and the best method of teaching it.

5.4 Directions for Future Research.

Educational problems of learning and teaching are very complex and more information, further evidence and new insight from research programmes are always welcome to help educationists and psychologists to set better understanding. School performance is affected by many factors that interact with one another. It is difficult in any given research like this to identify all the factors, but data are now available only on isolated factors that have been shown to affect achievement test performance. The combination of these isolated factors shed some light on our understanding of school performance and Mathematical Achievement in particular.

Further research is required to reveal the possible interactional effects between Mathematical Ability, Mathematical Vocabulary, English Language Proficiency and Type of School. The present data did not provide information about the actual experiences and activities that the children are exposed to in the classroom as well as out of the classroom, teacher-pupil interactions and methods of teaching adopted by the different teachers in the three categories of schools. This study only established the score differences among the pupils which was a result of whatever experiences, activities and methods of teaching.

In actual fact there would be a need to carry out studies to provide more information on main factors within the school environment which contribute significantly to Mathematical Achievement and are responsible for the differences.

Sex differences in almost every aspect of human behaviour have been consistently observed, and the most widely accepted explanation for this is that boys and girls are exposed to different experiences during socialization (Maccoby, 1966). Cross cultural evidence reveals that socialization influences how a child acts, feels and thinks (Whiting and Whiting, 1968). On school achievement tasks, it has been demonstrated that boys and girls tend to achieve higher scores on tasks that are stereotypically and culturally perceived as appropriate to their sex differences in performance and that the sex-typed socialization practices constrain the child's development of sense of competency in specific areas of study he/she perceives are not appropriate to his/her sex. More research is therefore needed to reveal more reasons for sex differences. It would also be important to determine at what age and stage such sex differences in mathematics appear. Even in the teaching process, the teacher-pupil interaction especially between male teachers and female pupils, and female teachers and male pupils should be investigated. The sex differences in mathematics need to be identified at their earliest stage so that programs to minimize them can be developed.

5.5 Conclusion

When human beings are subjected to different learning environments, the experiences of these environments lead to the development of different cognitive skills and personality characteristics. In our society today, the schools hold the responsiblity of nurturing talent in the pupils and helping them in the process of instruction to develop certain desirable skills. It is on the level of competence in the required skills that decisions are made about the pupils for the next stage of formal education. The quality of the cognitive skills and personality characteristics, and their desirability must be related to the needs of the society.

Although the main function of the school is to help develop talent of the pupils through curricular demands, it also creates inequality through the screening process such as achievement tests (C.P.E.) that are developed to halt mass access to the few available positions in the society.

The latter function can cause a very serious damage to some pupils especially if the schools are not equivalent in standard, that is teaching and learning environment. This fact is clear from the fact that even though there are individual differences among pupils, if in the process of nurturing talent , which is normally accomplished through classroom instruction and curriculum contents some pupils are exposed to better learning facilities, wider experiences, better instruction, etc, than others, then obviously they have to lead in the achievement tests and get access to the fewer places.

Although it is admitted that school performance is a multi-dimensional concept, that is, there are multiple contributing factors that interact to unknown degree, the present data have shed some light on the significant influence of the type of school a pupil attends. This suggests that when considering pupil performance, the type of school he was attending must not be ignored especially in a situation where there is a high variation of the schools.

Educators are always keen on knowing the factors affecting the pupils' achievement so that if they can be identified then they can attempt to minimize the variance in pupils' achievement and optimize the available resources.

Along with the other factors, we have the evidence that factors within the school environment contribute significantly to pupils' achievement.

In conclusion, this Study has shown that the quality of a school makes a difference in pupils performance. So if the variance in school achievement among pupils has to be minimized then the schools have to be of equivalent level of maintenance. In addition to this, significant differences in performance between males and females in certain subject areas would call for further research where they occur for either sex.

A P P E N D I X   A

1. RESEARCH CLEARANCE LETTER

2. RESEARCH PERMIT

3. A LETTER FROM MUNICIPAL EDUCATION OFFICER , KISUMU

4. LETTER TO PRIMARY SCHOOL HEADS

5. PROGRAM FOR THE ADMINISTRATION OF THE TEST BATTERIES.

OFFICE OF THE PRESIDENT
CABINET AFFAIRS

Telegrams: "RAIS", Nairobi
Telephone: Nairobi 27411
When replying, please quote
Ref. No. OP.13/001/10C 384/4
and date

P.O. Box 30510
NAIROBI, KENYA

3rd February 1981

Mr. Raphael J. A. Kapiyo,
Kenyatta University College,
NAIROBI.

Dear Sir,

RESEARCH CLEARANCE

Your application for authority to conduct research on, "An investigation into the relationship between Mathematical Ability and Mathematical Achievement of Primary Seven", has been received and it is being processed.

In meantime you are hereby authorized to go to Kisumu District for your preliminary inquiry.

Yours faithfully,

E.K. RUCHIAMI
for: PERMANENT SECRETARY/CABINET AFFAIRS

c.c.

The Permanent Secretary,
Ministry of Basic Education
NAIROBI.

The Secretary,
National Council for Science and Technology,
NAIROBI.

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NOTES

1. Government Officers will not be interviewed without prior appointment.
2. No questionnaire will be used unless it has been approved.
3. You must report to the District Commissioner of the area before embarking on your research.
4. Excavation, filming and collection of biological specimens are subject to further permission from the relevant Government Ministries.
5. The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice.

GPK 1869—2m—10/78

REPUBLIC OF KENYA

RESEARCH CLEARANCE PERMIT

PAGE 2

THIS IS TO CERTIFY THAT:—

~~Prof./Dr.~~/Mr./~~Mrs./Miss~~ KAPIYO

RAPHAEL J.A.

of (Address) KENYATTA UNIVERSITY COLLEGE

has been permitted to conduct research in ....

.... Location,

KISUMU District,

NYANZA Province,

on the topic "AN INVESTIGATION INTO THE RELATIONSHIP BETWEEN MATHEMATICAL ABILITY AND MATHEMATICAL ACHIEVEMENT OF PRIMARY SEVEN CHILDREN OF KENYA".

for a period ending 30TH SEPTEMBER, 1981.

PAGE 3

Research Permit No. OP.13/001/11C 384/7.

Date of issue 30TH MARCH 1981

Fee received 25/=

PERM... CABINET...

Applicant's Signature

E.K. RUCHIAMI

for Permanent Secretary, Office of the President

MUNICIPALITY OF KISUMU

Tel. Nos: Kisumu
Office 2251 - 55

Town Hall
Court Road
P. O. Box 105
Kisumu Kenya

Our Ref: MEO/26/VOL.I/195

Your Ref:

11th February, 1981.

Headmasters/mistresses,
Municipal Primary Schools,
KISUMU.

RE: MR. R.J.A. KAPIYO:

The bearer wishes to carry out research relating to his Studies at the University of Nairobi.

Kindly afford him available facilities to do this at your school.

V. J. ODUOR,
MUNICIPAL EDUCATION OFFICER

VJO/jaw.

..../140

KENYATTA UNIVERSITY COLLEGE
(DEPARTMENT OF EDUCATIONAL PSYCHOLOGY)

P.O. Box 43844,
NAIROBI.

TO ---------------------------

I am writing to inform you that I have been granted the authority to carry out a research study in Kenya by the President's Office. Your school has randomly been chosen as one of the sites for the study. This is a scientific educational research to be carried out in my personal capacity, with the support of Kenyatta University College, Department of Educational Psychology, Nairobi. The study is designed to investigate into the relationship between Mathematical Ability and Mathematical Achievement of Standard Seven pupils of Kenya. It is hoped that the results of the study may be of help to teachers, parents, pupils and curriculum planners of Kenyan primary schools.

