EFFECT OF MATERIALS FAMILIARITY ON CLASSIFICATORY ABILITIES OF RURAL AND URBAN SCHOOL CHILDREN

BY

OTIENO - ALEGO

A THESIS

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This thesis is my original work and has not been presented to any other University for any kind of award.

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This thesis has been submitted for examination with my approval as University supervisor.

M.B.R. Savage.

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Abstract

The study reported here was conducted in two environmental settings, one urban the other rural. Thirty nine rural and thirty urban pupils, all males aged from eight to ten years were given familiar and unfamiliar materials to classify. The objective of the study was to find out whether or not familiarity with test materials influenced childrens classificatory abilities. Various sets of test materials were selected from rural and urban surroundings. Attempts were made to ensure that materials familiar to rural children were unfamiliar to urban children and vice versa. However, on the basis of familiarity test some materials which were found to be unfamiliar or familiar to both groups were also included for use in the tests.

The number of subjects (frequency) who identified a particular attribute in their classificatory tasks was determined for each of the attributes used in sorting the given test materials. A x^2 test of significance between the two samples was performed since the two samples were independent. A further test to find out if the number of criterial shifts per set of test materials depended on materials familiarity was also performed using the x^2 test. Two main hypotheses were advanced in the study.

One hypothesis predicted that there would be no significant difference in classification between rural and urban subjects regardless of material familiarity but if a difference was noted, it would be in favour of the subjects for whom the materials were familiar. The second prediction was that in making classificatory shifts per given set of test materials, no difference would be noted regardless of materials familiarity but if however a difference was observed, then the subjects for whom the materials are familiar would make significantly more shifts than the other group.

The study found that there was no significant difference in sorting abilities between rural and urban subjects where the three 'common' attributes of size, shape and colour were used. However, there were significant differences where the 'rare' attributes like 'transparency', softness of the material and pattern were involved in classifying materials. Secondly, there was no significant difference in the criterial shifts made, but those tasks for which such differences were noted favoured the urban subjects in one case and rural subjects in another case.

This study has one important implication for the classroom teacher of science in the primary school. If in the learning of science, the child's environment and the materials available within the environment are utilized then both groups of children (rural or urban) are likely to perform equally in one cognitive task investigated, namely classification.

With further studies in other areas of cognitive functioning it may be brought to light that despite environmental differences childrens' acquisition of scientific skills at least at the elementary stage is not dependent of on being exposed to sophisticated alien science materials but on the full utilization of their environment.

CHAPTER ONE

INTRODUCTION

The child of today is the scientist of tomorrow.

The effectiveness and the competence of Kenya's future scientists will depend on the quality of science teaching imparted to the present generation of school children. There is critical and desperate need for well trained and competent scientific personnel in the fields of medicine, engineering, education and agriculture to steer and advance the development of Kenya and other third world countries experiencing similar constraints. The role of the primary school in the formation of these future scientists is extremely crucial since the primary school is the natural place where the teaching of science begins. This view is emphasized by Weiss (1968, p. 14) when he states:

> Here (the primary school) is where the task of educating village Africans into modern world begins, and here is where the generation of African scientists must ultimately begin.

Besides the crucial role played by the primary school in the making of scientists, the type of science education programme designed for use in the primary schools should include certain important components. One of these components is the dissemination of scientific information commensurate with the intellectual level of the children.

More important however, is the need to inculcate the attitude of scientific enquiry and the development of the techniques of scientific problem solving. It is encouraging to note that innovations in a number of modern primary science programmes have put some of these points into consideration. The Elementary Science Programme, Science A Process Approach (innovated in the United States); Nuffield Primary Science (developed in the United Kingdom) are a few of the programmes designed to meet these challenges. It is encouraging to observe that in its attempts to fulfil the same objectives, the Kenya Primary Science Programme under the auspices of the African Primary Science Programme has been introduced into primary schools and taken its hold. The philosophical basis for teaching science in African countries is well expounded in the Science Education Programme for Africa (SEPA) Handbook in which it is stated:

> Sepa's approach to science education takes the view that science is a medium through which a child might develop his natural curiosity, his power of observation and enquiry and constructive attitudes to problem solving.
>
> (Sepa Publication, p. (I)).

Statement of the problem

1. The scope of elementary science curriculum should be the total environment of the child.

(Hedges, H.G., p. 67)

2. Classificatory behaviour seems to be preliminary and necessary for effective conceptualization to take place.

(Allen & Lowery, p. 248)

The resultant effect of the above quotations clearly highlights the importance of investigating a child's classificatory abilities, particularly how this is affected by his environment if childrens'"scientific operation" is to be understood. The child's activity in science can be expected to be dependent on a science programme suitably designed to take into consideration the type of environment in which the child functions. If the child's environment is neglected, it is very doubtful if science at the primary level would be taught effectively. It is even more doubtful if children would find science interesting at all. Classification is an important component of the scientific process on which depends(as pointed by Allen and Lowery)a l higher cognitive skills. Noted scholars like Bruner similarly emphasize the significance of classification.

Consequently, it is considered important to study the effect of the environment of the child, specifically the materials which are available to him, on his ability to classify.

The question of the learning environments of Kenya's school children is so important that some categorization needs to be made. For the purposes of the study, the environments will be classified mainly as two; namely the Urban and Rural environments. This simplified categorization even though appropriate for this study neglects some variations within the overall learning environments in the whole of the republic. Only a small proportion of primary school children learn in an urban environment where there is greater contact with western artifacts compared with children in the rural areas, where the majority begin their learning. Because of the differing environmental settings, the materials children of one setting get in contact with differ from those the other group gets exposed to. Bearing in mind the factor of materials familiarity, it was felt important to find out whether or not children from the two differing environmental settings differ in their ability to classify real objects.

Significance of the study

The need to understand the influence of the environment on childrens' learning particularly in science, is a cardinal issue. Since the materials available in the child's environment forms the foundation of science education, a study of the influence of materials familiarity on one aspect of science activity namely classification is considered significant for the cause of science education. From this study, deficiencies in the learning of science which could be attributed to the environment could be identified and corrective measures taken.

Although only one component of the science processes is investigated, a lag by one group in relation to the other in this process will highlight the need to bring all children beginning their science learning at par irrespective of varying environmental experiences.

Test Hypotheses

The urban - rural dimension as well as the effect of familiarity or non-familiarity with materials were borne in mind when formulating the following hypotheses concerning childrens' classificatory abilities.

H_o: There will be no significant difference between rural and urban children in their ability to classify concrete materials using a particular attribute, whether or not the stimulus materials are familiar to one group.

H_1: There will be a significant difference between rural and urban children in their ability to classify concrete materials using a particular attribute in favour of the group for whom the materials are familiar.

H_o: There will be no significant difference between rural and urban children in their ability to make three or more classificatory shifts per set of stimulus materials whether or not the materials are familiar to one group.

