TO ANALYSE ARITHMETIC COMPUTATIONAL ERRORS MADE BY CLASS THREE, CLASSS FIVE AND CLASS SEVEN PRIAMRY SCHOOL PUPILS IN WEBUYE DIVISION, BUNGOMA DISTRICT.

A RESEARCH PROJECT SUBMITTED TO THE FACULTY OF EDUCATION, KENAYTTA UNIVERSITY IN PARTIAL FULFILMENT OF THE DEGREE OF MASTERS IN EDUCATION.

BY

FRANCIS M.M. WANYONYI

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

FRANCIS M.M. WANYONYI

"This research project paper has been sumitted for examination with my appropal as a University supervisor".

PROFESSOR M.M. PATEL

DEDICATION

This research project is dedicated to the following persons:

My wife Reginalda N.M. Wanyonyi who gave me support and encouragement throughout my two years away from home.

My children, Jimmy Wanyonyi, Rebekkah Wanyonyi and Mercy Wanyonyi.

My parents, Ibrahim Muchanga and Crescenthia Namarome who never lived to see me accomplish this work.

My sisters, Rosemary Wasike, Evalyn Satia and Metrine Wabomba and my brothers, Geoffrey Muchanga, Gabriel Muchanga, David Muchanga and Jacob Muchanga.

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ABSTRACT

The main purpose of the study was to analyse Arithmetic computational errors made by pupils of class three, class five and class seven, in Webuye Division of Bungoma District. 360 pupils from six primary schools formed the subjects of the study.

The errors made by pupils were grouped into eight categories to facilitate analysis. Errors made by different classes were compared. Also errors made by boys were compared to those made by girls.

The major findings of the study are the following:

1. Most errors were committed by class three primary school pupils.

2. Errors decrease as one goes up the academic ladder. Standard three pupils committed more errors than standard five, standard five pupils committed more errors than standard seven pupils.

3. Most errors made were of Basic Fact type. These were followed by Grouping Errors.

4. The errors that were committed least were zero errors and Incomplete Algorithm.

5. The errors made by children decrease as age increases.

6. There were no significant differecnes in the errors made by boys in comparison to girls.

7. Even in schools which do well in public examinations, errors are being made.

CHAPTER ONE

THE PROBLEM AND OBJECTIVES OF STUDY

1.0 Introduction

Arithmetic is considered by mathematicians and non mathematicians as being of great value. To the mathematician, arithmetic is the foundation upon which the mathematics superstructure is built. To the ordinary man in the street, Arithmetic helps him in his daily monetary transactions, and many other such activities that may involve counting, adding, subtracting, multiplying or dividing.

The teacher of arithmetic should be clear about why he is teaching the subject. It should be noted that from ancient times, mathematics, of which arithmetic is part, has been taught for two reasons. The first reason is that mathematics should be taught for its own sake; and the second reason is that mathematics should be taught for its utilitarian value.

Taking the first aspect, arithmetic would be taught as a base upon which other branches of mathematics would be build. Thus, emphasis on this aspect leads, hopefully, to pursuance of a professional career such as teaching of mathematics. The second aspect, emphasizing the utilitarian value, seems to suggest that at every stage teachers teach what is considered useful: - from a social standpoint. Thus arithmetic taught has to have practical value in commerce, agriculture, building, carpentry, etc.

Looking at the Kenyan Scene, it is noteworthy that the curriculum has been revised at least twice in two decades. The reasons given for the revision have to do with the subjects utilitarian value, ignored by the other curricula. However, any curricula which neglects any of the two aspects; namely the utilitarian aspect and learning for its own sake - is not balanced.

Downes and Paling (1970), noting that arithmetic was important, have listed the following reasons that they feel should be why arithmetic should be taught:

1. Arithmetic is useful in everyday life; as in Commerce and Agriculture.

2. Arithmetic helps our understanding of the world, e.g., the knowledge of time helps in understanding of seasons.

3. Arithmetic helps to develop a healthy attitude towards learning. This is developed when pupils learn to search for the truth, realising that a result may be right or wrong, and therefore accuracy needs to be tested, and that it is necessary to work in a logical order.

4. Arithmetic is necessary in the study of Science.

The question that now remains is how much of this arithmetic should be taught? At this point it should be recalled that the purpose of the 8:4:4 system (Eight years primary, Four years secondary and Four years university) was introduced to meet the needs of the majority of Kenyan pupils, who cannot climb the academic ladder. It is hoped that at the end of each cycle, pupils will be well equipped to meet the demands of life outside school. From this view point, the arithmetic taught should help pupils meet their own needs and those of society in which they live.

Eshiwani (1979) addressed himself on what he calls "minimal competencies" that a pupil leaving primary school should be equipped with. Listed below are these competencies:

1. Recognition of the size of numbers

2. Ability to count

3. Ability to read and write well, numbers up to 20

4. Be able to handle money in a fairly complex way so that he is not robbed through short-changing.

5. Be able to measure.

These, Eshiwani declares is 'all' he would teach a pupil for whom primary school is terminal. This requires ofcourse, to find a method of identifying such a pupil. These so-called "competencies" compare well with what Downes and Paling (1970) call "the desirable minimum of arithmetic which all our children need to know". It should be noted that the Kenya primary mathematics curriculum has addressed itself to these competencies and little or nothing more.

This in essence means that the utilitarian aspect of arithmetic is being emphasized or overemphasized at the expense of the aesthetic aspect.

Dienes, as quoted by Jensen (1973) feels that the aesthetic considerations of mathematics are more important than the utilitarian aims. He believes that the major aims of mathematics education are found in the area of the development of an integrated personality. He lists the characteristics of an integrated personality as:

1. The taking of a broad rather than a personal view on most issues.

2. Confidence of personal worth.

3. Constructive rather than ~~critical~~ behaviour

4. The seeking of connections and relationships.

5. The ability to adjust to surroundings, particularly to people in the environment.

There is therefore need to balance what we as educators give to the pupils, so that we do not overdo one aspect and leave no room for the other. Considering that the primary mathematics syllabus addresses itself almost totally on arithmetic, proficiency in arithmetic is a must if the pupils have to pass their mathematics examination at the end of eight years of primary education. This also means that if they would use the arithmetic learned in school, they must have learned with understanding, otherwise their skills may not be transferred to different situations.

The type of teacher and how he teaches the subject is very important if a foundation for mathematics is to be laid. It is to be regretted that in many of our primary schools, trained teachers take upper classes (class five, six, seven and eight) leaving the lower classes in the hands of untrained teachers. This could be one reason why many children never master basic mathematical concepts.

Literature which has been reviewed suggests that many pupils make computational errors in all the four basic operations of Addition, Subtraction, Multiplication and Division. Since, as has been suggested earlier, arithmatic is very important, these errors can be a bottleneck in the academic development of the child. It is for this reason that this research has been carried out to find what errors children are making, and make suggestions on how these chidlren could be helped.

1.1 Statement of the Problem

The study was concerned with collecting data on errors made by primary school pupils. The subjects in the study were three hundred and sixty pupils drawn from six schools in Webuye Division of Bungoma District. Three classes, namely, Class Three, Class Five and Class Seven pupils were the focus of the study.

The research Topic was: To analyse arithmetic computational errors made by class three, class five and class seven primary school pupils in Webuye Division, Bungoma District.

1.2 Rationale of the Problem

The general aim of teaching mathematics, of which arithmetic is part, is to produce an individual who will be able to use a mathematical way of thinking in the solution of problems, both familiar and unfamiliar. Thus, the objective would not have been achieved if, at the end of an arithmetic programe, the pupil is unable to solve problems.

Balow (1964) in his study found that there is a direct relationship between problem solving and computational ability in arithmetic. A child who is unable to compute, is unable to solve mathematical problems. This implies that teachers must identify computational problems being faced by pupils if they hope to make their pupils adept in problem solving. The difficulties the children are facing in solving problems may be because of the errors they are making or used to make in their computation. If these errors were identified, children may be helped to become better problem solvers. It is noteworthy, that the problems that have been appearing in the Examinations at the end of primary school are mainly Arithmetic. In the 1979 examination, 28 out of 50 questions were on arithmetic. In 1981, 35 out of 50 questions were on arithmetic. In 1982, 39 out of 50 questions were on arithmetic. This shows that much of the failure in the national examinations at the primary level may be because the children do not have mastery of their computation.

It is hoped that the identification of the effors and the patterns into which they fall, will sensitize teachers in their endeavour to help pupils in arithmetic. This may lead to teachers conducting remedial classes to assist pupils who make the computational errors. Considering that the majority of pupils fail mathematics, the identification of how these errors are made may assist teachers prepare their pupils better for national examiantions.

1.3 Research Questions

In this study, the researcher was interested in analysing arithmetic computational errors made by primary school pupils of class three, five and seven, in six selected schools in Webuye Division, Bungoma District. The researcher was guided by the following question: Do the errors made by pupils follow an identifiable pattern that will lend itself to analysis?

1.4 Objectives of the Study

Throughout the study, the researcher was guided by the following objectives:

1. To determine the type of errors made by pupils.

2. To classify the errors into different categories.

3. To determine the overall magnitude of each category of error.

4. To determine the magnitude of each category in each of the six schools that were studied.

5. To determine the magnitude of each category of errors, in each of the selected classes, from the three categories of schools.

6. To determine the magnitude of each category of error in each of the classes, in each of the six schools studied.

7. To determine the overall magnitude of errors made by boys in comparison to those made by girls.

8. To determine the magnitude of each type ~~of~~ of error made by boys in comparison to those made by girls, in each of the three categories of schools.

9. To determine the magnitude of each type of errors made by boys in comparison to girls in each of the classes, in the three categories of schools.

10. To determine the magnitude of each type of error made by boys in comparison to girls, in each of the classes, in all the six schools.