The main purpose for writing this letter is to inform you that I will visit your school any time starting from February to March, 1981. During this visit which is expected to take two consecutive days, several tests will be administered to Standard Seven pupils. Your cooperation will be of utmost importance.

Thanking you in advance for your attention to this matter.

Yours sincerely,

RALPHAEL J.A. KAPIYO

KENYATTA UNIVERSITY COLLEGE
(DEPARTMENT OF EDUCATIONAL PSYCHOLOGY)

PROGRAM FOR THE ADMINISTRATION OF THE TEST BATTERIES

It is expected that if all is to go well then all the testing will take a whole working day as is indicated below, otherwise we proceed for half day the next day.

Important instructions for the tests will be read aloud and written on the blackboard before the test. For example: The pupils will be required to have a pencil and rubber before the test.

Time Schedule:

8.15 a.m. - 10.15 a.m.: MATHEMATICAL ABILITY TESTS.

10.30 a.m. - 12.30 a.m.: MATHEMATICAL ACHIEVEMENT TEST.

LUNCH BREAK

2.10 p.m. - 2.30 p.m:: MATHEMATICAL VOCABULARY TEST.

2.40 p.m. - 4.00 p.m.: ENGLISH LANGUAGE PROFICIENCY TEST.

If the above cannot be accomplished in one day then we shall proceed to the next day.

APPENDIX B

1. MATHEMATICAL ABILITY TESTS

   (a)
      (i) ARITHMETIC REASONING TEST
      (ii) COMPUTATION TEST
      (iii) WHOLE NUMBER COMPREHENSION TEST
      (iv) HIDDEN FIGURES TEST
      (v) FOARM BOARD TEST
      (vi) FIVE DOTS TEST
      (vii) PROBLEM SOLVING TEST

   (b) STUDENT IDENTIFICATION QUESTIONNAIRE

2. MATHEMATICAL ACHIEVEMENT TEST

3. MATHEMATICAL VOCABULARY TEST

4. ENGLISH LANGUAGE PROFICIENCY TEST.

ARITHMETIC REASONING

INSTRUCTIONS

This section consists of problems in arithmetic. However, you do not have to find the answer to each problem. You only have to tell how the answer could be found.

EXAMPLE 0.

Jane's father was 26 years old when she was born. Jane is 8 years old. How old is her father now?

(A) Subtract
(B) Divide
(C) Add
(D) Multiply

Jane's father is now 34 years old. But, you are not asked to find this. You are asked how to find this. Since his age is found by adding 28 and 8, choice (C) should be circled.

EXAMPLE 00

Desks are priced at Shs. 40/- each. If bought in lots of 4, the total price is reduced by Shs. 20/-. How much would 4 desks cost?

(A) Divide and add
(B) Multiply and multiply
(C) Subtract and divide
(D) Multiply and subtract

One way to solve the problem would be to multiply Shs. 40/- by 4 and subtract 20 from the product. So you should circle choice (D).

Although some problems may be worked in more than one way, only one of the ways will be given among the answer choices.

You should only guess if you can rule out some of the choices. DO NOT guess wildly.

You will have 15 minutes for this section. If you finish before time is called, check you work.

For each question choose the correct answer from those given and mark the correct answer on the answer sheet with an X. DO NOT WRITE ON THIS QUESTION PAPER.

1. There are 4 quarts in a gallon and 4 cups in a quart. How many cups are there in a gallon?

   A) add.
   B) Subtract
   C) Multiply
   D) Divide.

2. An electric planer is set to remove .02 of a centimetre each time a piece of wood is passed through it. If a board is put through 7 times, how much wood will have been removed?

   A) Multiply
   B) Subtract
   C) Divide
   D) Add.

3. There are 54 children at a small holiday camp. If there are 33 boys attending the camp, how many campers are girls?

   A) Add
   B) Multiply
   C) Subtract
   D) Divide

4. A man wants to seed a lawn around his new home. His lot is 120 metre by 90 metre (10, 800 sq. metre). His house is centered on the lot and occupies 2,785 square metre. How many square metre of ground may be put into lawn?

   A) Add
   B) Divide
   C) Multiply
   D) Subtract

5. A wholesale fruit dealer sells oranges at Shs. 7 per kilo and lemons at 3 Shs. per kilo. One day he sold 79 kilos of each type of fruit. How much money was taken in?

A) Add and divide
B) Add and multiply
C) Multiply and subtract
D) Divide and divide

6. A cyclist in an international bicycle race has covered an average of 9 kilometres every 20 minutes. If he can maintain the same average speed, how long will it take him to cycle the remaining 84 kilometres of the race?

A) Divide and multiply
B) Subtract and divide
C) Add and subtract
D) Divide and add.

7. A grocer sells oranges for 60 cents a dozen. The oranges cost him 30 cents a dozen. How much profit is there on each orange?

A) Subtract and multiply
B) Divide and subtract
C) Add and divide
D) Subtract and divide

8. A boy works in a shop after school for a total of 10 hours a week. He also works 8 hours on Saturdays. How much is he being paid per hour, if he makes Shs. 20/70 per week?

A) Multiply and subtract
B) Add and divide
C) Add and divide
D) Add and multiply

9. A housewife took a job which pays Shs. 65/00 per week. After paying taxes she is left with 76% of her salary, and each week she spends a total of shs. 56/00 on lunches and bus fares. How much does her job increase the family income?

A) Divide and subtract
B) Subtract and multiply
C) Add and divide
D) Multiply and subtract

10 A rectangular underground reservoir is 15 metre deep and contains 2,000,000 litres of water, when it is full. The short rains filled the reservoir, but a drought in January caused the water level to drop 8 metre. Approximately how many litres of water were consumed during the drought?

A) Subtract and divide
B) Add and subtract
C) Divide and multiply
D) Subtract and multiply.

11. A certain part of beef costs Shs. 7/50 per kilogramme. How much beef could a mother serve to each of 5 children, if she could only afford to spend Shs. 20/00 for the beef?

A) Divide and divide
B) Multiply and add
C) Subtract and multiply
D) Divide and multiply.

12. A coat marked Shs. 40/- was sold for Shs. 29/95 during a sale. What was the per cent reduction?

A) Divide and add
B) Subtract and divide
C) Multiply and subtract
D) Add and divide

13. At the beginning of a month, a car rental organization rented 37 cars. During the month, 32 or these cars were returned. If, at the end of the month, 43 of their cars were being rented, how many new rontals had been made?

A) Subtract and divide
B) Subtract and subtract
C) Add and subtract
D) Multiply and add.

14. A corporation duoubled its assets by selling 1,000 shares of stock at Shs. 75/- per share. What were the corporation's total assets after the stock had been sold?

A) Multiply and divide
B) Add and multiply
C) Add and subtract
D) Multiply and multiply.

15. A certain mother generally squeezes 1½ oranges for a glass of orange juice . The average cost of the oranges she bought during one year was 40 cents per orange. Approximately how much did it cost the family for the 827 glasses of juice that they drank during the year?

A) Multiply and subtract
B) Add and divide
C) Multiply and multiply
D) Divide and multiply.

STOP

IF YOU FINISH BEFORE TIME IS CALLED? CHECK YOUR WORK.

COMPUTATION

This scale is intended to measure ability to add subtract, multiply and divide whole numbers and to add or subtract simple fractions.

INSTRUCTIONS

There are 15 questions in this section. Write the answer to each of the questions on the answer sheet. DO NOT WRITE ON THE QUESTION SHEET. ROUGH PAPER FOR WORKING IS PROVIDED.