H_2: There will be a significant difference in favour of the group for whom the materials are familiar in their ability to make three or more classificatory shifts per given set of stimulus materials.

Limitations of the Study

Some limitations were imposed on the study to make investigations possible. The justification for these limitations are expounded in Chapter Three dealing with the design of the study. It is however appropriate here to mention briefly the variables that were limited.

(i) Boys constituted the test samples.

(ii) Subjects of a particular age range were tested.

The nature of test administration precluded the possibility of including other age ranges for test as the tests were individually administered. It was found more appropriate from a statistical point of view to test one large group from each environmental setting to obtain a large number of subjects than to test various age groups but with small numbers.

(iii) Subjects were tested at the concrete mode.

Although a study of childrens classification at the abstract level is equally interesting and educationally useful, the study was confined at the concrete level. Interaction of children with physical materials forms the basis of science at the elementary stage.

Similarly interest of this study was focused on interaction of children with materials.

(iv) Only Luo children were tested.

As familiarity with materials varies from one ethnic background to another, it was considered appropriate in order to control familiarity to confine the study to Luo children whose language is common with that of the tester.

Assumptions of the Study

(i) Nairobi's schedule A schools being the lowest of the three categories were considered from a socio-economic point of view as being comparable with the rural schools.

(ii) It was also assumed that differences (if any) in the groups ability to make careful observations and to be able to verbalize their bases for categorization were negligible.

Definition of Terms used:

(i) The terms "categorization", 'sorting', and classification are interchangeably used and should be taken to mean in this study "putting together two objects which look alike in some way".

(ii) The words "classificatory shifts" or "criterial shifts" in this study are used to mean the number of different sorting bases within a given set of materials which a subject can identify.

The words subjects, test subjects, test pupils, rural pupils, urban pupils, rural subjects and urban subjects are used one way or the other in referring to one or both groups of children to whom the test was administered.

(III) Environment as used in this study is restricted to mean the physical materials which are either available in Urban areas or Rural or both which children interact with within their respective environments.

CHAPTER TWO

REVIEW OF LITERATURE

Introduction:

The process of categorization represents an elementary and general form of cognition by which an organism, human or otherwise adjusts to its environment. Its utilization in the learning environment is therefore important. Three main reasons can be advanced to emphasize the importance of classification particularly to human beings. First, different kinds of stimuli are encountered within the environment. They are so varied and overwhelming that a process of selecting and organizing these stimuli is necessary. It is not difficult to imagine how a child's inability to organize and select various stimuli would affect his learning. It is doubtful if learning would occur at all, but even if it did, it would result in confusion and intellectual retardation. Secondly, because of the ability to categorize, identification of various stimuli is possible to achieve. This is also very important in that the need to learn afresh every type of stimuli a person is subjected to is minimized. Lastly, the order which an individual imposes on sets of objects and the relationship that he makes between classes of objects and events is possible due to ability to categorize. Noted scholars including Bruner have expressed the importance of categorization. The significance of classification as a component of cognition is exemplified in the statement:

> Much of our commerce with the environment involves dealing with classes of things rather than unique events and objects. Indeed the case can be made that all cognitive activity depends upon a prior placing of events in terms of their category membership.
> (Bruner, J.S., et al. 1956, p. 231)

A study of some aspect of classificatory behaviour in children is relevant to the process of education particularly to science education at the primary level where the scientific approach to problem solving has been emphasized in recent years. Bruner, Goodnow and Austin point out that all higher cognitive skills employed in problem solving are to a large measure determined by the classification strategy a thinker imposes on the objects in his environment. Consequently the necessity to study how young children classify objects as they interact with their familiar as well as unfamiliar environment needs no further emphasis as it has been mentioned already.

It is imperative for this study to trace the general developmental trend in childrens' classficatory abilities even though the area in which this study was undertaken was not developmental. A clear picture ensues when this is done since differences between children of differing backgrounds can be understood when differentials in their development in classification is noted.

Developmental psychologists (Piaget, Inhelder, Vygosky)and some science educators (Allen, Lowery, George,Dietz) and others have undertaken studies on how children develop the ability to classify. In some studies, attempts have been made to describe various phases of classificatory behaviour through which children pass. Noted among them is the work of Piaget and Inhelder on the development of classification. An appropriate start in review of literature should then be with the description of the work of Piaget and Inhelder on classification. The development of classificatory behaviour according to Piaget is dependent on the formation of logical structures which permit the child to co-ordinate the two components, extension and intension properties. When the extension property is applied, the class members are specified whereas intension property is used to specify common attributes defining the members. Piaget enumerates three broad stages. Within these three stages, there are altogether eleven phases starting with the alignment phase and progressing upwards to hierarchical classification. The three stages are each described below.

Stage One:

The beginning of development of classification is characterized by the figural or graphical phase. At this phase, the child is dominated by the attempt to make a figure or construct a pattern. If a child is confronted with a set of geometric shapes such as triangles, squares, circles he has the tendency to make a line or a figure with the objects he is sorting.

For example he may begin by putting all the circles in a line. When he finishes up with the circles, he may continue forming a line using triangles and so on. Evidently the child is dominated by forming figures and neglects choice of an attribute for sorting the objects. Hence at this stage figural presentation seems to take precedence over consistent sorting in which an attribute is used.

Stage Two:

This stage is referred to as Quasi-classification. At this stage of classification the ability exhibited by the child is characterized by some attempt to employ an attribute in the sorting process. Figural presentation though still featuring, is no longer a dominant factor. But the child lacks consisistency and tends to shift from one attribute to the other. As a consequence, he tends to be inexhaustive in his sorting. The inability to carry sortings exhaustively is because the child is 'uni-dimensional' in that he concentrates on a single feature thus ignoring other dimensions of the materials in the sorting tasks he performs.

Stage Three:

This final stage according to Piaget is not reached until the child has reached the age of seven or eight. The child's ability to form class hierarchies is due to his capability to perform consistent and exhaustive sorting. This is made possible because of the child's ability to make criterial shifts easily in his classification and to simultaneously consider several classificatory dimensions. It is the contention of Piaget that only when a child is capable of forming

classes of these sorts can he be referred to as having a true operational understanding of classes. Thus, it is from this stage onwards that a child is capable of grasping the concept of class inclusion since he has developed the ability to consider the properties of objects separately from the objects themselves.

Kofsky (1966) constructed a scalogram of classificatory behaviour to test the Piagetian developmental stages. She used the scalogram to test children aged from four to nine. Her other interest was to find out if age had an effect on classificatory ability. The construction of the scalogram began with the resemblance sorting stage where two objects are put together because they are alike in some way or the other. The intervening stages leading to hierarchical classification were named as follows: the exhaustive, consistent, multiple class membership and horizontal classification. One of her findings was that there was a relationship between a child's age and the type of task mastered. Further more, she found that the order of difficulty was similar to the Piagetian construction. However there was no set order in the mastery of the tasks since mastery of one task did not imply an earlier one had been mastered. Other than these differences, Kofsky supports the development trends in classification as defined by Piaget.