11. To determine whether errors made are related to age.

1. 5 Basic Assumptions

The researcher made the following assumptions in the study:

a. That the pupils do make some errors in arithmetic computation.

b. That the errors would follow some identifiable pattern.

c. That the patterns the errors follow are classifiable into eight categories.

d. That there should be no error pattern that will not fall into one of the eight categories.

e. That the research instrument would be effective in discriminating or isolating the error patterns.

1.6 Significance of the Study

The purpose of the study is to analyse arithmetic computational errors made by class three, class five and class seven priamry school pupils. The study is in some respects related to that conducted by Gohil (1984) among class four, class five and class six primary school pupils in Nairobi. It is hoped that the results of this study will try to fill some of the gaps left by Gohil's study. Other than Gohil, no other person has conducted a related study in Kenya.

It is also hoped that the results of this study will be of help particularly to primary school teachers of mathematics, Teachers Advisory Centre (T.A.C.) tutors and curriculum developers at Kenya Institute of Education. It is hoped that with the identification of the errors according to specific patterns that they follow, pupils making them will be helped. This may lead to better peformance in mathematics. For those pupils who may not pursue secondary school education, they will be better equiped for the rough life outside school.

1.7 Scope of Study

The study covered six schools in Webuye Division, Bungoma District. From each school, sixty pupils were selected as subejcts. Each of the classes three, five and seven contributed twenty pupils (10 boys and 10 girls). All the schools selected were mixed. The study was designed to classify computational errors in the four operations of Addition, Subtraction, Multiplication and Division. The study showed that the children were committing computational errors in arithmetic; and an attempt was made to show which errors were more frequent and which ones were not.

1.8 Limitation of the Study

Owing to the small sample that was involved in this study (only 360 pupils) the results may not be generalisable to the rest of the country. The Schools involved in this study are in the rural areas, so it would be difficult to generalize the results to urban schools.

The researcher was only interested in collecting data about the errors and classifying them for the purposes of analysis. Undoubtedly, there are many reasons that may lead to the making of these errors, for example, the type of teacher-whether trained or untrained, type of school - whether it has facilites or not, type of parents of the children - whether educated or illiterate, whether rich or poor, attitudes of the pupils - whether positive or negative and so on. Such variables were not considered by the researcher and so it would be a mistake to overgeneralize the results.

1.9 Definition of Significant Terms

Errors: These are taken as mistakes made by pupils leading to wrong answers, and not simply as wrong answers themselves.

Computational error: These are mistakes arising from the failure of the child to use any of the four arithmetic operations (Addition, Subtraction, Multiplication and Division) appropriately.

Catetory: Class into which errors are grouped.

Teachers Advisory Centre: Centres located in every educational division, under a tutor, called T.A.C. tutors, from where primary school teachers get advise on the best teaching aids to use and best approaches in teaching some particular topics. The centre acts as a resource for primary school teachers.

Kenya Institute of Education: The centre for the design and development of curriculum materials for schools and colleges in Kenya.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Introduction

The purpose of the study is to analyse errors made by primary school pupils. It is not possible to exhaust all the possible factors that may lead to the making of three errors. Indeed the variables involved are many and confounding. For the purpose of clarifying ideas on errors made in Arithmetic computation, literature on the following topics has been included:

1. Literature on concepts and concept-formation.

2. Literature on Age difference

3. Literature on Sex differences.

4. Literature on Mathematical ability.

5. Literature on errors in Arithmetic

2.1 Literature Related to Concepts and Concept Formation

Lovel (1971) says that a concept may be defined as generalisation about data which are related. A concept enables one to respond or think about specific stimuli or percepts in a particular way. Lovel admists that there is probably no known way about how children form their concepts, for indeed, it seems that different children arrive at the same concept in different ways. Lovel however, suggests that there are three steps involved in forming a concept. These steps are perception, discrimination or abstraction and finally generalisation. Discrimination and generalisation may be enhanced by exposing the child to a variety of stimulating experiences, provided these experiences are matched with the child's neuro-psychological development. Language, Lovel says, together with mathematical symbols play a part in concept formation, for they enable the individual to pin down and clarify concepts or act as a frame of reference.

Gagne' (1970) says that concept learning is the type of learning that makes it possible for the individual to respond to things as a class. This capability requires that the individual be able to distinguish or discriminate among collections of things and that he should respond to the class as a whole. He distinguishes between two types of concepts, namely concrete concepts and relational concepts. Concrete concepts are exhibited whenever an individual responds to a class of observable objects or object qualities, usually by pointing at or naming them. Relational concepts (defined concepts) may be learned by definition. They relate two or more simpler concepts that is, some concepts may be pre-requisites in the learning of other concepts.

Skemp (1971) refers to a concept as just an abstraction. He says that an abstraction is some kind of lasting mental change, and this abstraction enables one to recognize new experiences as having similarities of an already formed class. Thus an abstraction is something that is learned, and which makes classification possible. To distinguish between abstraction as an activity and abstraction as an end product, the latter he calls a concept. A concept is therefore an end product of abstraction. He agrees with Gagne' that concepts which are of higher order must be learned after those of lower order have been mastered. He adds that the criterion for having formed a concept is not that of simply saying its name, but behaving in a way indicative of classifiying new data according to similarities.

Johnson and Rising (1972) define a mathematical concept as a mental construction; a mental abstraction of common properties of a set of experiences of phenomena. The elements of these sets may involve objects (set obejcts), operational concepts (relational concepts) or organisations (structural concepts).

Dienes (1966) in a study of mathematical concept - formation in children, makes some suggestions about how children may form concepts. he distinguishes between two modes of thinking, analytic and constructive thinking. In the former, the child uses logical thought so far as he is able so that his concepts are clearly formulated and defined before he uses them. In the latter, he first uses an intuitive perception (i.e., perception not based on reasoning) of something which is not understood. This rather vague perception urges the child on the constructive or creative effort to confirm intuition by logical arguments. In Dienes' view, constructive thinking develops before analytic thinking, although both are required in mathematical and scientific concept development.

Dienes (1973) says that concept formation proceeds in stages, and identifies six such stages. The first is what he calls the play stage. The child's games represent a kind of exercise which helps the child to adapt to situations which he is going to meet in life. The ingredients of the concept are played with long before there is any idea that these ingredients will be used to classify events in a useful way. The second stage is ushered in where there is a realisation that there are constraints in the game and play must be according to rules. The play is given some sense of direction. The third stage is characterised by the child being able to extract mathematical abstractions, through playing games which possess the same structure, but which appear different to the child. In the fourth stage, the child learns to represent his abstractions. Such representation allows the child to talk about what he has abstracted, to look at it from outside; to dispense with the actual games or set of games, but to examine the games in general and reflect upon them. In the fifth stage, the child examines his representation. He learns to have a description of what he has represented. To describe, he will need to be proficient in language. Such a description forms a basis of a system of axioms. In the sixth stage, the child develops theorems, by which he can reach any part of the possible description, given a first part as a starting point.

Bruner (1960), like Dienes, suggests that there are two ways in which the child can arrive at concepts.

This could be through intuitive thinking or analytic thinking, and the two are complimentary in nature. Intuition, he says, implies the act of grasping the meaning, significance or structure of the problem or problem situation, without resorting to formal proofs. Analytic thinking, characteristically, proceeds a step at a time, and proceeds with relative awareness of the information and operations involved, and may also involve careful and deductive reasoning. Intuitive thinking does not advance in careful, well defined steps.

Bartlett (1958) has put forward some suggestions about concept formation. He says when generalisation takes place (concept formation) in any kind of formal or experiemental thinking, the mind most make an active search for all points of agreement that are consistent with the observed differences, have been recognised in such a way that a number of steps (i.e., direction) in the thought sequence is the same for all instances. The agreements noted are thus treated as belonging to a system and they can be recognised in any other example.

Piaget (1969) is of the view that thought arises out of actions and mathematical concepts arise out of the actions the child performs with the objects and not from the objects themselves. As a result of interactions with objects in the environment, the child constructs certain concepts, for example number, time and develops certain forms of internally consistent thinking that maximises his chances of understanding. He therefore brings about maximum adaptation; which is highly influenced by practice and experience. The type of concept developed depends on the level of abstraction or dissociation which the child is capable of, and this in turn depends on the quality of the sequences of action in mind, termed schemata or schemas that the child is capable of elaborating.

Copeland (1982) says that for Piaget, the terms such as assimilations and accomodation are important mental operations by which understanding is acquired. The child must assimilate new data into concept he has already formed and accomodate data that does not fit. Logical processes such as mathematics must be based on the psychological structures available to the child. These structures change as the child matures physiologically and neurologically, and as the child has the necessary experiences in the physical world. These experiences must involve actions performed on objects and communication with other people such as the teacher and children help clarify the concepts so formed.

UNESCO (1974) discussing the extend of Piaget's work and influence, add that children begin to form concepts from about four or five years of age, when they understand how to take classes and see relationships. At first they can do so in action only. For example, children can put a series of sticks in order of height, but they do so slowly comparing each pair of sticks. Later they are able to imagine the series of actions and so put sticks in order rapidly. Concepts are formed by many varied experiences from which they are gradually abstracted. They are understood first in those situations where the relationship is most obvious and the objects to be compared, measured or classified are most familiar. In acquiring each concept, he passes through three stages; from that of total absence of the concept to a transitional stage, when he understands the concept to some extent only, until in a third stage he applies it generally and can use it in logical operations with objects on mental images.

2.2 Literature Related to Age Difference

Piaget (1969) says that cognitive development proceeds in stages which are related to age. He identifies four stages in the intellectual development of a child from birth to adolescence. The time and appearance of these stages vary from individual to individual and from culture to culture. The first period stretches from birth to about the age of two years. During this stage, the reflexes present at birth have opportunities to develop. The child starts using his senses. At about two years, the second stage known as the pre-operational period sets in. During this period which runs to approximately the age of seven years, the child learns ways to explain the external world to himself through the use of objects and symbols. He also begins to develop intuitive ideas of causal relations, quantity, time and space and to assemble objects on the basis of a variable which may change with time. But he may see only one relationship at a time and cannot coordinate variables. Dominated by his perception, he is usually carried away by physical appearance. He does not comprehend that the object may have more than one property and so lacks the ability to reverse his thought processes and conserve discrete and continuous quantities. Then from about the age of seven, the child begins to appreciate that certain properties of objects (examples; area, volume and weight) remain unchanged, inspite of external tranformations. He attains what Piaget calls the conservation of quantity. He can now function through an internalised structure. This stage is called the concrete operational stage. Anywhere between eleven and fourteen years, the final period called the stage of formal operations stage sets in. Now the child is no longer dominated by his own experience. He starts to operate on hypotheses and begins to appreciate the interaction of various variables which he can control and handle in a systematic way. He can now evaluate his ideas and reason purely in the abstract. He has arrived as an adult thinker.