You will have 15 minutes for this section

DO NOT TURN THIS PAGE UNTIL YOU ARE ASKED TO DO SO.

PLEASE DO NOT WRITE ON THIS PAPER

1. 13 - 8 = ______ 2. 7 x 4 = ______

3. 9 + 5 + 8 = ______ 4. 24 ÷ 6 = ______

5.
```
  103
+   7
```

6.
```
+ 96
  85
```

7.
```
  378
   63
+ 504
```

8.
```
  56
x  3
```

9.
```
  32
x 12
```

10
```
  72
- 65
```

11
```
 834
- 49
```

12
```
 600
-123
```

13 2) 412

14. 1/4 + 2/4 = ______

15. 1 - 1/3 = ______

1.

WHOLE NUMBER COMPREHENSION

All the questions in this section must be answered on the answer sheet that you will be given by your teacher. Mark with an "X" the correct answer.

DO NOT WRITE ANYTHING ON THE QUESTION PAPER.

In this part there are 12 questions on numbers and how we write them.

Here is an example to show how you should mark your card.

Example 0.

Subtract 807 from 1,725

(A) 819
(B) 918
(C) 928
(D) 1,018
(E) 1,622

Ans. Ex. 0.

A ~~B~~ C D E

The answer is B. See how bubble B has been Marked with X for Ex. 0.

For these problems, you will mark all of your answers on the Answer Sheet. Be careful that you mark the correct answer for each question.

You are to work as many questions as you can. Do not spend too much time on any one question. You should only guess if you can rule out some of the choices. DO NOT guess wildly.

You will have 20 minutes for this section.

1. The closest the earth comes to the sun is 91,000,000 miles. How should this number be said?

(A) ninety-one million

(B) nine million one hundred thousand

(C) ninety-one thousand

(D) ninety-one billion

(E) ninety-one hundred thousands

2. Which of the following shows the correct meaning of 407?

(A) (4 x ten) + (7 x one)

(B) (4 x one) + (7 x ten)

(C) (4 + 0 + 7) x (one hundred)

(D) (4 x one) + (0 x ten) + (7 x ten x ten)

(E) (4 x ten x ten) + (0 x ten) + (7 x one)

3.
$$\begin{array}{r} 400 \\ -199 \\ \hline 201 \end{array}$$

In this subtraction problem, we must borrow or regroup. Which statement below shows how to do it for this problem?

(A) 400 = (3 hundreds) + (9 tens) + (9 ones)

(B) 400 = (3 hundreds) + (9 tens) + (10 ones)

(C) 400 = (3 hundreds) + (10 tens) + (9 ones)

(D) 400 = (3 hundreds) + (10 tens) + (10 tens)

(E) 400 = (5 hundreds) - (9 tens) - (10 ones)

4. On the blackboard Joe read the warning:

A MISPLACED DECIMAL POINT MEANS A LARGE MISTAKE!

How does a misplaced decimal point change a number?

(A) One place too far to the right makes the number 10 times too large

(B) One place too far to the right subtracts 1 from the number

(C) One place too far to the left subtracts 1 from the number

(D) One place too far to the left makes the number one-half as large

(E) One place too far to the left makes the number 10 times too large

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5. A bank clerk reports that he has 10,000 One hundred shillings notes. How much money does he have?

(A) Sh.1,000

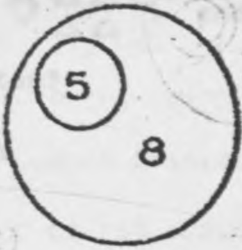
(B) Sh.10,000

(C) Sh.100,000

(D) Sh.1,000,000

(E) Sh.10,000,000

6. In Circleland, people write:

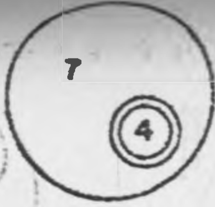


when they mean 58, and they write:

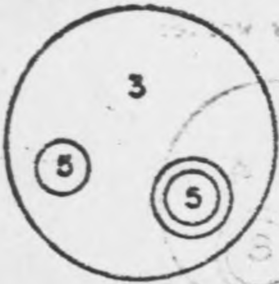
when they mean 834. What number do they mean when they write the following?

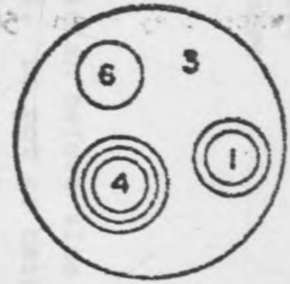
(A) 2359
(B) 3529
(C) 5239
(D) 9325
(E) 532

+

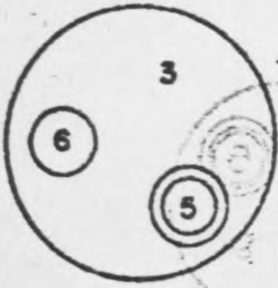


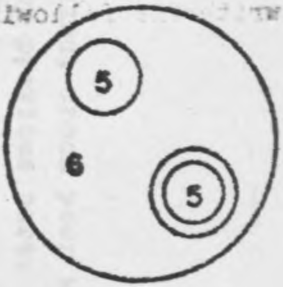
(A) (C)



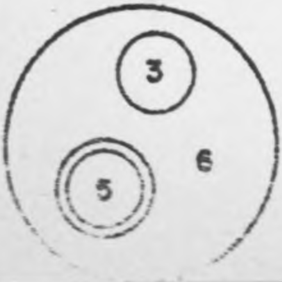


(B) (D)





(E)



For example:

6 = △△△ △△△ , and 15 = ▽ △△△ △△, and 123 = ⧗ ▽ ▽ △△ △

How would 324 be written?

(A) ⧗ ⧗ ⧗ ▽▽ ▽▽ △△

(B) ⧗ ⧗ ▽▽ ▽ △△ △△

(C) ⧗ ⧗ ⧗ ▽ ▽ △△ △△

(D) △△ △ ▽ ▽ ⧗ ⧗ ⧗ ⧗

(E) ⧗ ⧗ ⧗ ⧗ ▽ ▽ △△ △

Which of the following is equal to 37 tens?

(A) $\frac{37}{1000}$

(B) $\frac{37}{100}$

(C) 37

(D) 370

(E) 3700

```
3 2 4 . 6 8
↑ ↑ ↑   ↑ ↑
F G H   J K
```

Which arrow points to the tenths' place?

(A) F

(B) G

(C) H

(D) J

11. If a new system of number notation used the following symbols

△ stands for zero   □ stands for five

◇ stands for eight   ○ stands for two

Which is the correct answer to the example?

	□	△	○
−	○	◇	△

(A) □ ◇ ○

(B) ○ △ ○

(C) ◇ ○ ○

(D) ○ ○ ◇

(E) ○ ○ ○

12. If the two middle digits of 6348 were interchanged, the number would be

(A) 100 less
(B) 90 less
(C) unchanged
(D) 90 more
(E) 100 more

STOP. If you finish before time is called, check your work on this part. Do not go back to any previous part. Do not turn this page until you are asked to do so.

HIDDEN FIGURES

INSTRUCTIONS

In this section you have a pattern on the left. On the right there are five figures. You have to find which one of these five figures can be found in the pattern on the left.

Look at the sample question below.