The contribution by Vygosky (1962) to the development of classification also merits review. Vygosky also attempted to analyze various stages of development in classification.

Although in his study, language is significant in that its usage in classificatory behaviour was analyzed, Vygosky presents the development of classification in various phases similar to the Piagetian approach but with some differences. According to Vygosky, the lowest stage is the so-called 'Syncretic Heap' stage during which the child's grouping is random on the basis of the objects contiguity in time and space. Classificatory development proceeds onwards upto the Pseudo - Concept stage at which the child is capable of consistent sorting using a selected attribute. There is concurrence in Piaget's and Vygosky's studies concerning classification and the various phases through which children pass. Basically, classificatory behaviour is perceptually based progressing upwards to the conceptual level.

Denney (1972) designed two tests to study childrens free classification. One test was designed similar to the Piagetian approach while the other followed the Vygosky pattern. Neither Piaget'snor Vygosky'sstages were replicated as reported by Denney. But one pertinent point which arose from the study was the fact that there was progression from the perceptually oriented level of classification to the conceptually based level. At the perceptual stage the relevant attributes can be easily discerned as the process of classification at this level involves identifying common physical attributes. A more difficult strategy of search is involved with conceptual grouping where class membership may not be defined by a physical attribute. But the work of Denney confirmed the general broad classification set-up as defined by Vygosky and Piaget. The study of Bruner, Greenfield and Olver (1966) also enhances the point

about progression from perceptual to the conceptual level, and goes on to state that younger children group according to perceptible attributes as the protocols they use are tied up with colour, shape and size. The use of a superordinating base whether at the perceptual or conceptual mode progresses with a child's age.

The studies of Evans & Serpell, Suchman, Rosslyn, Serpell and Greenfield all confirm the progression of childrens' classification from the perceptible to the conceptual along the colour - form - function line in sorting objects.

The review has so far concerned itself with general development of classification in children. It is noted that childrens' classifications progresses from the perceptible level to the conceptual, and the physical attributes such as colour, shape and size are predominant at the lower level. But how the ability to classify varies with childrens' background is an interesting area. It has been the objective of a number of studies, which was also the objective of this study. Some studies examined differing childrens' environments and their effect on childrens' ability to classify. In some of these studies, urban-rural dimensions was considered. Other studies were cross-cultural in that children from different cultural backgrounds were tested in classification tasks. Some studies reviewed were conducted with children of the same cultural background except for variations in socio-economic status. The effect of familiarity with stimulus materials was considered in the design of some studies while others assumed or neglected such a variable.

Whatever the dimension used, these studies were reviewed because of their relevance to the study undertaken here as they all tended to throw light on the performance of childrens' classification where materials were familiar or unfamiliar, and where childrens' environments differed.

Maccoby and Modiano (1963) in studying classification using rural and urban Mexican children (at which they attempted to control such variations as language, level of technology) tested these groups of children in their ability to sort objects according to their similarities and differences. By the age of nine for example, twice as many urban children as rural children succeeded at their equivalence tasks. By the age of twelve four times as many urban as rural succeeded in their equivalence groupings. However there was no observed differences where formulating differences between items was concerned. The test assumed same familiarity with the materials for both rural as well as urban subjects. Further more, although not tackled in this study the urban subjects performed better in using functional as well as nominal bases for grouping. In another study conducted by Greenfield, Reich and Oiver (1966) in which the test materials were assumed familiar to both groups of children, classificatory ability of illiterate Wolof children was tested. The test materials were a set of ten familiar materials some of which were red,some round and so on. Yet despite familiarity with the test materials these childrens classification was found to be primarily colour based probably indicating that the type of environment these children lived in inhibited the growth of classification towards conceptual level.

In a further study Greenfield (1966) used test materials which consisted of three sets of three picture cards to study urban schooled (Dakar) and rural schooled and unschooled childrens in equivalence sortings. The stimulus materials (though artificial) were considered familiar to all the three groups of children. Excluding the performance of rural unschooled children as it is not relevant here, it was found that for the urban schooled children there was a more rapid progression from colour, towards function than among rural school children. In other words, the growth of classificatory ability was more rapid in urbanized schooled children than in their rural counterparts. Thus assuming equal familiarity with the test materials, urban subjects performed better than rural children. It would appear therefore from Greenfield's study that an urban environment fostered a more rapid development of classification.

Price - Williams (1962) having expressed general dissatisfaction with the Western-type of tests administered to African children using artificial stimuli, undertook some important modifications in his study. This study is important because the effect of familiarity with stimulus materials was carefully controlled. He designed a study in which the test materials that were familiar and appropriately suited to Tiv childrens' background. The children used in the study were of the same ethnic background except that some of them were illiterate while the others were schooled. One of his finding was that young children, some as young as six years were capable of classifying.

Secondly reclassifying was possible among his subjects. This tends to suggest that children easily made shifts in their sortings because familiarity with materials became a significant factor which improved their performance. In summary, Price-Williams found no significant difference between schooled and unschooled children with respect to their sorting abilities. Although Price-Williams' study compared educated with uneducated children which was not the primary objective of the study reported here, the fact that the factor of familiarity was carefully controlled makes its review pertinent and appropriate in considering the influence of materials familiarity on classification. The factor of familiarity does appear to have an influence on performance as supported by other studies which follow in which rural and urban school children were compared.

In a study which similarly considered familiarity with materials, Irwin and McLaughlin (1970) tested Mano adults and children. The subjects were given two kinds of tests. One test (the unfamiliar materials) utilized the geometric shapes such as circles, triangles and rectangles while in the test with familiar materials, the subjects were given eight bowls of rice differing in colour coarseness and other properties to sort. Geometric shapes being unfamiliar with Mano people, one of their findings was that with respect to sorting unfamiliar materials, the illiterates performed poorly. They were unsuccessful at finding more than a single base for classification. However when the subjects were given rice bowls to classify, the adults who previously lagged behind the school children were equally capable of making classification and reclassification.

Although adults and children cannot be adequately compared, it is noted that the adult performance did improve in the test due to the use of familiar materials in classification. Thus like Price - Williams' test, familiarity with test materials appears to influence performance in classificatory tasks and it would also be expected to influence performance when comparing school children from rural and urban environments.

The study by Sharp and Cole (Unpublished) was conducted to find out the influence of schooling on ability to classify and reclassify. In the study conducted among Mayan (Mexico) school children, uneducated teenagers and adults, they found that there was a higher percentage of correct sorting (52% versus 25%) among the educated school children compared with uneducated teenagers. On the choice of a new dimension for sorting, 60% of the educated subjects employed a new attribute for sorting compared to only 8% of the uneducated teenagers. Since the influence of schooling on classification cannot be neglected as found in the Sharp and Cole as well as Greenfield studies, it was important in the study undertaken here that in comparing rural with urban children, the school differential be controlled by making it as similar as possible for the two groups.