Piaget (1969) explains the transition from one state to another in terms of four factors. Two of these are maturation or "the increasing differentiation of the nervous system", and social transmission or the transfer of information from one person to another. The remaining two are experience with one's environment and what Piaget calls equilibration, auto-regulation of self-regulation.

Bruner (1960) both challenged and shocked the educational world with his famous statement, "we begin with the hypotheses that any subject can be taught effectively in some intellectually honest form to any child at any stage of development". Taken at face value, the statement appears to reject the generally accepted notions of individual differences attributable to age, mental ability, developmental stage and experience. However, examining Bruner's general theories of human learning, it does not seem that he meant to contradict himself.

Bruner (1964) views a concept or a body of subject matter as capable of being passed through certain stages of development. He sees the child as passing through three levels. Before getting to the first level, the child has already developed regularities in his intuition. When he encounters new situations then, he has to recognise ideas known to him in order to adjust to or accomodate them. The first stage is called the enactive stage and involves direct manipulation of objects. The child is able to reach this level by associating intuitive regularities already developed with the ikonic level, at which stage he learns by seeing objects or by picturing them in his mind. Direct manipulation is unneccesary at this level.

Finally, he progresses to the third level called the symbolic level. Now he manipulates symbols and uses language and logic to represent what he has learned. Thus both Piaget and Bruner agree that learning must occur in stages; although Bruner does not mention age as a factor, but this is implied.

Gohil (1984) in her study about the errors committed by primary school in Nairobi, found that age was an important factor. Older children committed less errors compared to the younger ones in the lower classes. Thus class four pupils committed more errors than class five pupils; and class five pupils committed more errors than class six pupils.

Wamani (1980) in his study to find out mathematical abilities of boys and girls in primary schools in Nyeri district, found that even in the same classes, children who were older seemed to perform better on the mathematical ability test.

Dye and Very (1968) say there is what is termed as "age differentiation" as the individual matures. This differentiation accounts for better performance at higher ages. They say that this degree of age differentiation in mathematical abilities seems to be greater for boys than for girls, but that this depends on other factors such as social and cultural environment.

2.3 Literature Related to Sex Difference

Studies on sex differences are many, and results are quite contradictory. Many of the studies have, however, been done on the Western World.

In a study to establish whether there were any sex differences in learning of mathematics among Kenyan high school students, Eshiwani (1974) found that boys achieved higher than girls, and had even a more positive attitude towards mathematics than girls. Boys scored higher on tests of mathematical reasoning, computation and mathematical and scientific terms.

Six year's later, Wamani (1980) in his study on mathematical ability among primary school children in Nyeri District, found that, infact, girls tended to do better than boys, although, overall, there were no significant differences in mathematical abilities of the two sexes.

Mondoh (1986) conducting her research in Nairobi to determine whether there were sex differences in mathematical ability among school children, found that there there were no significant differences overall, but looking at results on the different tests administered, one can see that girls were doing consistently better than boys.

Sumumkut (1986) in his study on attitude and sex differences in performance on Mock mathematics examinations in Narok District found that there were significant differences. Boys performed significantly better than girls on the mock examinations.

Wozencraft (1963) found that there were differences between boys and girls on an arithmetic that was administered. Girls did better than boys. She argues that the reason why at times there are sex differences in performance in favour of boys, is that usually, intelligence is not taken into account. But if girls of equal intelligence with boys are compared, boys will not perform better than girls.

Morehead (1984) in her article "nice girls do not do mathematics", tries to analyse three sets of books, primary mathematics (S.P.M.G.), Beta mathematics, and Mathematics for schools, to find biases in the book.

Diagrams, cartoons, drawings related to boys and girls in each book were counted. In Mathematics for schools, there was a discrepancy of 7.8% in favour of boys. In Beta mathematics, the overall discrepancy was 16%, and in Primary mathematics (S.P.M.G.), the discrepancy was 35% in favour of boys. Thus the majority of illustrations in mathematics books were in favour of boys. She points out that although girls are more than boys in terms of population, one reading the books would think that girls are in the minority. Girls, she argues, do not do well in mathematics because they are not expected to do well.

Herill and Wallis (1976) say that girls do not do well because of the type of roles they are expected to play. They assert:

> "At home girls are given baby dolls to play with. Boys are given car dolls, train sets, building bricks and the like. Girls make tea and dress dolls while boys built castles, watch trains. When these children go to school, the role they play is also biased. Books used by children perpetuate and strengthen these early differences".

Adams and Rae (1980) add that almost from the time the child is born, he is taught to be male or female. The behaviour the child takes, is not necessarily natural for his or her sex. Children are taught to act and behave by their parents, relatives, teachers and all other adults they come into contact with. There is sex-steriotyping in the type of roles boys and girls have to play.

Fennena and Carpenter (1981) found that at lower ages, there does not seem to be any sex differences in mathematical achievement, but as girls grow, they drop in terms of achievement while boys continue to do better in mathematics. The general consensus among researchers is that dislike or poor performance in mathematics is not innate, but is due to external factors; which could be controlled.

2.4 Literature on Mathematical Ability

The review of literature on mathematical ability indicates that mathematicians and psychologists are not agreed on what mathematical ability is all about.

Goslin (1963) argued that although it is not possible to really see an ability or locate it in the cell structure of the brain or muscles, we can however infer its presence or lack of it in an individual from his performance. The usefulness of such an ability construct makes it possible the prediction of actual performance in similar, but not exactly identical situations. Thus, the whole notion of human abilities implies a set of responses that are burried deep within the individual, and the manifestation of an ability requires a situation in which that ability is appropriate.

Rogers (1981) split mathematical ability into two aspects namely reproductive and productive abilities. To him, the reproductive aspect is related to the function of memory, while the productive aspect is related to the function of thought. The latter, he thinks, is more important.

Burt (1967) says that mathematical ability has alsmost always been referred to as a gift or a distinct ability. To him, mathematical ability is undoubtedly a composite, with the essential constituents including an ability to form, retain and use associations, between numerical or at least non-verbal symbols.

Aiken (1973) presented a summary of the findings of different researchers on the factors that compose mathematical ability:

These are:

1. Deductive (general) reasoning

2. Inductive reasoning

3. Numerical ability

Kruteskii (1966) through a series of observations and impressions of responses of Russian school children to mathematics problems, says that the basic components of mathematical ability are the following:

(a) Formalised perceptions of mathematical material

(b) Generalisation of mathematical material

(c) Curtailment of thought

(d) Striving for economy of mental forces

(e) Flexibility of thought

(f) Mathematical memory

(g) Spatial concepts

Wilson et al (1968) in carrying out the national longitudinal study of mathematical ability viewed mathe-

mathematical ability as composed of:

(a) Mathematical reasoning ability

(b) Spatial - perceptual (Visualisation) ability.

(c) Numerical (computational) ability.

(d) Problem solving ability.

Tests covering these four components of mathematical ability have been adapted and used by Wamani (1980), Eshiwani (1984) and Mondoh (1986).

Mathematical ability, as shown above, is still an elusive concept. With time, hopefully, research will shed more light on what it may actually be.

It is not known to what extend mathematical ability relates to mathematical achievement, which to many is important. Researches are, as usual, contradictory.

Wick (1965) carried out a correlational study between mathematics achievement and scores of tests of mathematical ability. His results indicated very low correlations.

Adejumo (1977) carried out a predictive study on mathematical achievement of some Nigerian children. He used the Modified Halls Matrices (MHM) test of mathematical reasoning ability. With 180 subejcts of seven and eight year olds, the predictive power of MHM for mathematics ability of young Nigerian schools was found to be satisfactory and acceptable. The high correlations found showed that MHM could be used to detect children with possible deficiencies in logical operations and computational ability.

El-Abd (1971) carried out a study on the relationship between Ability and Achievement of college students in East Africa. He found that there were significant correlations between the achievement of the students and their mathematical ability.

2.5 Literature on Errors in Arithmetic

Research evidence abounds to show that children commit computational errors in all the four areas of Addition, Subtraction, Multiplication and Division.

Downes and Paling (1970) discuss at legnth some of these errors and their possible causes. Some of the reasons given for makin gerrors include: Not knowing the basic facts, faulty setting down of the problem, particularly when dictated, mistakes in carrying reflecting lack of understanding of the idea of place value; and fatigue leading to lack of concentration.

Shaw and Palosi (1983) say that the determination of the learner's strengths or weaknesses involves a search for the errors he is making; and, subsequently, development of a search for computation errors must, however, go beyond paper and pencil test; beyond the group situation, and to each individual learner in an oral interview situation to determine what processes the learners are using in order to have a clue at the remedial process.

Corte and Verschaffel (1981) in their study aimed at analysing and improving children's solution processes, hypothesized that the errors may occur in three stages; the thinking phase, operation executed and Verification. In their study, they found that:

1. Most children (78%) make errors in the thinking phase (the thinking error). In this case children chose and performed an incorrect operation.

2. Fewer pupils committed technical errors- where a child chooses the correct operation but fails in the execution; only 13% of the errors were technical errors.

3. When interviewed, most of the children who answered correctly exhibited no trace of the thinking phase in their solution process - they performed them by rote, not conscious of exactly what they were doing.