Example 0

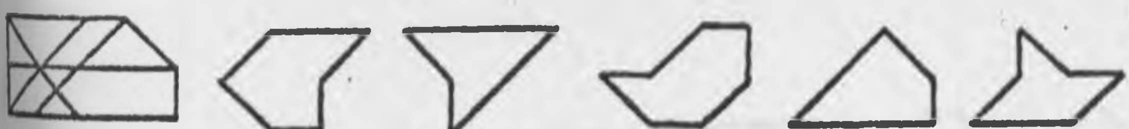
A B C D E

Ans. Example 0 ~~A~~ B C D E

The correct answer is A as figure A is the only figure hidden in the pattern. The figure below shows how figure A is hidden in the pattern.

You see that there are some extra lines passing through this figure. These extra lines are to make the figures harder to find.

Here is a sample question for you to try.



L M N P Q

Ans. Example 00 L M N P Q

There will be only one figure in each pattern. It will always be the same size and shape. <u>It will not be turned around</u> or turned over.

For this section you will mark all of your answers on the answer sheet.

Be careful that you mark in the correct letter for each question. Your answer sheet has five choices given to each question. Choose only one answer and mark this using an X on the answer sheet.

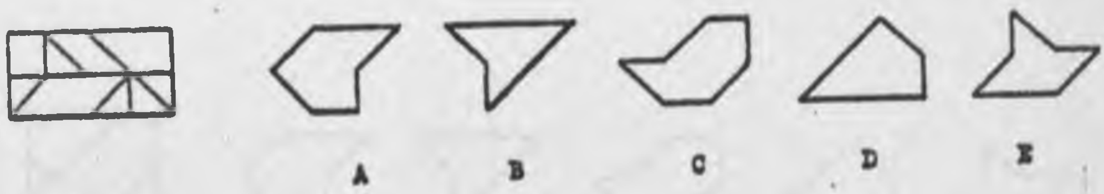
Work as quickly and as accurately as you can. You should only guess if you can rule out some of the choices. Do not guess wildly.

You will have 10 <u>minutes</u>.

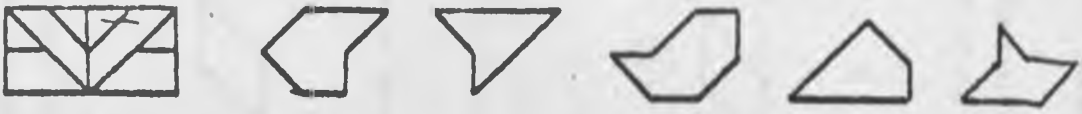
1.

2.

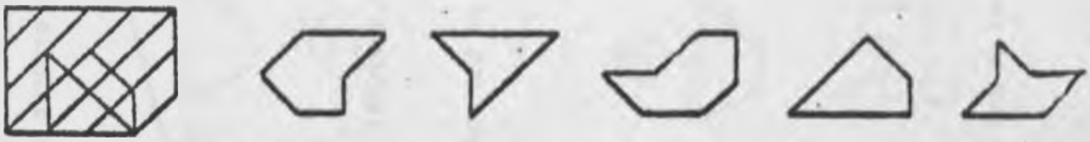
3.



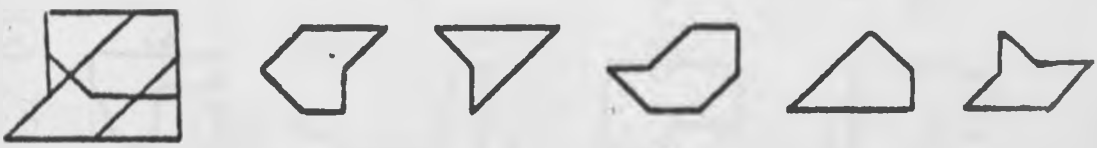
4.

5. 

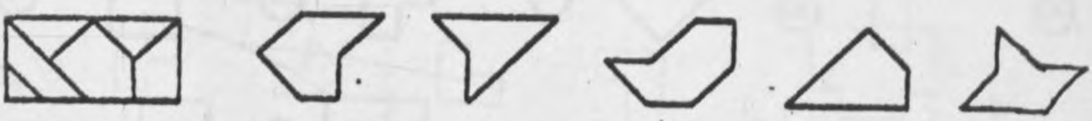
A B C D E

6. 

L M N P Q

7. 

A B C D E

8. 

L M N P Q

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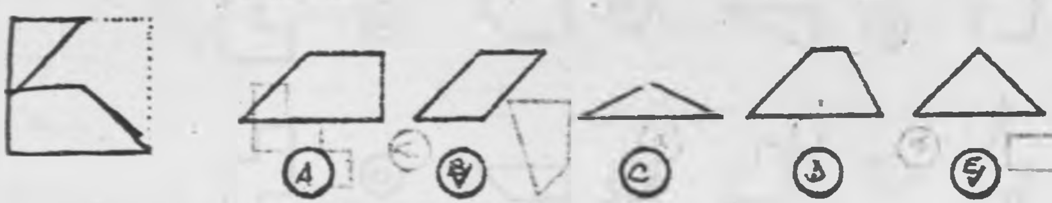
FORM BOARD

[illegible] BOARD 1

INSTRUCTIONS

In this section you are to tell which two pieces can be put together to complete the square at the left of the row.

Look at Example 0. 2



3

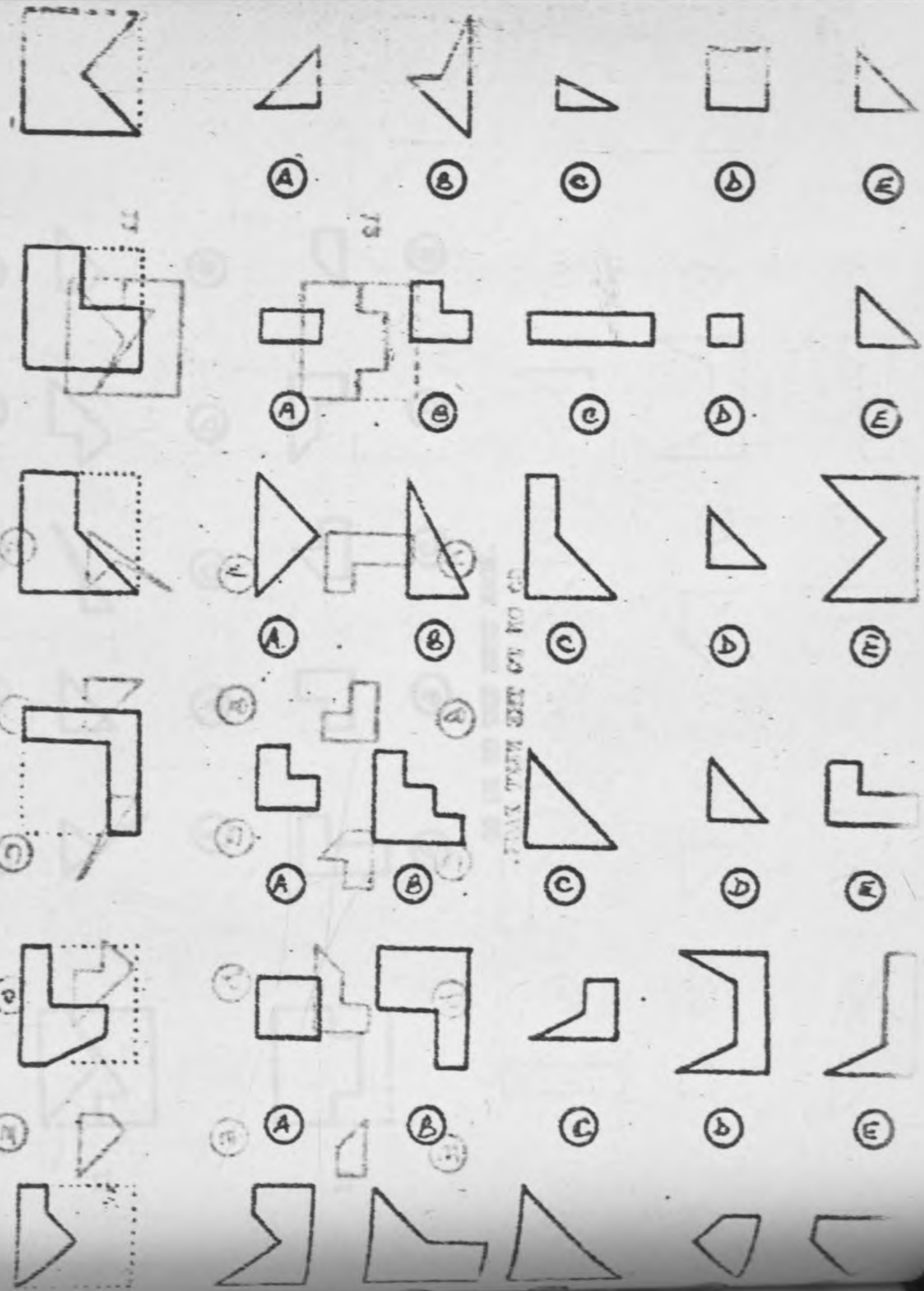
You are to decide which two of the five pieces can be put together to form the square. 4