Deregowski and Serpell (1971) conducted a cross-cultural study involving Zambian and Scottish school children. The children were given two kinds of test materials to sort. One task required them to sort immitations of real objects made from plastic materials while the other test required them to sort coloured as well as black and white pictures of the given objects. No difference in

sorting ability was observed between the two groups of children in sorting real objects. However, in comparing childrens' sorting of black and white as well as coloured photographs, there was a difference in favour of the Scottish children. Deregowski and Serpell contended that the difference arose because real objects and pictures of objects elicited different interpretation which in turn affected childrens' sorting. Their study brought out clearly the importance of physical presentation of the materials. Similarly, in the design of the study reported here physical presentation of test materials was carefully taken into consideration. But beside the aspect of physical presentation, the study also clearly brought out the significance of familiarity as a factor and its effects on sorting task. Zambian children being less familiar with pictures did not perform as well as Scottish children in the same sorting test. A secondary finding but which is in agreement with other researchers already mentioned was that Zambian childrens' grouping was more likely to be based on colour than Scottish childrens' grouping.

Okonji (1971) studied the effect of familiarity with test materials on classification. His subjects were Scottish and Ibusa (Nigerian) children. Although he clearly expressed the inconclusive nature of his findings, he felt that familiarity with objects used in testing affected a child's efficiency in classification. He noted that differences between Scottish and Ibusa children were observed in the age range from eleven to twelve years. However, at the lower age range, the difference was not significant. The need for consideration of the types of stimulus materials used was also sounded by Kellagan (1965) in his study of Western Nigeria's Yoruba children.

He expressed the feeling that if appropriate familiar materials were considered in investigatory work there would be no differences in classificatory abilities. The influence of environment on classification was also studied by Scribner (unpublished) though it appears no attempts were made to consider materials familiarity for the group. Scribner wanted to find out to what extent "modern influence" affected taxonomic categorization among the Kpelle people exposed to various degrees of contact with western culture. His subjects were high school students, non-literate adults from villages exposed to western influence as well as subjects from remote rural areas presumed to have experienced little western influence. One of his findings was that high school students and adult workers exposed to western influence made predominantly more taxonomic categories than their illiterate counterparts. He also found out that the use of category membership dropped sharply in the case of remote area subjects. However, despite the drop they were at least capable of making some taxonomic categorization. In comparing adults who had been subjected to western influence with high school students, Scribner observed that the performance of these two group was about the same. Scribner's study is considered relevant for review because it exposed the influence of environmental variations in categorization. Although again as mentioned earlier that adult performance cannot be meaning fully compared with younger people, Scribner's study seemed to suggest that experiential factors other than formal western type of schooling have influence on classification.

But it should be noted that experiential factors derive from a subjects environment. In other words, the type of environment a subject is exposed to, plays an important part in moulding up his classification abilities. Although a term such as 'western influence' as implied in Scribner's study is not definitive enough, the study points to the fact that the type of environment a subject lives in has an influence in his ability to classify.

Four Piagetian tasks were administered by Tam et al (1971) to groups of socially advantaged and socially disadvantaged children. Categorization of environments as 'socially advantaged' and'socially disadvantaged' may be considered as analogous to 'deprived' and 'stimulating' environments. In comparing the two groups in Piagetian tasks, they found that 'culturally deprived' children progressed at a much slower rate in their classification compared to the children from culturally stimulating environment. Although variation in culture was not a subject of investigation in the study undertaken here since this was controlled, the results of Tam and associates further stress the influence of environment on classification. It is a fact that materials in a given environment do not constitute the entire child's environment, however, such differences between 'deprived' and 'advantaged' environments are partially contributed to by the difference in the types of materials with which children from these settings interact. In a study of childrens' social background on ability to group objects, Shlomo (1971) compared the performance of children of differing social classes, ethnic background and sexes.

The interest in Shlomo's study was in the performance of children of differing social backgrounds in grouping objects. Shlomo found that 'lower' class subjects were less able in employing abstract grouping styles and in achieving required conceptual breadth compared with the higher social status children. In Shlomos' test, familiarity with the materials was apparently assumed to be the same for all the social classes, sexes and ethnic background. The use of words like 'lower' and 'higher' social classes may be inappropriate and are irrelevant for the study undertaken, but serve to categorize various childrens environments and hence their differing experiences. In another study using Piagetian classification tasks, De Lacey (1970) studied the effect of environment on classificatory ability and what type of association existed between the two. His findings too supported other findings about the influence of environment on classification. He concluded by stating that there was a marked relationship between the degree of enrichment in the child's environment and the area of mental growth manifested in the ability to classify. De Laceys' study like other studies reviewed indicates the extent to which materials in a child's environment affect his classification.

Davey's (1968) invesigation of Tristan da Cunhas' childrens classification abilities according to various age groups also supports some of studies already reviewed. He too found that there was a progression from the perceptible to the conceptual level.

Orbell's study (1967) also found that remote rural children (remote presumably in terms of their contact with Western Culture) were more concrete and less abstract in the choice of categories used by them. It is apparent from Orbell's study that an assumption about equal familiarity with the materials for all the children was made. On the basis of that assumption Orbell's study supports other findings which observed differences between rural and urban children in their ability to classify objects.

Two other studies which did not deal with classification specifically were reviewed but there was justification for reviewing them. In the first instance the researchers considered the effect of stimulus familiarity on one aspect of cognitive development namely conservation. Secondly since studies which test childrens' conservation and classification abilities basically investigate their cognitive functioning, a study of conservation using familiar materials would to some extent be helpful in looking at the effect of material familiarity on classification. One such study was conducted by Klein and Lester (1973) who studied conservation among Guatemalan children using familiar and unfamiliar materials. The children were drawn from rural surrounding. The development of conservation of Guatemalan children and the results pertaining to it is not of concern here. But one relevant finding by Klein and Lester was that familiarity with stimulus materials improved performance on conservation. This experimental study is one of those which show the important role that materials familiarity plays in studies which test childrens performance in the areas of conservation and classification.

But it is fair also to point that Lloyd (1971) in studying conservation of Yoruba childrens' conservation of discrete and continous materials which were familiar and unfamiliar to them, did not find any differences in the performance in conservation whether familiar or unfamiliar materials were used. Although Lloyd's study found that familiarity was not a critical factor in her test, the study itself is important in that the significance of familiarity had been realized and was borne in mind in the design of the tests.