Engelhart (1982) in discussing the use of computational errors in diagnostic teaching agrees with Corte and Verschavel (1981) saying "The most obvious way to explore what a child is thinking is to talk with the child. In order to learn from such a discussion, the teacher should reflect on the computations so as to know which directions to explore". He goes further to classify these computational errors.

1. <u>Mechanical errors</u>: An incorrect response resulting from motor or perceptual- motor difficulties (misformed symbols or misaligned symbols).

2. <u>Conceptual error</u>: Incorrect responses resulting from absent or incorrect concepts or principles (e.g., inappropriate use of zero).

3. <u>Careless error</u>: Incorrect response resulting from responding without engaging the task.

4. <u>Procedural erros</u>: An incorrect response resulting from misordered or inappropriate procedures.

Engelhart, however, admits that it is possible that categories mentioned above may not be infact mutually exlussive. In practice, it can be hard to distinguish one from the other. For example, an error which would be classified as procedural, will when closely scrutinised, appear to be conceptual and so on. He advises that when teachers do examine the errors, they should be free to explore the possible routes the children may use in arriving at the wrong answers.

Engelhart (1977) categories the errors that are usully made by pupils into eight categories.

These are basic fact error, grouping errors, inappropriate inversion, incorrect operation, defective algorithm, incomplete algorithm, identity errors and zero errors. In this study, he analysed every wrong resposne with the view to classifying it in any one of the eight categories that have been mentioned above.

Copeland (1982) discusses error patterns that are common in arithmetic; and suggests ways and means of correcting the mistakes. Children may make errors because they have not mastered basic facts, the idea of place value, or lack of understanding of which symbol to use and when.

Roberts (1968) also tried, as Engelhart, to classify errors according to the strategies, referred to as failure strategies, used by pupils in arriving at the wrong answer. He isolated four such classes.

1. Wrong operation: The pupils attempts to solve a problem with an inappropriate operation.

2. Obvious computational error: The pupil attempts to solve a problem using an

erroneous basic number fact.

3. Defective Algorithm: The pupil attempts to solve a problem employing other than basic number fact errros or inappropriate operation errors.

4. Random responses: the pupil attempts to solve a problem in a way showing no discernible relationship to the given problem.

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CHAPTER THREE

RESEARCH DESIGN AND COLLECTION OF DATA

3.0 Introduction

The aim of this study was to analyse Arithmetic computational errors made by primary school pupils of stardard three, standard five and standard seven, in Webuye Division, Bungoma District. The design of the study was planned in such a way as to discover the type of errors that children do make, and whether these errors are ralated to the age of the child, the sex of the child or the type of school the child was learning.

As has been mentioned earlier under the limitations of the study, it was not possible to collect information about the other factors that may have led to the errors being committed, such as Education of the parents, social-economic background of the children, the health of the children, etc.

Children sat for the test containing eighty questions covering the four basic operations in Arithmetic, namely; Addition, Subtraction, Multiplication and Division.

3.1 Design of Study

Evidence abounds to show that children make Arithmetic computation errors. For the purpose of this study, the Errors that were committed by the pupils were grouped into eight different categories depending on the strategy the child uses in arriving at the Wrong answer. These eight categories are as follows:

a) Basic Fact Error: The pupil makes an error in recalling the basic addition and multiplication facts.

b) Defective Algorithm: The pupil carries out the computation systematically but the procedure is erroneous.

c) Group Error: The pupil makes errors due to misunderstanding of the Place Value.

d) Inappropriate Inversion: The pupil responds with a computation involving the reversal of some critical aspects of the solution process.

c) <u>Incorrect Operation</u>: The pupil performs an operation other than the appropriate one.

f) <u>Incomplete Algorithm</u>: The pupil starts with the correct computation but stops the computation half-way or omits critical steps.

g) <u>Identity Errors</u>: The pupil computes problems containing o's and l's in ways suggesting confusion of operation identities.

h) <u>Zero Errors</u>: The pupil computes problems containing o's in ways suggesting difficulty with the concept of zero.

3.2 Sampling Procedure

Primary schools in Webuye Division, were divided into three categories, namely those which performed well in the 1986 K.C.P.E., those which did averagely well and those which did poorly on the same examination.

From each category, two schools were selected at random; but these schools were co-educational, to make it possible to study both boys and girls.

3.3 Research Subjects

Three hundred and sixty pupils were selected for this study; one hundred and twenty from standard three, one hundred and twenty from standard five, and the rest of one hundred and twenty from standard seven. Thus, from each of the six schools, sixty pupils were selected; twenty from standard three, twenty from standard five and twenty from standard seven. Ten boys and ten girls were selected from each of the three classes.

To assist in the selection of pupils, Mark-lists were used. No pupil who was likely to score everything on the Arithmetic computational test was selected.

The schools from which the pupils were selected are Webuye D.E.B. (A), Lugulu Boarding primary school (b), Milo primary school (C), Sinoko primary school (D), Masindu primary school (E) and Yalusi primary school (F). The schools A and B were those which did well in last years examiantion, C and D from those which did averagely, E and F from those which did poorly.

In tabular form, the sample was selected as shown on the next page.

Table III.1

Selection of subjects from the six schools in Webuye Division, Bungoma District.

Primary School	Std.III	Std.V	Std.VII	Total
WEBUYE D.E.B. (A)	20	20	20	60
LUGULU BOARDING (B)	20	20	20	60
MILO (C)	20	20	20	60
SINOKO (D)	20	20	20	60
MASINDU (E)	20	20	20	60
YALUSI (F)	20	20	20	60
TOTAL	120	120	120	360

3.4 Research Instrument

In Appendix A, is the tool the research used in this study. This is an Arithmetic computational test which was been compiled and standardized by Professor M.M. Patel of Communications and Technology Department, Kenaytta University. The test was designed for writing remedial material for children in basic computational skill development.

The research isntrument has eighty questions covering all the four basic operations of Arithmetic; namely Addition, Subtraction, Multiplication and Division.

3.5 Administration of the Tool

For the purpose of administering the test, all the sixty pupils in any one school sat in one place. Each pupil sat alone on the desk; each desk being about a metre away from the other. The researcher ensured that each pupil had a pen. No pupil was allowed to start before the others. The researcher checked to see that no question was missing in the booklet. The researcher talked to the pupils so that they would not be scared of the test. They were made to feel that they were doing the test for the researcher, and that the test was just like any other that they usually do in class. Half of the pupils started doing the test from number one, while the others started from the last problem, just to ensure that all the problems were attempted. The test was not timed; but most children were asked to show all their work in the booklets, and were not allowed to carry rough papers.

3.6 Test Scoring and Coding

The researcher marked the test manually. This was very tedious. The test was marked out of eighty. A mark of $0/_{80}$ meant that the child got everything right on the test. A mark of $80/_{80}$ meant that the child made 80 errors. Each error was then scrutinized to find out the strategy the child used in arriving at the wrong answer. The errors were then categorized in any one of the eight categories. This was also a very difficult task as it had to be done manually also. Had there been enough time, the computer might have been more appropriate.

CHAPTER FOUR

ANALYSIS AND OBSERVATIONS OF DATA

4.0 Introduction

The purpose of the study is to analyse Arithmetic computational errors made by standard three, standard five and standard seven primary school pupils in Webuye Division, Bungoma District.

The six schools that were selected for study will be referred to in terms of the letters A, B, C, D, E, and F. The respective schools for which the letters stand are;

A. Webuye D.E.B. Primary School

B. Lugulu Boarding Primary School

C. Milo Primary School

D. Sinoko Primary School

E. Yalusi Primary School

F. Masindu Primary Shool.

Due to the scope of the study and the time set aside for it, it has not been possible to use complicated statistical measures for analysing data. The magnitudes and relative percentages of errors have been computed to allow for comparisons of errors between one school and nother, one class and another, and boys and girls.

The errors made on the test have been classified into Eight categories, as has been outlined in chapter three. This chapter attempts to give details of the findings of the test. For purposes of the analysis, attempts have been made to keep in tune with the objectives of the study.

Three hundred and sixty pupils were selected for this study, 180 of them being boys and 180 being girls. This makes comparisions easier, than if unequal numbers of boys and girls were selected.

The data has been broken down into tables to assit in easy visualisation of the data.

Errors made by pupils in each of the six schools were worked out, and their relative percentages also worked out.

Table IV: 1

Number of Errors in each School

SCHOOL	NUMBER OF ERRORS	%
A	2474	20.00
B	1791	14.36
C	2261	18.13
D	1363	10.94
E	1813	14.54
F	2763	22.13
TOTAL	12465	100.0

The figures in the table show that in all the schools children do make errors in Arithmetic computation. In those schools which did well (A and B) in last years K.C.P.E., we find that school A accounts for twenty percent of the errors, while school B accounts for 14.36%. In all, the two school A and B account for 34.36% of all the errors. In the average schools

(C and D), school C accounts for 18.13% while school D(10.94%). For those schools which did poorly (E and F), E accounts for 14.54% and F, 22.13%. In all they account for 36.67% of all the errors. The poor schools account for the most errors, followed by good schools (34.36%) and lastly average schools (29.07%). But the differences in terms of percentages are not very large.

Table IV: 2

Errors in each Standard in the six schools

	STANDARD					
SCHOOL	III	%	V	%	VII	%
A	1226	20.12	894	20.28	244	13.62
B	952	15.13	600	13.61	139	13.23
C	1112	17.70	882	20.01	275	15.35
D	750	11.92	777	17.63	286	16.00
E	1439	22.10	862	19.55	531	10.69
TOTAL	6291	100.00	4408	100.00	1792	100.00

From the table it can be observed that in all the six schools studied, most of the errors were committed by standard three pupils, followed by standard five pupils, and lastly the standard sevens. The percentage of the errors made reduces as one moves from standard three upwards. Standard three pupils in school F made most of the errors, while in school F, they made the least errors. In standard five, pupils in school A made most errors, while pupils in school D made the fewest errors. In standard seven, pupils in school F made the most errors, while pupils in school D made the fewest errors. It can be observed that errors are still being committed in upper classes of the primary schools, an indicator that this may lead to poor performance in public examinations.