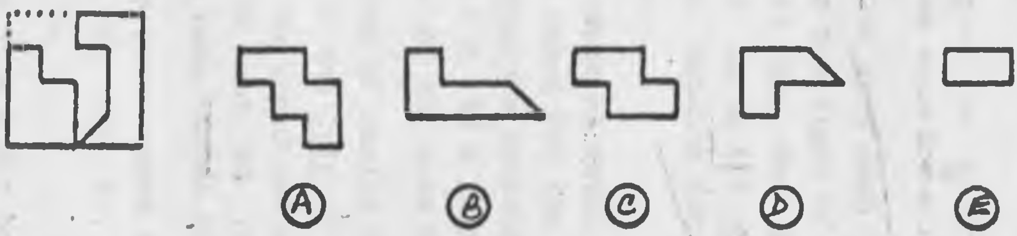
The way to do this problem is to form the square as follows:

5

When you know which pieces make the square check the circles under the pieces that are used. See how it has been done is Example 0.

You will have 15 minutes for the test. 6


A B C D E
A B C D E
A B C D E
A B C D E
A B C D E

7


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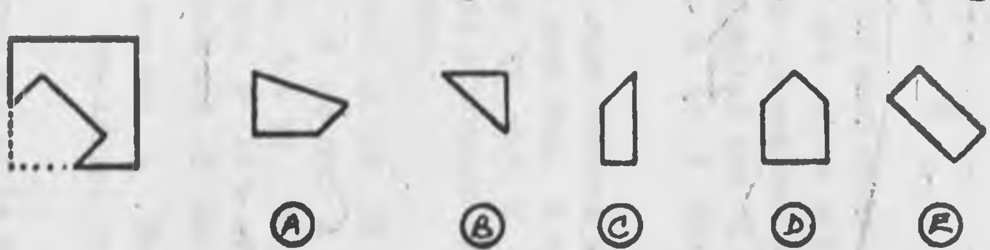

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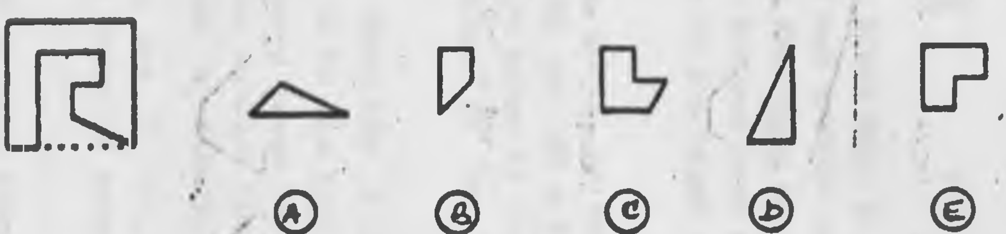

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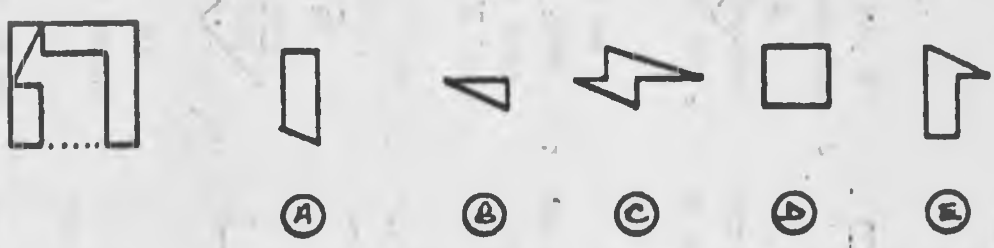

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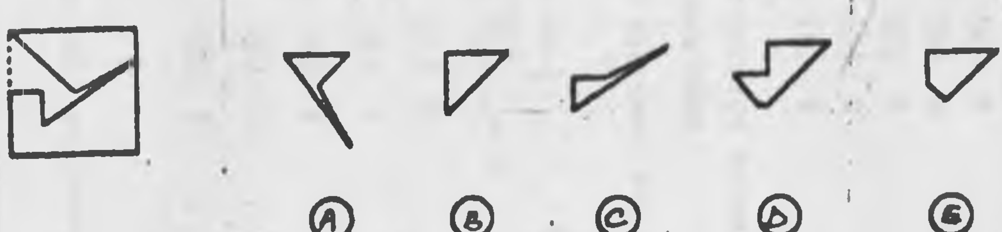


12


GO ON TO THE NEXT PAGE.

FIVE DOTS

The questions in this section are based on five dots in a row. There is one inch between each dot. Each dot is named with a capital letter as shown below.

P   Q   R   S   T
•   •   •   •   •

We agree to give each dot many names. Since dot S is 2 inches to the right of dot Q, we will say another name for dot S is Q2. The 2 is written to the <u>right</u> of Q as dot S is to the <u>right</u> of dot Q. Another name for dot S is R1 because dot S is 1 inch to the right of dot R.

When we write an equal sign between two names, we say we have two names for the same dot. S = Q2 or Q2 = S are true statements because Q2 and S are names of the same dot. P3 = Q is a false statement because P3 and Q are not names of the same dot.

Another way of naming dot S is 1T. Here the 1 is written to the <u>left</u> of T as dot S is to the <u>left</u> of dot T. We could write S = 1T. Two more names for dot S are OS and SO (the O is a zero) because the dot which is zero inches from dot S is dot S itself.

There are seven names for dot S. They are S, OS, SO, R1, Q2, P3 and 1T. See if you can think of seven names for dot R.

S2 looks like a dot name but it is not because there is no dot 2 inches to the right of dot S.

All the questions in this section are about dot names. You may read the explanation at any time during the test.

Here are some practice examples:

EX. 0.

A B C D E

Q2= ________

(A) P
(B) Q
(C) R
(D) S
(E) T

The correct answer is S, which is choice (D). See how D has been

Try the next two examples.

EX. 00. A B C D E

Q____ = S

(A) 0
(B) 1
(C) 2
(D) 3
(E) 4

EX. 000. A B C

____Q = P

(A) 0
(B) 1
(C) 2
(D) 3
(E) 4

For this section, you will mark all of your answers on

Your first answer is numbered 13.