Otaala's (1973) study of classification among Teso children is important for one main reason. It was administered by the tester who spoke the same language as the test subjects. This approach was similar to the study reported here. Although the study did not attempt to compare urban with rural children in classification, it expressed a contrary opinion concerning the use of colour as a base for classification by African children. Contrary to other findings already mentioned, Otaala found that colour as a basis for classification was not as proponderant as had been suggested in other studies, considering the type of tasks used among his rural sample. Like Price - William's, Scribner's and Okonji's designs, his study was based on materials available within the subjects environment.

Some studies particularly relevant to elementary science education are reviewed below. Those reviewed here were mainly conducted in the United States. The influence of Urban-Rural dimension on performance in some tasks was shown by the study of Dietz and George (1969).

In this study, urban and suburban children were compared in their performance of eight tasks of basic skills. Though not specifically classificatory tasks, one of the findings was that there was a differential in performance favouring one environmental setting (suburban). Thus the type of skills a child learns and uses, seems to be influenced by the type of environment to which such a child is exposed.

In a further study by the same authors in 1971 on How children classify, they found that the properties selected in classificatory tasks differed between urban and suburban children. Raven (1968) in studying classification abilities among the culturally disadvantaged children obtained results which tended to support Brown's hypothesis about their (culturally disadvantaged) reduced analytic power in analyzing categoric relationship. But it is doubtful whether Raven's design favoured both groups of subjects. However, it also supported other findings which observed differences in classificatory abilities between children from two environment settings. In a study by Johnson (1973) on categorization between low and high socio-economic status children, he observed that high socio-economic children demonstrated greater ability to categorize on attribute resemblance. Although 'high' and 'low' socio-economic terms were not relevant in this research, non the less such differences are indicative of the different types of environments various children live in, a situation somehow analogous to urban-rural dimension in the study here. Lastly the study of Roland (1968) on science achievement also confirmed the existence of a difference in performance as dependent on socio-economic status.

Performance favoured children of 'high' economic status who performed better than the 'low' class children.

Comment on review of Literature

Studies reviewed in the preceeding section dealt mainly with childrens' classification and how various environmental settings to which these children are exposed influence this ability. As stated by Piaget and other scholars, the development of a child's classification is dependent on his interaction with the environment. Various studies categorized the environments as 'low socio-economic' versus 'high socio-economic';'rural' versus 'urban' disadvantaged versus advantaged; urban versus suburban. Whatever the categorization, the reviewed studies looked at children performances in differing environmental settings. Since various types of environments implicitly impose on the child the types of material objects he handles and manipulates, there was justification to review all these studies since they threw light on the objective of the study which was undertaken. Some studies have shown that the development of childrens' classificatory behaviour progresses from the perceptible level to the conceptual level and that colour is the most prominent attribute used in categorization of objects. Differing performances in classification have been shown in some studies. These studies have noted differences in classificatory abilities between rural and urban children in favour of urban children. However, it may be questionable whether the test materials used in these studies took into consideration the differing environments.

Greater contact with Western environment has been found to influence classification. Attempts to consider familiarity with test materials were made in some studies, their results being relevant here. The effect of content domain (the types of materials used in testing children) was observed to influence performance in classification. Scribner and Cole (1973 p.122) implicitly emphasize the importance of considering familiarity with the test materials when they state:

> "The attribute selected as the basis for grouping is sensitive to the nature of materials worked with: how familiar they are (rice versus geometric stimuli) the content domain from which they are drawn (animal versus plants) and the form in which they are presented (objects versus pictures)".

The review then tends to support the contention that if a comparative study of rural and urban school children was undertaken in which the influence of materials familiarity on the ability to classify materials was considered, then no differences would be observed between the two groups, at least at the concrete mode of classification. However, if such differences were observed, then they would be in favour of the group for whom the materials are familiar.

CHAPTER THREE

DESIGN OF THE STUDY

The experimental work was conducted in two separate locations, one rural, the other urban. For the rural study, schools in Asego Division of Homa Bay district were selected; while the Eastern division schools of Nairobi district were chosen for urban study. Three schools were selected from each of the divisions mentioned. The majority of the schools in the Eastern Division are predominantly schedule 'A' type. Other schools classified as 'B' and 'C' also exist under the management of City Council of Nairobi Education Department. In relation to these two categories, schedule 'A' schools constitute the 'low income' schools. They are referred to as 'low income' in the sense that the attendance at these schools is mainly by children of low salaried parents, such as unskilled and semi-skilled workers, domestic servants and petty traders. The choice of schedule 'A' schools rather than 'B' or 'C' for comparison is explained later.

The test subjects were all males aged between eight and ten years. In view of the difficulty that was anticipated in fixing the exact ages of rural children, it was found that estimating the ages of children within an interval would be easier than trying to find a child's exact age. Problems like guessing childrens' exact ages were likely to be minimized with the use of an age interval.

The test subjects were chosen from standards three and four rather than a single class.

The reason for this becomes clear when the ages at which rural and urban children begin schooling is considered. Generally, most rural pupils begin school later than their urban counterparts. Urban children particularly in Nairobi, enrol in standard one at around the age of six so that by the age of eight most of the pupils are in standard three. On the other hand, because of late start in schooling, most rural children are likely to be as far below as in standard one by the age of eight. Unless this differential in beginning school is considered, there is the possibility that in testing both rural and urban pupils, older rural pupils of the same class are likely to be compared with younger urban children. For this reason it was considered more appropriate to sample two classes, three and four rather than one in order to obtain adequate number of subjects comparable both in terms of schooling experience and in their ages. The possibility of school influence on classification tasks was considered an important factor considering the result of the studies of Sharp and Cole (unpublished) as well as that of Greenfield (1966) in which they found that schooling experience was an influential factor in classification. Similar views had been expressed earlier by Dent (1937) in investigating the applicability of some tests to the Zulu children in which he compared three groups of children. He found that performance in the test depended on schooling as well as the amount of contact with urban european culture.

Selection of male subjects

Review of literature in the previous chapter indicated that performance in classificatory tasks is influenced by a number of factors. One of these variables is the content domain, that is the type of materials contained within an environment. Since in the rural area where the study was conducted boys and girls engage in distinct domestic duties, the domain in which the boys operate mostly differs from that of the girls. In other words the types of materials boys become more familiar with cannot be assumed to be the same for girls. This difference is likely to affect the factor of materials familiarity and should therefore be controlled. Rural boys to cite an example, perform the primary role of tending cattle (although this role is rapidly diminishing) while girls draw water from rivers and pick vegetables in the shambas to prepare meals. It is a reasonable assumption bearing in mind such differences that boys as a whole would be more familiar with cattle while girls are likely to be more familiar with vegetables. Since classification is senstive to the type of domain used, it became necessary to either design a test in which the materials were equally familiar to both sexes or alternatively to use test materials suitable for only one sex and exclude the other sex from the study. In the design of this study it was decided that only materials familiar to the boys be used. Hence the justification for the test being confined to one sex. This made the control of familiarity with test materials more meaningful as it narrowed the content domain for the subjects under investigation.