This has served as an introduction to this chapter. The rest of the chapter continues to deal with the errors, of different categories made by pupils; in all the six schools that were studied.

4.1 Categories of Errors

In the previous section of this chapter, errors committed by pupils in each of the six schools has been discussed . Also discussed were errors made by each of the of the standards in the six schools. In this section, the researcher analyses the errors by breaking them down into eight categories. For purposes of clarifying how the categorising was done, this secton is devoted to this.

(a) Basic Fact Error:

In this type of error, the pupils responded with a computation involving an error in recalling basic number facts. Thus, an error was classified as basic fact error if a pupil gave a wrong answer to simple problems in Arithmetic. For example,

$$8 \div 2 = 3 \ , \quad \begin{array}{r} 5 \\ \times \ 3 \\ \hline 10 \end{array} \ , \quad \begin{array}{r} 4 \\ \times \ 3 \\ \hline 8 \end{array} \ , \quad \begin{array}{r} 7 \\ - \ 3 \\ \hline 5 \end{array}$$

(b) Defective Algorithm

In this type of error, the pupils responded by executing a systematic but erroneous procedure. The errors could not be described as random, because the steps that a pupil followed were explainable, and responses to similar computational tasks were predictable. Examples within this category included the following:

$$\begin{array}{r} 402 \\ \times\ 201 \\ \hline 802 \end{array} \qquad \begin{array}{r} 345 \\ \times\ 111 \\ \hline 345 \end{array} \qquad \begin{array}{r} 33 \\ 22\,\overline{)\,66} \end{array}$$

(c) Grouping Error:

In this type of error, the computation was characterised by lack of attention to the position of numbers in the number system. Errors of this type were specially obvious in computational tasks that required regrouping or carrying. Examples of these are:

(i) 100 + 1 + 10 = 300

(ii)
$$\begin{array}{r} 23 \\ +\ 120 \\ \hline 350 \end{array}$$

(iii)
$$\begin{array}{r} 345 \\ \times\ 111 \\ \hline 345 \\ 345 \\ \hline 1035 \end{array}$$

This was a common multi-digit multiplication error where the place value was totally ignored.

(iv)
$$\begin{array}{r} 38 \\ +\ 12 \\ 54 \\ \hline 914 \end{array}$$

The columns were added separately without any carrying.

(d) Inappropriate Inversion:

In this type of error, the pupil responded with a computation involving the reversal of some critical aspects of the solution process.

Examples included the following:

(i)
```
  7000
 - 999
 -----
  7999
```

(ii)
```
   500
 - 209
 -----
   309
```

In these two cases, the pupil reversed the subtrahend and minuend, and thus avoiding any "borrowing".

(e) Incomplete Algorithm:

In this type of error, the pupil initiated the appropriate computational procedure but aborted this computational procedure. Examples included the following.

(i)
```
  345
  111
  ---
  345
  345
  ---
 3795
```

(ii)
```
       21
 3 | 639
     63
     --
      9
```

The pupil does not continue until the procedure has been completed, but leaves it along the way.

(f) Incorrect Operation:

In this type of error, the pupil performed an operation other than the appropriate one. Examples included the following:

(i)
```
  5
x 3
 --
  8
```

(ii)
```
  8
+ 2
 --
 16
```

(iii)
```
  7
- 3
 --
 10
```

(iv) $8 \div 2 = 16$

(g) Identity Errors:

In this type of error, the pupil computed problems needing zero and one in the answers, in ways suggesting confusion of operation identities. Some of the examples included the following:

(i)
```
  1
x 9
 --
  9
```

(ii)
```
 104
   5
 ---
 120
```

(iii)
```
        11
   11 |1111
       11
       --
         11
         11
         --
         ..
```

(h) Zero Errors:

In this type of errors, the pupils computed problems containing 0's in ways suggesting difficulty with the concept of zero. Common examples included the following:

(i) $\begin{array}{r} 5 \\ -\ \underline{0} \\ 0 \end{array}$ (ii) $\begin{array}{r} 60 \\ \underline{8} \\ 488 \end{array}$ (iii) $\begin{array}{r} 4 \\ \times\ \underline{0} \\ 4 \end{array}$

4.2 Magnitude of Errors in Different Categories

After looking at the magnitude of errors in all the schoolsthe frequency of each category of error was computed. Relative percentages of each category of error was computed to give a clearer picture of how errors were committed. The frequencies of each category of error and relative percentages were also computed when comparing the errors committed by boys and girls.

An attempt was also made to show how the errors vary with the ages of the children.

Table IV: 3

Error Magnitude in each Category

NO	CATEGORY OF ERRORS	MAGNITUDE OF ERRORS	%
1	Basic Fact Error	6595	52.91
2	Defective Algorithm	969	7.77
3	Grouping Error	2534	20.33
4	Inappropriate Operation	580	4.65
5	Incorrect Operation	833	6.68
6	Incomplete Algorithm	191	1.53
7	Identity Errors	572	4.60
8	Zero Errors	191	1.53
	TOTAL	12465	100.00

From the data in the table it can be observed that over 50% of the errors committed by the pupils were of Basic Fact type. This is followed by Grouping Errors which account for 20.33% of all the errors. The pupils made the least errors of incomplete Algorithm and zero type. The rest of the errors made in order of their magnitude are Identity errors (4.60%) Inappropriate Algorithm (4.65%) Incorrect operation (6.68%) and Defective Algorithm (7.77%).

4.3 Errors in Different Schools

After computing the overall magnitude of each category of error, error magnitudes of different categories were computed for each of the six schools studied.

Table IV: 4

Magnitude of error types in the six schools

	CATEGORY OF ERRORS	MAGNITUDE OF ERRORS							PERCENTAGE OF ERRORS					
		A	B	C	D	E	F	TOTAL	A	B	C	D	E	F
1	BASIC FACTS	1457	987	1198	568	870	1515	6595	58.49	55.11	52.99	41.61	47.99	54.85
2	DEFECTIVE ALGORITHM	129	128	189	165	179	179	969	4.20	7.20	8.36	12.11	9.87	6.48
3	GROUPING ERROR	414	346	453	432	446	443	2634	16.70	19.82	20.04	31.77	24.60	16.06
4	INAPPROPRIATE	90	75	146	61	85	123	580	3.64	4.18	6.46	4.47	4.69	4.45
5	INCORRECT OPERATION	189	130	113	49	101	261	843	7.64	7.31	4.55	3.60	5.57	9.45
6	INCOMPLETE ALGORITHM	37	34	18	34	29	39	191	1.49	1.84	0.08	2.50	1.60	1.45
7	IDENTITY ERRORS	106	69	133	54	81	129	575	4.34	3.86	5.88	4.00	4.47	4.67
8	ZERO ERRORS	52	22	11	19	22	73	199	3.50	0.68	1.64	1.47	1.01	2.59
	TOTAL	2474	1719	2291	1363	1813	2762	12465	100	100	100	100	100	100

From the table it can be observed that children are committing errors of all types. However, they commit more errors of Basic Fact. In school A, for example, Basic Fact errors account for 58.49% of all the errors committed, while in school B, Basic Fact errors account for 55.11%, school C(52.99%) school D(41.61%), school E(47.99%) and F(54.85%). Thus, for most schools, Basic Fact errors account for over 50% of all the errors. Grouping errors are next in magnitude to Basic Fact errors, and for School A they account for 16.70% of the errors, School B(19.82%), School C(20.04%), School D(31.77%), School E(24.60%) and School F(16.06%). The errors which were committed least varied from school to school. For School A,, Incomplete Algorithm (1.49%), School B, Zero Errors (0.68%), School C, Incomplete Algorithm (0.08%), School D, Zero Errors (1.47%), School E, Zero errors (1.01%) and School F, Incomplete Algorithm (.45%).

The order in which the errors were committed, has been organized into a table.

Table IV: 5

Order in Which Errors Were Committed in each School

NO	A	B	C	D	E	F
1	Basic Facts	Basic Facts	Basic Facts	Basic Facts	Basic Facts	Basic Facts
2	Grouping error	Grouping error	Grouping error	Grouping error	Grouping error	Grouping error
3	Incorrect operation	Incorrect operation	Incorrect operation	Defective Algorithm	Defective Algorithm	Incorrect operation
4	Identity error	Defective Algorithm	Inappropriate Inversion	Inappro-priate Inversion	Incorrect operation	Defective Algorithm
5	Defective Algorithm	Inappropriate Inversion	Identity errors	Identity errors	Inapprop-riate Inversion	Identity errors
6	Inappropriate Inversion	Identity errors	Incorrect operation	Incorrect operation	Identity errors	Inappropriate inversion
7	Zero errors	Incomplete Algorithm	Zero errors	Incomplete Algorithm	Incomplete Algorithm	Zero errors
8	Incomplete Algorithm	Zero errors	Incomplete Algorithm	Zero errors	Zero errors	Incomplete Algorithm

The table above shows the order in which the errors were committed in the schools, in order from the highest magnitude to that of lowest magnitude. For example, in School C, the errors which were committed most were of Basic Fact, followed by Grouping Error, Defective Algorithm, Inappropriate inversion, Identity errors, incorrect operation, Zero errors and lastly Incomplete Algorithm. The same pattern of errors can be observed from this table, namely; Basic Fact errors followed by Grouping Errors are committed most.

4.4. Magnitude of Errors in Each School in Accordance With Difference Standards

In the previous section, Data has been analysed according to each school. In this section, Data will be analysed in relation to the standards: namely standard three, standard five and standard seven. To assist in this analysis, errors have been classified into the eight categories, and for each standard, percentages have been computed, to make it easier for comparisons.

Table IV: 6

Magnitude of categories of Errors according to each Standard.