Work as quickly and as accurately as you can. You should g only if you can rule out some of the choices. Do not guess

You will have 15 minutes for this section.

P Q R S T

13. P3 = ______

(A) P
(B) Q
(C) R
(D) S
(E) T

14. 2R = ______

(A) P
(B) Q
(C) R
(D) S
(E) T

15. OT = ______

(A) P
(B) Q
(C) R
(D) S
(E) T

16. R = ______ T

(A) 0
(B) 1
(C) 2
(D) 3
(E) 4

17. ______ T = Q

(A) 0
(B) 1
(C) 2
(D) 3
(E) 4

18. 4 ______ = P

(A) P
(B) Q
(C) R
(D) S
(E) T

19. 0 ______ = R

(A) P
(B) Q
(C) R
(D) S
(E) T

In the following questions x stands for one of P, Q, R, S or T and n stands for one of 0, 1, 2, 3 or 4.

20. If T = x4, then x = ____

(A) P
(B) Q
(C) R
(D) S
(E) T

21. If x0 = Q, then x = ____

(A) P
(B) Q
(C) R
(D) S
(E) T

22. If Pn = S, then n = ____

(A) 0
(B) 1
(C) 2
(D) 3
(E) 4

23. If T = Rn, then n = ____

(A) 0
(B) 1
(C) 2
(D) 3

24. If Qn = 1T, then n = ____

(A) 0
(B) 1
(C) 2
(D) 3
(E) 4

25. If nS = R1, then n = ____

(A) 0
(B) 1
(C) 2
(D) 3
(E) 4

P Q R S T

By using the symbols ( ) more names can be given to a dot. For example, (P1)2 names the dot which is 2 inches right of the dot P1. Dot P1 is Q. Thus, (P1)2 is another name for dot S.

The name 3((P1)2) names a dot 3 inches left of (P1)2. We have just shown that (P1)2 = S. P is 3 inches to the left of S. Thus, 3((P1)2) = P. Now answer the following questions.

26. (2T)1 = ______
(A) P
(B) Q
(C) R
(D) S
(E) T

27. If 2(Q3) = x, then x = ____
(A) P
(B) Q
(C) R
(D) S
(E) T

28. ((P1)1)2 = ______
(A) P
(B) Q
(C) R
(D) S
(E) T

29. If T = (x1)2, then x = ____
(A) P
(B) Q
(C) R
(D) S
(E) T

30. If (2R)n = R, then n = ____
(A) 0
(B) 1
(C) 2
(D) 3
(E) 4

31. If (nS)2 = S, then n = ____
(A) 0
(B) 1
(C) 2
(D) 3
(E) 4

STOP. If you finish before time is called, check your work in this section. Do not go back to the earlier sections.

PROBLEM SOLVING

INSTRUCTIONS

In this section there are 10 problems about several types of mathematics. For each question choose the correct answer from those given and mark the correct letter on the answer sheet with an "X". DO NOT WRITE ON THIS QUESTION PAPER.

You will have 20 minutes for this section.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

1. Tom's mother cooked 48 potatoes.
   She also cooked 64 bananas.
   She cooked how many fewer potatoes than bananas?

   A. 112
   B. 48
   C. 26
   D 14
   E. 16.

2. Ann has Shs. 30 to spend for books.
   Each book costs Shs. 5.
   How many books can Ann buy?

   A. $n = 30 - 5$
   B. $n = 30 \div 5$
   C. $n = 5 \times 30$
   D. $n = 30 + 5.$

3. Daniel bought a bag of 20 new marbles.
He now has 75 marbles.
How many marbles did Daniel have before he bought the new ones?

A. $20 + 75 = n$
B. $75 = 20 + n$
C. $n + 20 = 75$
D. $n = 75 - 20$.

4. Suppose you have a marble game.
You drop a marble at A. It goes to B.
How many ways can it go?

A. 2
B. 4
C. 5
D. 6
D. The number of ways is not given.

5. Look at the chart at the below.
Some numbers are needed to complete it.
What would you write instead of the question mark (?) in the ring?

	MON.	TUES.	WED.	TOTAL
BILL	5	3	2	10
JOE	4	8	(?)	?
TOM	1	7	3	11
TOTAL	10	18	?	37

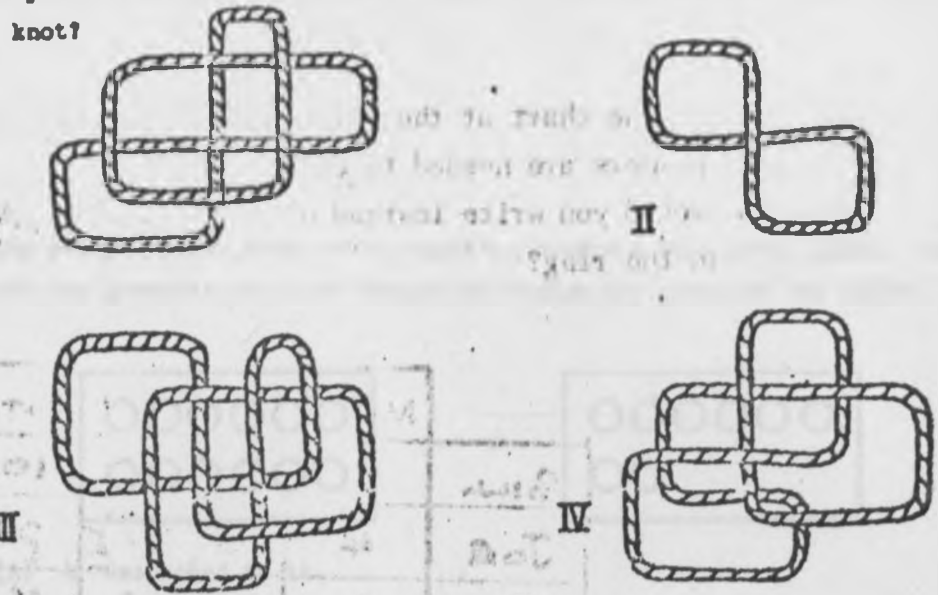
A. 3
B. 4
C. 10
D. 13
E. My answer is not given.

√6. If R - S = T, then which of the following is (are) true?

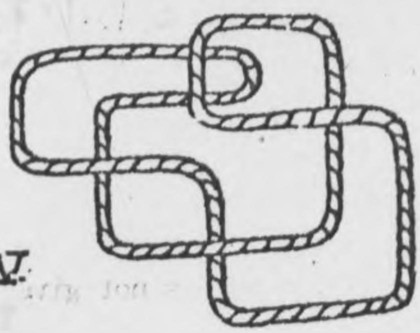
I. R + T = S
II. R - T = S
III. S + T = R

(A) I only
(B) III only
(C) I and II
(D) I and III
(E) II and III

7 The following diagrams are pictures of loops of cord. Which one <u>cannot</u> be pulled or twisted (without cutting) to form a circular loop without a knot?

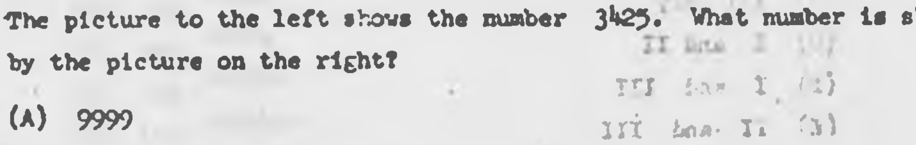


I II III IV



V

(A) I
(B) II
(C) III
(D) IV
(E) V

8. 

The picture to the left shows the number 3425. What number is shown by the picture on the right?