The second point for excluding girls was based on consideration of problems of communication with the subjects. It was felt that communication during the administration of the test would be easier with boys than girls.

Procedure for selection of Test Subjects

A letter of introduction to the heads of the three urban schools was obtained from the Deputy Chief Education Officer of Nairobi City Council. The tester then proceeded to each school and introduced himself to the headmasters. The objective of the study, its organization as well as the specific help required from the headmasters were explained. The headmasters in turn directed the tester either to his deputy or to the class teacher concerned. With co-operation from these teachers, male pupils of Luo ethnic background around the required 'age' interval and level of education were summoned before the tester. This initial group which was selected by the classteachers to be used in selecting the final test sample was a large one. At this initial stage the intention was also to be acquainted with the pupils so that later on the subjects would be relaxed and feel at home during the test, an important factor in working with young children. Hence at the first meeting with the large group, children were asked about their ages, their residence, interests, parents occupation and other matters concerning their homes generally. Some of the questions did not bear direct relevance to the test but they served to stimulate and gain confidence of the children who initially felt rather withdrawn.

The age of every child was jotted down and any child who it was felt was younger or older than the specified age interval was excluded. A random selection of the subjects was made to choose from the large group, the test sample to be administered the test. This was done by giving children numbered and unnumbered papers to pick from a container. Those pupils who picked numbered papers constituted the test sample from that particular school. After the selection procedure, the non-selected candidates were requested to return to their classes. To the remaining group it was briefly explained that at the next meeting they would play a game of putting things together. This was considered necessary in order to let the children anticipate what they would be doing rather than be confronted with what they knew nothing about. An interview schedule was then fixed on a suitable day generally in five or six days time during which period the tester proceeded with test arrangments in other remaining schools.

The procedure in selecting rural test subjects was similar to the one used in selecting urban subjects. However, greater help was solicited from the class teachers to find the ages of children. Below is a table of the numbers of test subjects from both rural and urban schools.

Table 1: Number of Subjects selected from Test Schools

SCHOOLS	RURAL	URBAN
School 1	13	9
School 2	14	11
School 3	12	10
TOTAL	39	30

Choice of Test Materials

Real objects were used in the administration of the test rather than pictures or drawings of objects. It was forseen that testing subjects with real objects was likely to take longer to administer compared with pictures or drawings. Firstly from a scientific point of view, since the objective of the study was science oriented, it was decided that real physical objects be used rather than any form of representation of the objects. This was because as the basis for science at Primary Schools is on childrens' handling and manipulating objects in their science activity, a design using real objects was considered appropriate for the study. Another important point in deciding to use real objects was the fact that the type of representation used could influence a child's performance in a test. Biesheivel (1968, p. 63) observed that tests using pictorial materials neglect the fact that a picture particularly on printed paper is

> "a highly conventional symbol which the child reared in the western culture has learnt to interpret because he is confronted with pictures from his earliest days, gets much of his pre-school education from picture books and toys with pictures on them .... To make the object culturally meaningful is of little avail, if pictorial presentation itself is unfamiliar and it does not evoke an attitude of interpretation which a european group automatically assumes".

Schooling has made contributions to both rural and urban subjects in their interpretation of pictures since most of the books children use in their schools contain pictures and drawings in them. However, the urban environment is far more permeated with pictures and similar modes, than a rural one; hence urban subjects may be reasonably more familiar with picture presentation than rural children. If such differences are not considered this would bias the test. This was the justification for the use of real objects as test materials. Because familiarity with materials was an important factor in design of the test, precaution was taken to ensure that a form of presentation to which a subject was unfamiliar with was not used as this could create confusion and hence render an object that was otherwise familiar to the subject to appear unfamiliar. Lastly picture presentation limits to visual the choices a subject can make use in sorting objects.

Sorting by non visual attributes such as weight, smell and others are precluded when picture of objects are used. The study aimed at testing childrens' ability to sort objects using as many attributes as could be identified beside the common attributes of shape, size and colour.

Definition of familiarity with test items

Before the final set of test items were chosen an attempt was made to define the term 'familiarity' since the design required materials that were familiar to one group but not the other. It would be appreciated that it is not an easy task to declare some materials familiar to one but unfamiliar to the other group. An object that a child sees in his surrounding does not necessarily constitute familiarity in the sense it is applied here. An urban child for example who has seen a telephone and therefore 'knows' it cannot be assumed to be familiar with the item. This exposes the inadequacy of defining familiarity on the basis of visual response only. The problem of familiarity in the study is complicated further by the fact that some modern products have found their way even to the remotest part of the country. Hence western materials that could be considered to be predominantly urban may be available and equally familiar to the rural children. With this consideration in mind, an attempt was made to define a child's familiarity with an object using the following criterial bases:

(I) Having seen the object. This is an important condition for familiarity particularly with regards to concrete objects. A child can only be familiar with what he has seen.

(II) The child can state the use of the object.
A child who has seen an object but is unable to state its function cannot be considered to be familiar with such an object.

(III) An object is easily available in the environment.
This was crucial point in the study. The materials that are easily available to a child are those which he mainly interacts with in his environment.
To decide whether objects were easily available or not, a number of objects within that particular environment were collected and a consesus established among the pupils whether such an object was easily available or not.

(iv) The object has been handled within a specific period:
A common everyday object should be the type of material with which a child very often comes in contact. There is however the possibility that despite availability of the object in the surrounding, a child may not have handled an object for some time. That is, the fact that an object is commonly available in the child's surrounding does not mean he is familiar with such an object, if he does not handle it often enough to be able to make observations and abstract its features.

To ensure that all the subjects were reasonably well exposed to a set of objects, the period within which they had handled the set was considered. It was arbitrarily fixed to three months to allow as many test subjects as possible to fit the condition. This procedure was later found to be superflous but it was however initially a necessary step. For the type of materials used the mere fact that the subject had considered it common automatically implied his usual contact with such an object.

All of the four defined bases were used in defining familiarity. It should be noted that positive response to both (iii) and (iv) implied (i) and (ii). However, as a procedure in testing familiarity, the first question had to begin with base (i) and then proceed onwards to the fourth base.

Five sets of urban materials and four sets of rural materials were chosen from a larger list of materials that had been collected. Then on the basis of the definition of familiarity, the materials were tested for familiarity by noting childrens' responses to the four familiarity criterion questions.

The test materials consisted of sets of objects. The sets of materials were as follows:-

Selected Urban Test Sets

SET ONE Electric bulbs.

SET TWO Salt containers with sugar, water and salt.

SET THREE: Rectangular pieces of foam rubber.

SET FOUR: Balls.

SET FIVE: Cut outs of transparent shapes.

Selected Rural Sets

SET ONE: Three heads of finger millet (kal).

SET TWO: Three pieces of reeds (odundu).