	STANDARD						
	CATEGORY	III	%	V	%	VII	%
1	BASIC FACTS	3319	52.84	2271	51.50	985	52.33
2	DEFECTIVE ALGORITHM	525	8.36	376	8.53	68	3.61
3	GROUPING ERRORS	1168	18.60	897	20.34	569	30.23
4	INAPPROPRIATE INVERSION	331	5.30	217	4.92	42	2.23
5	INCORRECT OPERATION	500	7.96	240	5.44	113	6.00
6	INCOMPLETE ALGORITHM	51	0.81	93	2.11	37	1.97
7	IDENTITY ERRORS	270	4.30	250	5.70	52	2.76
8	ZERO ERRORS	117	1.86	66	1.50	16	0.85
	TOTAL	6281	100	4410	100	1882	100

It can be observed from the table above that the magnitudes of the categories of errors decrease as one moves from standard three up to standard seven. This seems to show that maturation is an important factor in determining how well the children grasp basic arithmetic skills and concepts.

The data collected for each class was also analysed in relation to the school. The errors were classified into eight categories: the magnitudes and relative percentages of each category of error in each class was worked out in relation to the schools.

Table IV: 7

Magnitude of Category of Error according to each school for Standard three pupils.

		STANDARD THREE											
NO	CATEGORY	A	%	B	%	C	%	D	%	E	%	E	%
1	BASIC FACTS	754	59.56	532	55.77	557	50.09	283	36.80	390	39.33	820	56.60
2	DEFECTIVE ALGORITHM	54	4.27	92	17.09	95	8.54	129	16.78	85	11.33	70	4.83
3	GROUPING ERRORS	191	15.09	163	5.14	216	19.43	220	28.61	166	22.13	212	14.63
4	INAPPROPRIATE INVERSION	51	4.03	49	6.71	93	8.36	51	6.63	33	4.40	-	3.73
5	INCORRECT OPERATION	122	9.64	64	0.84	74	6.65	28	3.64	44	5.87	168	11.60
6	INCOMPLETE ALGORTHIM	18	1.42	08	2.94	04	0.36	13	1.69	05	0.67	13	0.90
7	IDENTITY ERRORS	47	3.71	28	1.87	69	6.21	36	4.68	40	5.33	60	4.14
8	ZERO ERRORS	29	2.28	16	1.87	04	0.36	09	1.17	07	0.94	52	3.57
	TOTAL	1266	100	954	100	1112	100	769	100	750	100	1449	100

Table IV:7 above shows the magnitude and relative percentages of each category of errors in standard three. Basic Fact errors are of highest magnitude in class three. The magnitude of each category of error is relatively high indicating that in standard three, most pupils have not understood concepts of Addition, subtraction, Multiplication and Division.

The magnitudes and percentages of each category of errors were also computed for class five.

Table IV: 8

Magnitude of Category of errors in Standard Five

		STANDARD FIVE											
NO	CATEGORY	A	%	B	%	C	%	D	%	E	%	E	%
1	BASIC FACTS	518	57.94	326	55.33	480	54.30	175	44.53	370	47.62	402	46.64
2	GROUPING ERRORS	137	15.32	116	19.33	161	18.21	127	32.31	174	22.40	182	21.11
3	INAPPROPRIATE INVERSION	48	5.37	26	4.33	45	5.10	09	2.30	43	5.53	46	5.33
4	INCORRECT OPERATION	51	5.70	37	6.17	43	4.3	07	1.78	47	6.05	55	6.40
5	DEFECTIVE ALGORITHM	68	7.61	30	5.00	79	8.94	33	8.40	81	10.42	85	9.86
6	IDENTITY ERROR	49	5.48	37	6.17	62	7.01	15	3.82	33	4.25	54	6.26
7	ZERO ERRORS	14	1.57	06	1.00	05	0.57	10	2.54	13	1.67	18	2.10
8	INCOMPLETE ALGORITHM	09	1.01	22	3.67	09	1.01	17	4.32	16	2.06	20	2.30
	TOTAL	894	100	600	100	884	100	393	100	777	100	862	100

Table IV: 8 shows the magnitude and relative percentages of errors in standard five. The same pattern of errors as in standard three is depicted. The dominant errors are Basic Fact and Grouping Errors, while the least are incomplete Algorithms, Zero errors and Identity errors. It can be seen that in comparison to standard three, standard five pupils are making less errors.

The magnitude of each category of error was also computed for pupils in class seven.

Table IV: 9

Magnitude of Category of Errors in Standard Seven

		STANDARD SEVEN											
NO	CATEGORY	A	%	B	%	C	%	D	%	E	%	F	%
1	BASIC FACTS	185	57.28	128	53.97	161	58.55	107	49.31	130	45.45	173	39.23
2	GROUPING ERRORS	86	26.62	67	28.03	76	27.64	85	39.17	106	37.06	149	33.79
3	INAPPROPRIATE INVERSION	00	00	00	00	08	2.91	01	0.05	09	3.15	23	5.22
4	INCORRECT OPERATION	16	4.95	29	12.13	06	2.18	14	6.45	10	3.50	38	8.62
5	DEFECTIVE ALGORITHM	07	2.17	06	2.51	15	5.45	03	1.38	13	4.55	24	5.44
6	IDENTITY ERRORS	10	3.10	04	1.67	02	0.73	03	1.38	08	2.80	25	5.67
7	ZERO ERRORS	09	2.80	00	00	02	0.73	00	00	02	0.69	03	0.68
8	INCOMPLETE ALGORITHM	10	3.08	04	1.69	05	1.81	04	2.26	08	2.80	06	1.35
	TOTAL	323	100	239	100	275	100	217	100	286	100	441	100

The table above shows the magnitude and relative percentages of errors made by standard seven primary school pupils. It can be seen that, in some categories or errors, no errors were made by standard seven pupils, showing that the pupils have gained greater proficiency in Arithmetic Computation than pupils in standard three and standard five. Although the magnitudes of Basic Fact and Grouping errors continue to be highest in the class, they are however, relatively smaller in comparision to those of standard three and standard five pupils.

4.5 Magnitude of Errors Made by Boys and Girls

Error analysis was also made to compare the errors made by boys and girls. For each school, the errors made by both sexes, and the relative percentages of these errors were computed.

Table IV: 10

Errors made by Boys and Girls in the Six Schools

SCHOOL	BOYS	%	GIRLS	%	DIFFERENCE IN ERRORS	% DIFFERENCE
A	1180	9.50	1294	10.40	114	0.9
B	887	7.04	914	7.33	37	0.29
C	1295	10.40	966	7.75	329	2.65
D	792	6.40	571	4.58	221	1.82
E	737	5.91	1076	8.63	339	2.72
F	1483	11.90	1279	10.16	204	1.74
TOTAL	6364	51.15	6100	48.85	1244	10.112

The table shows the magnitude of errors made by boys in comparision to girls in all the six schools under this study. It can be observed that, overall, boys committed more errors than girls. Boys committed a total of 6364 errors, while girls committed a total of 6100 errors. The Boys' errors accounted for 51.15% of the errors. The absolute percentage differences in errors made by boys and girls was less than 3%, showing that overall, there is no significant difference between errors made by boys and girls.

The errors made by boys and girls were divided into eight categories. The magnitudes and percentages of these errors were then computed for every school.

Table IV: 11 shows the magnitude and relative percentages of each category of error made by boys in each of the schools studied. Table IV: 12 shows the magnitude and relative percentages of each category of error made by girls in each of the schools studied. Comparing the magnitude of each category of error made by boys and girls, it can be observed that there is no significant difference between errors made by boys and girls.

The magnitudes and relative percentages of each category of error was computed to compare errors made by boys in standard three.

Table IV: 11

Errors made by Boys in each School

		ERRORS MADE BY BOYS											
NO	CATEGORY	A	%	B	%	C	%	D	%	E	%	F	%
1	BASIC FACTS	677	27.15	473	26.41	690	30.52	314	23.04	345	19.03	762	27.60
2	GROUPING ERROR	203	8.14	193	10.78	260	11.50	241	17.68	205	11.31	274	9.92
3	INAPPROPRIATE INVERSION	56	2.25	26	1.45	84	3.72	43	3.15	33	1.82	70	2.53
4	INCORRECT OPERATION	73	2.93	67	3.74	57	2.52	35	2.57	48	2.65	173	6.26
5	DEFECTIVE ALGORITHM	76	3.04	61	3.41	119	5.26	89	6.53	57	3.14	82	2.97
6	IDENTITY ERROR	51	2.04	25	1.40	72	3.18	29	2.13	23	1.27	50	1.81
7	ZERO ERROR	29	1.16	15	0.84	03	0.13	17	1.25	13	0.72	49	1.77
8	INCOMPLETE ALGORITHM	15	0.60	17	0.94	10	4.42	14	1.03	13	0.72	23	0.83
	TOTAL ERRORS BY BOYS	1180	47.31	887	48.97	1295	61.25	792	57.38	737	40.66	1076	53.69
	TOTAL ERRORS IN SCHOOL	2494	100	1791	100	2261	100	1363	100	1813	100	2762	100

Table IV: 12

Errors made by Girls in Each School

NO	CATEGORY	ERRORS MADE BY GIRLS											
		A	%	B	%	C	%	D	%	E	%	F	%
1	BASIC FACTS	780	31.28	514	28.70	508	22.25	254	17.64	525	29.00	733	26.54
2	GROUPING ERRORS	211	8.46	153	8.54	193	8.54	191	14.01	241	13.29	269	9.63
3	INAPPROPRIATE INVERSION	34	1.36	49	2.73	62	2.74	18	1.32	52	2.87	53	1.92
4	INCORRECT OPERATION	116	4.65	63	3.52	56	2.48	14	1.03	53	2.92	88	3.19
5	DEFECTIVE ALGORITHM	53	2.12	67	3.74	70	3.10	67	3.92	122	6.73	97	3.51
6	IDENTITY ERRORS	55	2.21	44	2.46	61	2.70	25	1.83	58	3.20	79	2.86
7	ZERO ERROS	23	0.92	07	0.39	08	0.35	02	0.15	09	0.50	24	0.87
8	INCOMPLETE ALGORITHM	22	0.88	17	0.95	08	0.35	20	1.47	16	0.88	16	0.58
	TOTAL ERRORS BY GIRLS	1294	51.88	914	51.03	966	42.51	591	43.37	1076	59.39	1359	49.1
	TOTAL ERRORS IN SCHOOL	2492	100	1791	100	2261	100	1363	100	1813	100	2762	100