(A) 9999
(B) 9730
(C) 9269
(D) 973
(E) 269

9. The picture below shows that something happened to a large group. How was the group at the left changed to become the group at the right?

(A) 4 was added to it.

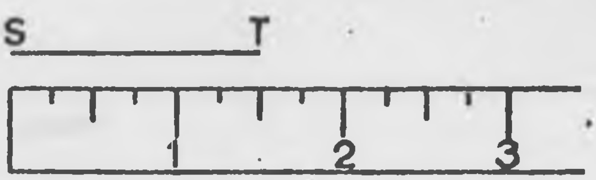
(B) 4 was subtracted from it.

(C) It was multiplied by $\frac{1}{4}$.

(D) It was divided by $\frac{1}{4}$.

(E) It was not changed.

10.



In the figure above, the line ST is drawn to the scale: 1 cm. to 100 metre. What is the distance represented by ST?

(A) 200 metre

(B) 175 metre

(C) 150 metre

(D) 125 metre

(E) 100 metre.

STOP

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THESE PROBLEMS. DO NOT WORK ON ANY OTHER SECTION IN THE BOOKLET.

A STUDY OF THE RELATIONSHIP BETWEEN MATHEMATICAL ABILITY AND MATHEMATICAL ACHIEVEMENT IN PRIMARY SEVEN CHILDREN OF KENYA

ANSWER SHEET

INSTRUCTIONS:

For each test there is a separate question paper. Please do not write anything on the question paper.

Now complete the information requested below and do not start answering any question until you are told to do so.

For each question choose the correct answer and mark it with an X on this answer sheet. MARK ONLY ONE ANSWER.

For test of COMPUTATION you write down the answer in the space provided.

1. What is your name?

   Surname ______________________________

   Other names ______________________________

2. What is the name of your school? ______________________________
3. Are you a boy or a girl? (tick) A. Boy B. Girl
4. When were you born?

   ____

5. How old are you? ______________________________
6. Have you repeated any class ______________________________

   If yes then which class ______________________________

7. Do you go for after class coaching in Mathematics or English ______________________________

ARITHMETIC REASONING

1.	A	B	C	D
2.	A	B	C	D
3.	A	B	C	D
4.	A	B	C	D
5.	A	B	C	D
6.	A	B	C	D
7.	A	B	C	D
8.	A	B	C	D
9.	A	B	C	D
10.	A	B	C	D
11.	A	B	C	D
12.	A	B	C	D
13.	A	B	C	D
14.	A	B	C	D
15.	A	B	C	D

STOP AND WAIT FOR NEXT TEST

COMPUTATION (Write answers since there is no multiple choice).

1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________
6. ______________________
7. ______________________
8. ______________________
9. ______________________
10. ______________________
11. ______________________
12. ______________________
13. ______________________
14. ______________________
15. ______________________

WHOLE NUMBER COMPREHENSION

1.	A	B	C	D
2.	A	B	C	D
3.	A	B	C	D
4.	A	B	C	D
5.	A	B	C	D
6.	A	B	C	D
7.	A	B	C	D
8.	A	B	C	D
9.	A	B	C	D
10.	A	B	C	D
11.	A	B	C	D
12.	A	B	C	D

STOP AND WAIT FOR NEXT TEST

HIDDEN FIGURES

1.	A	B	C	D	E
2.	L	M	N	P	Q
3.	A	B	C	D	E
4.	L	M	N	P	Q
5.	A	B	C	D	E
6.	L	M	N	P	Q
7.	A	B	C	D	E
8.	L	M	N	P	Q

STOP AND WAIT FOR THE NEXT TEST

FORM BORAD

1.	A	B	C	D	E
2.	A	B	C	D	E
3.	A	B	C	D	E
4.	A	B	C	D	E
5.	A	B	C	D	E
6.	A	B	C	D	E
7.	A	B	C	D	E
8.	A	B	C	D	E
9.	A	B	C	D	E
10.	A	B	C	D	E
11.	A	B	C	D	E
12.	A	B	C	D	E

STOP AND WAIT FOR NEXT TEST

FIVE DOTS

1 13 → 1.	A	B	C	D	E
2.	A	B	C	D	E
3.	A	B	C	D	E
4.	A	B	C	D	E
5.	A	B	C	D	E
6.	A	B	C	D	E
7.	A	B	C	D	E
8.	A	B	C	D	E
9.	A	B	C	D	E
10.	A	B	C	D	E
11.	A	B	C	D	E
12.	A	B	C	D	E
13.	A	B	C	D	E

STOP AND WAIT FOR NEXT TEST

PROBLEM SOLVING.

1.	A	B	C	D	E
2.	A	B	C	D	E
3.	A	B	C	D	
4.	A	B	C	D	E
5.	A	B	C	D	E
6.	A	B	C	D	E
7.	A	B	C	D	E
8.	A	B	C	D	E
9.	A	B	C	D	E
10.	A	B	C	D	E

S T O P

MATHEMATICAL ACHIEVEMENT TEST (45 MINUTES)

DO ALL THE QUESTIONS

Read the following questions carefully then choose the corrext answer to the problem. (Tick on the answer sheet)

1. 99 x 98 + 99 x 102 equals

   A. 19,790 B. 19,800

   C. 19,890 D. 19,900

2. 125 x 998 x 8 equals

   A. 99800 B. 998000

   C. 9980 000 D. None of the above

3. The expression 5 * 2 will not represent a whole number if * is replaced by

   A. + B. -

   C. ÷ D. x

4. If x = 4, then 2x - 3 equals

A. 3 B. 5

C. 11 D. 21

5. If p represents a whole number, then solution set of $4p < 16$ is

A. 0, 1, 2, 3 B. 0, 1, 2, 3, 4.

C. 1, 2, 3, 4 D. 5, 6, 7, ...

6. If X represents a whole number, then the replacement for X which satisfies $3X - 6 + 6 = 33$ is

A. 3 B. 7

C. 11 D. 15

7. If $X = 1$ and $Y = 2$, then $2(2X+5Y)$ equals

A. 14 B. 18

C. 24 D. 146

8. If $X = 2$, then $(3X)^3$ equals

A. 24 B. 54

C. 108 D. 216

9. $7x10^3+4x10+5x10^2+6x10^4$ equals

A. 590 B. 6754

C. 7456 D. None of the above.

10. 25.012 - 9.08 equals

A. 15.932 B. 16.004

C. 16.040 D. 16.932

11. Which one of the following represents the greatest number?

A. 2.3466 B. 2.3447

C. 2.3395 D. 2.346

12. 1/8 expressed as a percent is?