SET THREE Three pieces of stones (nyatieng').

SET FOUR: Three local lamps (nyangile).

Each set contained in it three objects similar to the three object sorting test administered by Greenfield to the Wolof children. However, there were differences in the choice of materials used in the study reported here. In Greenfield's test the objects could only be sorted into pairs and the choice of sorting attributes was restricted to colour, shape and function only. The advantage of three object sorting lies in the fact that it is exhaustive and simple. Children must put together any two of the three objects which are similar in some way leaving only one object. Had the objects been more, sorting would have been inexhaustive and scoring procedure would have created problems. Besides, not all children would have found the test easy. Although three object sorting was used in this study, some modifications were made to suit the design.

(a) Repeated sorting was allowed. In the Greenfield test the three given objects could be sorted in only three ways without repetition.

In the study reported here, the subjects were allowed to resort the same pair he had sorted earlier provided he gave a different basis for putting the two objects together.

(b) The Greenfield Test materials employed different objects from different domains. For example one of Greenfield's three object set was an orange, a clock and a bicycle. But this study used a set of objects, of the same kind. That is the three objects were all lamps or balls and so forth. The advantage of using a set of similar objects was that the dimension of sorting was made wider. Depending on the set, the test materials could be sorted according to colour, shape, size and any other basis a subject was capable of finding since repetition was allowed. However, functional categorization was sacrificed as objects being of the same kind precluded sorting on the basis of function.

Description of test materials

1. Urban materials

SET ONE: The set of electric bulbs fulfilled the following description:-

(a) Two large size, one small.

(b) Two reddish in colour, one yellow.

(c) Two of the same shape, one different in shape.

(d) Two with broken filament (made noise when shaken,) one did not.

SET TWO: The test set consisted of three salt containers filled with sugar, salt, milk and water. The set satisfied the following properties:-

(a) Two made of plastic, one made of glass.

(b) Two rectangular in shape, one circular.

(c) Two green, one white.

(d) Two containing liquids, one powdered solid.

(e) Two heavy, one light.

SET THREE: The set consisted of three balls. The salient features for sorting were:

(a) Colour (Two brown, one multicoloured)

(b) Size (Two small, one big)

(c) Pattern (Two with patterns, one without).

(d) Bouncing property: (Two bounced high, the other did not bounce as high).

(e) Softness: Two hard, one soft.

SET FOUR: The materials consisted of three pieces of foam cut into rectangular shapes. Although this set is artificial as opposed to the others in that they were cut to size by tester, they were used because rubber foams are commonly available in most urban homes as they are used in making mattresses, chairs and pillows. The three pieces are described as follows:-

(a) Colour (Two light green, one slightly different in colour).

(b) Thickness (Two same thickness, one thinner).

(c) Length (Two equal in length, one shorter).

In describing the sorting properties, it must be realized that in the actual sorting tasks, many more bases were identified by the subjects in their sortings as such the given description cannot be considered as exhaustive.

SET FIVE: The set of objects used for this test were artificial stimuli. The materials consisted of four geometric shapes as follows (i) two triangular (ii) one shape pentagonal and (iii) one rectangular. The four objects could be sorted according to the following properties:-

(a) Colour (Pentagon and triangle).

(b) Shape (Two triangles).

(c) Size (Two triangles).

(d) Thickness (Rectangle and Square).

(e) Transparency (Pentagon and red triangle).

II. Rural Materials

SET ONE: The materials consisted of three heads of finger millet (kal). The use of finger millet was appropriate because it is a commonly grown food in the location from which the rural test sample was drawn.

Moreover at the time of testing, 'kal' was in season and childrens' contact with it at that particular time must have increased their familiarity with it. The three heads of 'kal' could be sorted as follows:-

(a) Colour (Two same colour, one different)

(b) Size (Two small, one big)

(c) Number (Two with four fingers, one with six)

(d) Length of stem (Two with long stem, one short).

SET TWO: The materials for this test were three pieces of odundu (reeds). Reeds are commonly available and widely used materials in rural areas of Nyanza Province including the test area. Children in rural areas are familiar with reeds as houses, doors, windows and granaries are constructed from them. The three pieces of 'odundu' could be sorted as follows:-

a) Colour (Two yellow, one brown).

b) Length (Two pieces same length, one shorter).

c) Number (Two pieces with three nodes each, one with four).

d) Thickness (Two pieces thick, one thin).

ET THREE: A set of nyatieng' (spherical stones used for sharpening hand mills) were used. The hand mills are available in many homes in South Nyanza.

The handmill consists of a large stone base and a smaller one used for grinding millet to flour for preparation of food. 'Nyatieng' are used to sharpen the hand mill to make the surface rough, as grinding is most effective on such surfaces. The three pieces of 'Nyatieng' could be classified as follows:-

(a) Size (Two stones big, one small)

(b) Shape (Two stones 'less spherical' than the other)

(c) Colour(Two same colour, one different in colour)

(d) Weight (Two stones heavy, one light)

SET FOUR: Local lamps are widely used in most areas of Nyanza Province. The lamps (locally known as 'Nyangile') are made from scrap pieces of tin. Paraffin is used for lighting. They are also used in less ~~now~~ to do homes in urban centres including Nairobi though not as widely as in rural areas. Nyangile for most rural children is a primary source of light used for reading at night and for this reason they always handle these objects. The three lamps used in their "natural" state that is, when burning could be sorted as follows:-

(a) Weight (Two with a lot of paraffin in them to make them feel heavier).

(b) Colour (Two a mixture of yellow and blue, one red)

(c) Size (Two shorter and wider, one longer and narrower)

(d) Flame size (Two with small flames, one with big flame).

As with urban materials, children were able to identify more bases other than the ones listed.

Choice and use of Luo pupils and language

The test subjects were selected from a set of Luo children attending test schools. There were two main reasons for confining the study to children of Luo ethnic background. First it had been forseen that the problems of verbal communication might arise as the children were expected to justify their bases for categorization. Moreover to many children, particularly rural, the interview schedule was likely to be a novel experience which might adversely affect their responses. Since the tester was of Luo origin, it was felt that effective communication would be fostered if the study utilized subjects whose mother tongue was the same as that of the tester. Not only would communication be made easier but the subjects would feel free with the tester talking in their own language. Secondly, only Luo subjects were used and this was for cultural reasons.

Using children of various ethnic background such as Kamba, Kikuyu, Luhya for example in the same test would have required a more careful control of material familiarity, and probably it would have been difficult to find common materials,(let alone overcoming the problems of communication) that were equally familiar to all children of various backgrounds. Hence to minimize problems of communication and to control for familiarity only children of one ethnic background were used.