Table IV: 13

Errors made by Boys and Girls in Standard Three

NO	CATEGORY	STANDARD THREE							
		BOYS	%	GIRLS	%	TOTAL	TOTAL %	DIFFERENCE IN MAGNITUDE	ABSOLUTE % DIFFERENCE
1	BASIC FACTS	1551	24.63	1768	28.07	3319	52.70	217	3.44
2	GROUPING ERRORS	630	10.00	538	8.54	1168	18.54	92	1.46
3	INAPPROPRIATE INVERSION	183	2.91	165	2.62	348	5.53	18	0.29
4	INCORRECT OPERATION	250	3.97	240	3.81	490	7.78	10	0.16
5	DEFECTIVE ALGORITHM	261	4.14	264	4.19	525	8.33	3	0.05
6	IDENTITY ERRORS	128	2.03	142	2.25	270	4.28	14	0.22
7	ZERO ERROR	74	1.17	43	0.68	117	1.85	31	0.49
8	INCOMPLETE ALGORITHM	24	0.38	37	0.59	61	0.97	13	0.21
	TOTAL	3101	49.23	3197	50.73	6298	100	399	6.32

From table IV: 13, it can be observed from the column of absolute difference in magnitude that the differences are not very large. The differences are highest in the categories of Basic Facts and Grouping Errors. In the category of Basic Facts, girls had 1768 errors while boys had 1551 errors; while in the category of grouping errors, boys had 638 errors while girls had 538. The highest absolute percentage difference is 3.44%. This seems to indicate that the differences in errors made by boys and girls are not very signficant.

The magnitudes and relative percentages of errors were also computed for boys and girls in standard five.

Table IV: 14

Errors made by Boys and Girls in Standard Five

		STANDARD FIVE							
NO	CATEGORY	BOYS	%	GIRLS	%	TOTAL	TOTAL %	DIFFERENCE IN MAGNITUDE	ABSOLUTE % DIFFERENCE
1	BASIC FACTS	1331	29.53	1040	23.07	2371	52.60	291	6.46
2	GROUPING ERRORS	472	10.47	425	9.25	897	19.90	47	1.04
3	INAPPROPRIATE INVERSION	116	2.57	111	2.46	227	5.03	05	0.11
4	INCORRECT OPERATION	149	3.31	91	2.02	240	5.33	58	1.29
5	DEFECTIVE ALGORITHM	200	4.44	176	3.90	376	8.36	24	0.54
6	IDENTITY ERRORS	100	2.22	150	3.33	250	5.55	50	0.11
7	ZERO ERRORS	35	0.78	21	0.47	56	1.25	14	0.31
8	INCOMPLETE ALGORITHM	45	1.00	46	1.02	91	2.02	01	0.02
	TOTAL	2448	54.32	2060	45.7	450	100	490	9.88

Table IV: 14 shows the magnitude and relative percentages of errors made by boys in comparision to girls in standard five. It can be observed that absolute percentage differences, except for Basic Fact, errors, are less that 1.3%. This shows that in general, there isn't any significant difference between errors made by boys in comparision to those of girls.

Boys in standard five are committing less errors than boys in standard three. Similarly, girls in class five committed less errors than girls in class three.

Finally, error magnitudes and relative percentage errors were computed for boys and girls in Standard Seven.

Table IV: 15

Errors made by Boys and Girls in Standard Seven

		STANDARD SEVEN							
NO	CATEGORY	BOYS	%	GIRLS	%	TOTAL	TOTAL %	ABSOLUTE DIFFERENCE IN MAGNITUDE	ABSOLUTE % DIFFERENCE
1	BASIC FACTS	479	25.45	496	26.35	975	51.80	17	0.90
2	GROUPING ERRORS	274	14.56	295	15.67	569	30.23	21	1.11
3	INAPPROPRIATE INVERSION	23	1.22	19	1.00	42	2.22	04	0.22
4	INCORRECT OPERATION	54	2.87	59	3.13	113	6.00	05	0.26
5	DEFECTIVE ALGORITHM	33	1.75	35	1.86	68	3.61	02	0.11
6	IDENTITY ERRORS	22	1.17	40	2.13	62	3.30	18	0.96
7	ZERO ERRORS	7	0.37	9	0.48	16	0.85	02	0.11
8	INCOMPLETE ALGORITHM	23	1.22	14	0.74	37	1.96	09	0.48
	TOTAL	915	48.61	967	51.36	1882	100	78	4.15

Table IV: shows the magnitude and percentage of errors made by standard seven pupils in the schools studied. The column of absolute percentage differences shows more clearly that there is no significant difference between errors made by boys and girls. The highest percentage difference is 1.11%.

It can also be seen that Standard Seven pupils make fewer errors than Standard Five pupils.

In this chapter, data related to errors made by Standard three, standard five and standard seven primary school pupils has been analysed. Special attention was given to error magnitudes in each school and standard. The errors were also analysed to compare the performance of boys and girls on the Arithmetic computation test .

In the next chapter, we shall be concerned about making conclusions which ensue from the analysis in this chapter. Recommendations and suggestions for further research will then be made.

CHAPTER FIVE

CONCLUSIONS, IMPLICATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

5.0 Introduction

In this chapter, conclusions based on the analysis in Chapter Four will be made. Implications of the study and suggestions for further research will be made thereafter. It is hoped that with these suggestions, more researchers will carry out studies in this area.

5.1 Summary of the Study

The purpose of this study was to analyse Arithmetic computational errors made by standard three, standard five and standard seven primary school pupils in Webuye Division, Bungoma District. The objectives of the study were as listed here below:

1. To determine the type of errors made by pupils.
2. To classify the errors into different categories.
3. To determine the overall magnitude of each category of errors.

4. To determine the magnitude of each category of errors in each of the six schools studied.

5. To determine the magnitude of each category of errors in each of the classes, from the three categories of schools.

6. To determine the magnitude of each category of error in each of the classes, for all the six schools.

7. To determine overall magnitude of errors made by boys in comparision to those made by girls.

8. To determine the overall magnitude of each type of error made by boys in comparison to those made by girls, in the three categories of schools.

9. To determine the magnitude of each category of error made by boys in comparison to girls for all the classes under the study in the three categories of schools.

10. To determine the magnitude of each type of error made by boys in comparison to girls in all the classes under the study in the six schools.

Literature abounds to show that errors are made by pupils in Arithmetic computation. Other than Gohil (1984), no other researcher has investigated the errors made by pupils in this Country. For this reason, it was felt that this study would add some weight to that of Gohil, and perhaps fill the gaps left by her study in Nairobi. Since her study was carried out in Nairobi, an urban area, this study was planned to be carried out in a rural district. It was hoped that this study would assist all educators who are interested in Mathematics at the elementary level, to identify children's problems and so plan for remedial classes that would assist the pupils.

The subjects of the study were 360 pupils from six schools in Webuye Division, Bungoma. From each school, sixty pupils were selected for the study, from Standard three, five and seven. From each class 10 girls and 10 boys were selected.

5.2 Conclusions

The conclusions drawn will be in line with the objectives of the study. Reference will be made to tables used for analysis in Chapter Four. To assist in this, conclusions have been divided into groups.

5.2.1 Conclusions related error Magnitudes in Different Schools

(a) The total number of errors made by the pupils in all the six schools was 12465. The school with the highest number of errors was F with 2763 errors, followed by school A, with 2474 errors. School F is one of those which did poorly in last years Kenya Certificate of Primary Education (KCPE) and school A is one of those which did very well. It can be seen that errors are being made by pupils in all the schools, whether those which do well in public examinations or those which do poorly (Refer to Table IV: 1).
It can be concluded from this that most pupils in primary schools do make arithmetic computational errors.

(b) It can also be observed from Table IV:2, that errors made by pupils decrease as one moves upwards from one class to another in the schools.

The only exception is School E whereby the total number of errors committed by Standard Three is 750, Standard Five 777 and Standard Seven 286.

From this it can be concluded that pupils in higher standards commit less errors than pupils in the lower standards. This also indicates that as the child grows older, his/her capability in Arithmetic computation increases.

5.2.2. Conclusions related to Magnitudes in different Categories

(a) From Table IV: 3 it can be observed that most children are making errors of Basic Fact category. The magnitude of Basic Fact errors is 6595, accounting for 52.91% of all the errors made by pupils. This is followed by the Grouping Error category, whose magnitude is 2534 accounting for 20.33% of all the errors that were made by pupils on the Arithmetic computational test.

Errors which are being committed least by the pupils are Zero errors, whose magnitude is 191, and Incomplete Algorithm also of magnitude of 191, each accounting for 1.53% of all the errors made.

Thus, most pupils are committing errors of Basic Fact and Grouping. Fewer errors in the category Incomplete Algorithm and Zero categories are made.

(b) From Table IV: 4, it can be observed that in every school, Basic Fact errors and Grouping errors are committed. The order in which others are committed vary from one school to another. For example in school, the third in order after Basic Facts and Grouping errors is that of Incorrect operation, while for school C it is Defective Algorithm.

Thus the order in which errors are committed varies from one school to another. This is brought out more clearly in Table IV:5.

5.2.3 Conclusions related to Magnitudes of each category of Errors in every Standard Studied

(a) From Table IV: 7, it can be observed than in standard three, every category of error has a very high magnitude.

(b) From Tables IV: 8, and IV: 9, it can be obseved that the number of errors being committed is reducing as the child climbs the academic ladder.

5.2.4 Conclusions Based on errors made by Boys and Girls

From Table IV: 10, it can be observed that boys made a total of 6364 errors, while girls committed of 6100, a difference of 264 errors. Looking at the individual schools it can be observed that the difference in errors made by boys and girls is not significant.