A. 2.5% B. 12.5%

C. 37.5% D. 50%

13. The ratio of the speed of a bicycle to the speed of a motor cycle is 3:5. If the motor cycle is travelling at a speed of 45 miles per hour, then the speed of the bicycle in miles per hour is

A. 15 B. 27

C. 30 D. 35

14. Which one of the following products is equal to 7/15 x 8/13 ÷ 2/5 ?

A. 7/15 x 13/8 x 5/2 B. 7/15 x 8/13 x 5/2

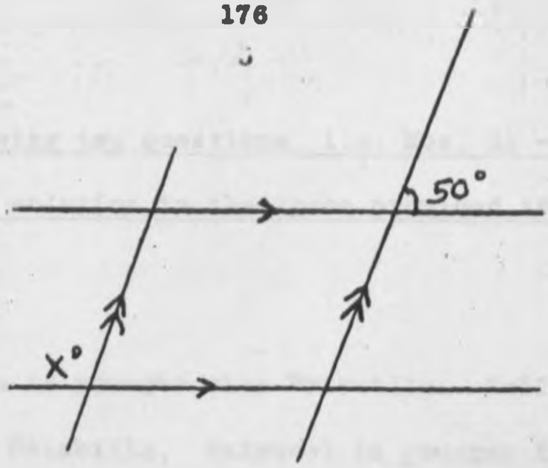
C. 7/15 x 8/13 x 2/5 D 7/15 x 13/8 x 2/5

15. 2/3 x 4/5 x 10/16

A. 1/3 B. 2/3

C. 3/2 D. 3/1

16. 27



In the above diagram, X^{o} equals

A. 40　　B. 50

C. 100　　D. 130

17. $^{+}6 + {}^{-}4 + {}^{-}5 =$

A. $^{-}7$　　B. $^{-}3$

C. $^{+}3$　　D. $^{+}7$

18. $^{-}2 \times {}^{+}5 \times {}^{-}4 =$

A. $^{+}40$　　B. $^{+}1$

C. $^{-}1$　　D. $^{-}40$

In the following ten questions, i.e. Nos. 31 - 40 work out the solution in the space provided in the answer sheet.

19. Susan is younger than Priscilla. Valleria older than Priscilla. Ralphael is younger than Susan, who is second oldest?

20 If the diameter of a circle is 8, then 3 times the radius of the circle is?

21. Juma worked for 3 hours and 35 minutes in the morning and 1 hour and 55 minutes in the afternoon. How long did he work altogether?

22. A bus has 75 seats. There are five seats in each row. How many rows of seats are there in the bus?

38. A rectangular piece of paper measures 321 cm by 26.3 cm.

A. What is the perimeter of the paper?

B. Write down the perimeter in millimetres.

24. The temperature of a frozen mass of ice was - 20°C. The ice was warmed until there was a rise of 32°C. What was the reading on the scale of the thermometer?

MATHEMATICAL VOCABULARY TEST (10 MINS.)

In this test, read the following questions carefully and then choose the correct answer to the question from the four choices given.

1. The total distance all the way round a figure is called --------------

   A . Circumference B. Diameter

   C. Perimeter D. Square.

2. If two straight lines are at right angles, one of them is said to be ---------------- to the other

   A. Horizontal B. Vertical

   C. Perpendicular D. Parallel

3. The numbers 2, 3, 5, 7, 11, 13, 17, 19 are all examples of ----------------- numbers.

   A. Odd B. Even

   C. Prime D. Irrational

4. If the numbers 3, 5, 6, 7, 9 are added and the total divided by 5 the result is called the ------------- of the five numbers.

A. Sum B. Average/Mean

C. Divisor D. Multiple.

5. In case of a circle the perimeter is given the name -----------------------

A. Radius B. Diameter

C. Circumference D. Centre.

6. When common elements of two sets are considered the operation is ----------------------

A. Union B. Subset

C. Complement D. Intersection.

7. What is true about the opposite sides of a parallelogram?

A. They are perpendicular B. They are parallel

C. They are tangent to the other

D. They can meet when produced.

8. The sum of five and six is eleven. What name is given to five and six?

A. Sums B. Multiples

C. Addends D. Factors

ENGLISH LANGUAGE PROFICIENCY TEST (30 MINUTES)

Read the instructions which appear before each set of five questions very carefully before you answer the questions.

Which of the words, or group of words is needed to complete each of the following sentences.

1. When I have completed my C.P.E., I -------------- something nice.

   A. Shall buy B. Will bought

   C. Buy D. Shall bought

2. I will not pay -------- you deliver the goods.

   A. Although B. Because

   C. Until D. Lest

3. If you can come to school early you ------------ be able to meet him before the class commences.

   A. Shall B. Would

   C. May D. Can

4. Mr. Kenyatta ----------------- our country to freedom

A. Lead B. Led

C. Leading D. Leaded.

Choose the word which is nearest in meaning to the word underlined in the sentences that follow.

5. Your failure is the result of laziness

A. Reward B. Fault

C. Consequence D. Cause

6. We must preserve our old customs.

A. Keep B. Continue

C. Forget D. Remember

7. He observed him lift the load onto his head.

A. Spied B. Watched

C. Saw D. Noticed.

<u>From the following lists of words numbered A, B, C, and D pick out the two words in each that are nearest in meaning and write as shown in the example</u>.

Example:

A. Imagine B. Fancy

C. Believe D. Think

Answer: A - B

8. A. Teach B. Inform

C. Instruct D Show

9. A. Grumble B. Abuse

C. Complain D. Tell

<u>Use one word instead of the words underlined in the Sentences below. Write your one word answer in the space provided in the answer sheet</u>.

10. Her dress is <u>able to be seen through</u>.

11. His friend is a <u>grown up person</u>.

<u>Read the following story carefully and then answer the questions that follow</u>.

A STORY

Mr. Onyango once found himself with a hyena, a goat and a bundle of sweet potatoes. He lived in the little town of Oboch. He decided to cross the Miriu river in his boat and take the three things to his father-in-law as presents. His little boat could only take himself and one article at a time. He realized that he could not leave the goat with the sweet potatoes. The goat would eat them up! He also realized that the hyena would kill the goat if the two were left together. In the end Mr. Onyango did manage to solve the problem. On the first and the last trips he took the same goat across the river.

12. Which of these trips would have been <u>impossible</u>?

A. Mr. Onyango takes the goat across the river.

B. Mr. Onyango takes the goat and sweet potatoes across the river.

C. Mr. Onyango comes back alone.

D. Mr. Onyango takes the hyena across the river.

13. Which of these trips did Mr. Onyango do twice?

A. Taking the goat across the river

B. Taking the hyena across the river

C. Taking sweet potatoes across the river.

D. Bringing sweet potatoes back.

14. Which of these actions would have been unwise

A. To leave the hyena and sweet potatoes together.

B. To leave the goat and hyena together.

C. To take one article across the river.

D. To bring back an article from across the river.

15. Which of these statements is TRUE of Mr. Onyango's boat?

A. It could carry the goat and the sweet potatoes in one trip.

B. It could carry the goat, the hyena and the sweet potatoes in one trip.

C. It could carry the hyena and sweet potatoes in one trip.

D. It could only carry one article at a time.

16. Which of the following statements is TRUE about Mr. Onyango's number of trips?

A. Mr. Onyango could carry all his three articles in one trip.

B. Mr. Onyango had to make three trips altogether.

C. Mr. Onyango made four trips altogether.

(d) Mr. Onyango made a total of seven trips.

In each of the questions study the underlined sentence. Then choose from the four sentences underneath it, the one sentence which means the same as the underlined sentence and which is also correct English.

17. "What shall we do this afternoon?" Mary asked her friend.

A. Mary asked her friend what they should do that afternoon.

B. Mary asked her friend what shall we do this afternoon.

C. Mary asked her friend what should they do this afternoon.

D. Mary asked her friend what we should do this afternoon.

18. Moses went to the shamba to get some maize

A. Getting some maize, Moses went to the shamba.

B. While going to the shamba, Moses got some maize.

C. As he was going to the shamba, Moses got some maize.

D. Moses went to the shamba because she needed some maize.

19. Unless he finds his bicycle, he will be punished.

A. He will be punished if he finds his bicycle.

B. If he found his bicycle, he would be punished.

C. He will not be punished if he finds his bicycle.

D. He will not be punished and will not find his bicycle.

20 However hard she works, nobody praises her.

A. She works hard, but nobody praises her.

B. No matter how they praise her, she works hard.

C. She doesn't work hard because nobody praises her

D. Even if she works hard, nobody praises her.

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