It can be concluded that the capability of a child in Arithmetic computation does not depend on the sex of the child. All children are equally pre-disposed in terms of what they can achieve on the Arithmetic computational test.

5.2.5 General Conclusions

(a) The Arithmetic computation test developed and standardized by Professor M.M. Patel of Communication and Technology Department was an effective instrument in isolating the error types being committed by pupils in the study. There was no error that could not be classified; at least every error could be placed in any one of the eight categories.

(b) The study revealed that children are committing errors in all the schools studied. Even those schools which do well in public examinations registered high magnitudes of errors; of all categories. This seems to imply that the teachers may be concentrating too much on standard eight, which is an examination class, at the expense of the lower classes.

(c) There was a marked difference in the magnitudes of errors made by standard three, standard five and standard seven; primary school pupils. As pupils grow older in terms of age, they seem to grasp the computational skills better.

(d) There were no significant differences in errors made by girls and boys. This means that girls, just like boys are capable of doing well in Arithmetic. They have the same capability. What sometimes may lead to boys doing better than girls may be sex-stereotyped roles; which gives no time to girls to practice their skills.

(e) The error type which occurred most frequently was that of Basic Fact followed by Grouping Error. If any remedial classes or materials have to be planned or written, they should cater for these types of Errors.

(f) The fact that even standard seven pupils are making arithmetic computational errors means that most of the children are not going to pass K.C.P.E., and that also means that pupils are dropping out of school who are not well equipped to face life in society. For to start even the smallest business, a child needs to be proficient in arithmetic.

5.3 Implications of the Study

This study has revealed that pupils in primary schools are committing various types of errors. This revelation has among others, the following implications.

(a) The greater part of primary mathematics is Arithmetic. The basic skills that pupils who might drop out of school need are those of Arithmetic. Thus pupils who are joining society after standard eight are ill equipped to face the grillings of life out of school.

(b) In most examinations, girls do poorly compared to boys in Mathematics. From the revelations of this study, it can be seen that girls do equally well as boys in Arithmetic. This implies that the reasons why girls do poorly in mathematics may not be due to their sexes, but rather on other factors such as attitudes, sex-roles etc.

(c) In those schools which were sampled from those which performed well in Kenya Certificate of Primary Education (1986), it was observed that pupils are making very many errors in arithmetic. This implies that at the lower level, pupils have comparable abilities. Also, most of the teachers do not take teaching pupils in the lower classes very seriously. The reason why one school does better than the other seems to be the amount of drilling of standard eight pupils.

(d) Examinations play an important part in the life of an individual. If a child passes, he might be entitled to better life in future. If he fails the future becomes dark. The fact that most of the pupils in primary schools are making such errors implies that these pupils, in the future, may lead an unhappy and uproductive life, because of failing in Examinations.

(e) It was obseved that as children mature up, they become more proficient in Arithmetic. Pupils in standard three commit more errors than pupils in standard five; and pupils in standard five commit more errors than pupils in standard seven. This means that arithmetic concepts be organised and planned in such a way as to relate to the age of the child. At some stage, the child may not be able to grasp a certain concept, but which he can very comfortably do at a latter stage.

It would also be useful if the curriculum in Arithmetic was Spiral, so that concepts may be revisited from time to time as the child advances. This makes it possible to clarify some concepts which had not been fully understood at an earlier stage.

(f) The errors that were committed most were those of Basic Facts and Grouping Errors. This poses a big problem to teachers. Teachers need to identify these type of errors and try to provide remedial exercises to the pupils before it is too late.

(g) Concepts in Arithmetic follow some certain order if they are to be mastered properly. The child needs to start with concrete concepts before proceeding to relational concepts. Some concepts act as prerequisites for other concepts. For example, a child who has not mastered the basic concepts of addition, should not be introduced to subtraction concepts. Similarly multiplication concepts should not be introduced before addition concepts are mastered properly, because multiplication is repeated Addition. Division should not be introduced before thorough understanding of the concepts of subtraction; because Division is repeated subtraction.

(h) Lower classes act as a base for upper classes. What pupils will learn at a later stage depends on what foundation they had in the lower classes. It is preferable, therefore, that trained teachers be deployed in the lower classes; rather than is the trend today where the most qualified teachers teach upper primary and Examination classes, while lower classes are manned by untrained teachers.

5.4 Suggestions for Further Research

(a) Only six primary schools in Webuye Division, Bungoma District were involved in this study. It is therefore, suggested that the same study be replicated in different parts of this country so that enough data could be collected on arithmetic computational errors. This will make it possible for one to make a generalisation.

(b) In this study, the researcher was limited to analysing the type of errors made on the written test. More light could have been thrown on how pupils committed the errors, if, after marking and identifying the mistakes, the researcher could talk to the pupils. The pupils will themselves tell the researcher how each child had arrived at the wrong answer.

(c) Other facts which may hamper development of arithmetic computational skills could have been included in the study. For example, the type of teacher, whether female of male, trained or untrained may have a bearing on the errors made by pupils. Other factors that would have included are: the type of school, whether it has enough teachers or not; the health of the child;

the socio-economic background of the child; the educational level of the parents; the type of profession of the parents; the type of parents, whether single or married etc.

(d) Research could be conducted to find out whether there is correlation between the number of errors a child makes on the arithmetic computational test and performance in Mathematics Examination's.

(e) Mathematics is considered to be important in learning scientific subjects. A study could be conducted to find out if there is a correlation between a child's performance on the Arithmetic computational test and performance in the science subjects.

(f) Facilities in schools are deemed important for academic excellence. Research could be conducted in schools which have the required facilities, and those which do not have adequate facilities, to find out if the errors made by pupils on the arithmetic computational test are related to facilities in schools.

(g) Research could be conducted to find out if the number of children in the class are related to the magnitude of errors that children make on the arithmetic computational test.

(h) Teaching methods are considered to play a big role in determing how children learn and form concepts. Research could be conducted to find out if a particular teaching method is related to the magnitude of errors that children make on the Arithmetic computational test.

(i) After analysing errors, as has been done in study; a researcher would work out and organise remedial exercises, administer them to the pupils and find out whether these exercises do correct the mistakes that children make on the arithmetic computational test.

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APPENDIX A

Shown below is the Arithmetic computational test that was used in this study. It contains 80 questions covering all the four Basic Arithmetic operations of Addition, Subtraction, Multiplication and Division. It was compiled and standardized by Professor M.M. Patel, of Communication Department, Kenyatta University.

1. $\begin{array}{r} 4 \\ +\ \underline{3} \end{array}$	2. $\begin{array}{r} 8 \\ +\ \underline{2} \end{array}$	3. $\begin{array}{r} 1 \\ +\ \underline{9} \end{array}$
4. $\begin{array}{r} 7 \\ -\ \underline{3} \end{array}$	5. $\begin{array}{r} 6 \\ -\ \underline{1} \end{array}$	6. $\begin{array}{r} 5 \\ \times\ \underline{3} \end{array}$
7. $\begin{array}{r} 1 \\ \times\ \underline{9} \end{array}$	8. $8 \div 2 =$	9. $27 \div 9 =$
10. $\begin{array}{r} 23 \\ \underline{45} \end{array}$	11. $\begin{array}{r} 5 \\ \underline{-0} \end{array}$	12. $\begin{array}{r} 40 \\ \underline{-27} \end{array}$
13. $100 + 1 + 10 =$	14. $12 + 54 + 38 =$	
15. $\begin{array}{r} 34 \\ \underline{\times\ 0} \end{array}$	16. $4 \overline{)\,40}$	17. $\begin{array}{r} 60 \\ \underline{\times\ 8} \end{array}$
21. $\begin{array}{r} 0 \\ \underline{\times 7} \end{array}$	22. $7 \overline{)\,210}$	23. $7 \overline{)\,58}$

24. 786 + 879

25. 68 + 25

26. 23 + 18

27. 3) 309

28. 27 x 72

29. 11) 1111

30. 10) 304

31. 7000 - 999

32. 63 x 5

33. 26 + 9 =

34. 18) 954

35. 8) 204

36. 5) 372

37. 124 x 30

38. 6 -9

39. 3) 639

40. 66 - 22 =

41. 500 - 209

42. 18 - 7

43. 47 + 74 =

44. 345 x111

45. 70 x 8

46. 2) 46

47. 54 x 12

48. 27 + 80

49. 94 + 57

50. 103 + 47

51. 64 + 8 =

55. 6) 24

56. 987 x 1

57. $7 \div 2 =$

58. $0 + 7 =$

59. $434 + 37 + 8 + 124 =$

60. $\begin{array}{r} 16 \\ -\ 9 \\ \hline \end{array}$

61. $\begin{array}{r} 38 \\ +\ 12 \\ +\ 54 \\ \hline \end{array}$

62. $\begin{array}{r} 23 \\ +120 \\ \hline \end{array}$

63. $\begin{array}{r} 58 \\ -\ 5 \\ \hline \end{array}$

64. $\begin{array}{r} 72 \\ -\ 27 \\ \hline \end{array}$

65. $5 + 0 =$

66. $\begin{array}{r} 624 \\ -346 \\ \hline \end{array}$

67. $\begin{array}{r} 24 \\ \times\ 10 \\ \hline \end{array}$

68. $17 \overline{)476}$

69. $\begin{array}{r} 76 \\ -\ 34 \\ \hline \end{array}$

70. $\begin{array}{r} 89 \\ \times\ 97 \\ \hline \end{array}$

71. $12 \overline{)804}$

72. $\begin{array}{r} 302 \\ -\ 8 \\ \hline \end{array}$

73. $31 + 0 =$

74. $17 \overline{)204}$

75. $\begin{array}{r} 88 \\ \times\ 9 \\ \hline \end{array}$

76. $\begin{array}{r} 8 \\ \times\ 94 \\ \hline \end{array}$

77. $3 \overline{)321}$

78. $74 + 47 =$

79. $3 \times 7 =$

80. $824 - 30 =$