Testing Procedure:

First, the test of familiarity with materials was given by soliciting childrens' responses to the four familiarity criterion questions. The test of classifying the three objects in a set then followed. As a result of testing for materials familiarity which required the subjects to respond positively to the first three or more familiarity criterion questions, the test sets were found to fit the following categories:-

(a) Familiar to Urban subjects only,

(i) Electric bulbs

(ii) Foams

(b) Familiar to both groups

(i) Nyangile (Local lamps)

(ii) Balls

(c) Familiar to rural children only

(I) Kai (Finger millet)

(II) Odundu (reeds)

(III) Nyatieng (Stones)

(d) Unfamiliar to both groups

Geometric materials.

The set of containers filled with sugar and salt was found to be too complicated and difficult to administer and therefore not used in the administration of the test.

In testing childrens' sortings using the test materials there was complete randomization of the test items. For example one child might start with the 'odundu' test and then proceed with an urban test while another child might start with a completely different item. The purpose of this was to ensure that one set of preceeding test materials did not in any way influence performance in the next set of items. For example there was the feeling that if a set of familiar materials were given first to a subject to sort, then in the next stage of sorting unfamiliar items, performance might be influenced as a result of earlier contact with familiar items and vice versa. To ensure that performance in the test using familiar or unfamiliar items was not

influenced through earlier contact with a set of test items, randomization was done to avoid any such influences.

Before the test subjects were given the sorting tasks individually, a ten minute duration was allocated to the entire test sample in that particular school to observe, handle and manipulate the materials in order to get the 'feel' of the materials.

After the expiry of the alloted time, a test subject was then called before the tester and allowed to handle the set of materials to be sorted for about two minutes. The tester then demonstrated what was expected to be done by using a set of three pieces of geometric shapes which could be sorted according to colour, shape and thickness. Once the child understood the procedure, he was told he had another two minutes in which to make careful observations of the set of three objects before him after which he would be expected to put any two objects together and to state the reason why he did so. It may be that the tester was too generous in his time allocation but it was considered worthwhile to give the subjects ample time to be able to work confidently with the tester. As might be expected, particularly with young children, some enthusiastic children started sorting without

taking time to make observations but they had to be restrained to fully use the two minutes alloted to them. After the expiry of the two minutes observation period, the child was told to begin sorting the three objects in twos and to state the reason for his sorting. He was clearly told that he could again put the two objects he had already put together provided he gave a different reason for doing so. If the child was unable to proceed with his sortings, probably because the instructions were not clear a repeat of the demonstration with the geometric shapes was given. However, except for only two cases out of the entire sample space, repetition of instructions did not occur. As the two cases of repetition of instructions were not considered significant enough to affect the results of the study, they were included in the analysis of results.

Scoring:

Correct sorting followed by a correct explanation for his sorting earned the respondent a tally in the response sheet. Wordy and elaborate explanations by a subject did not justify a higher score. What was important was that a subject stated the correct basis for his sorting. For example a child who put two reeds (odundu) together and briefly said they were put so because "kitgi chaire" (colour similar) or just said "kitgi" (colour) was awarded a tick for correct response.

It is important to point that problems of explaining the basis for sorting were not experienced since the language used was the mother tongue.

During the entire interview session again only two cases were noted in which the subject put two objects together but was initially unable to state the reason for his sroting. However, when the question was put in a different form such as "why have you left this one alone?" the subject was able to give verbal explanation at the second probing.

A child's score in a set of materials was taken to be the number of correct sortings he made when presented with the set of materials. The group score in an attribute was the number of subjects who identified the attribute in sorting the given set of test materials.

CHAPTER FOUR

RESULTS

Introduction:

The x^2 test was used in the analysis of the results obtained from the interviews. The subjects were compared in their ability to sort the materials according to the attributes which they identified. Two by two contingency tables were drawn for each of the attributes used in the sorting tasks to show the frequency of test subjects (both rural and urban) who used the attribute in their sorting task and those who did not employ the attribute. The x^2 test is important to note, on a 2 x 2 table is basically a test between two independent proportions. The test was also used for comparison of urban with rural pupils in their ability to use three or more sorting bases in the tasks. A further test of significance between two independent means was performed to test for differences in the mean number of attributes used by both categories of subjects per set of materials. Lastly, percentages of subjects who classified according to an attribute were calculated for all the fifteen dimensions identified in using rural materials and in all the seventeen dimensions identified in using urban materials. Tables of results are given at the appropriate places in the chapter.

Appendix One, Two, Three and Four show individual responses and the attributes used by the subjects in their classificatory tests; task by task. Appendix Five and Six give the number of sorting bases used per subject in each of the rural and urban tests.

[illegible] frequencies of settings
[illegible] each of the

[illegible] rural and urban
[illegible] bases for given

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] 26 13 1[illegible]	36		8	33	26 16	35		27
5 22 13 4 6 26 20	9		9	24	20 15	[illegible]	7	[illegible]

[illegible]

8 6 3 16 [illegible]
[illegible] 3 [illegible] 23 [illegible] 37 [illegible] 8 [illegible]

Key to readings Table One and Table Two

C	-	Colour	Tr	-	Transparency
Sh	-	Shape	SF	-	Flame Size
S	-	Size	P	-	Pattern
L	-	Length	T	-	Thickness
W	-	Weight	B/S	-	Bouncing or Softness
N	-	Number			
Sh/Size	-	Shape or Size			

Table IV: Frequency of Subjects who made Three or more classifications

TEST	URBAN	MATERIALS	RURAL	MATERIALS
	Nr	Nu	Nr	Nu
1	9	7	8	12
2	17	15	18	15
3	10	26	15	15
4	9	13	30	20

Nr - Rural frequency Nu - Urban frequency

(b) Contingency Tables

Contingency tables were drawn to show the frequency of subjects who sorted according to an attribute as opposed to those who did not use the attribute in their sorting.

Rural Tests

(I) Test One: Millet (R1)

Colour

	C	C'
R	22	17
U	15	14

(A)

Size

	S	S'
R	26	13
U	22	7

(B)

Number

	N	N'
R	13	26
U	13	16

(C)

Length

	L	L'
R	11	28
U	13	16

(D)

(II) Test Two: Reeds (R2)

Colour

	C	C'
R	17	22
U	15	13

(A)

Thickness

	T	T'
R	26	13
U	20	9

(B)

Number

	N	N'
R	18	21
U	9	20

(C)

Length

	L	L'
R	36	3
U	26	3

(D)

(III) Test Three: Stones (R3)

Colour

	C	C'
R	13	26
U	9	20

(A)

Size

	S	S'
R	33	6
U	24	5

(B)

Shape

	Sh	Sh'
R	26	13
U	20	9

(C)

Weight

	W	W'
R	16	23
U	15	14

(D)

(iv) Test Four: Local lamps (R4)

Colour

	C	C'
R	35	4
U	29	0

(A)

Size

	S	S'
R	30	9
U	27	2

(B)

Size of flame

	SF	SF'
R	27	12
U	19	10

(C)

Guide to reading tables

The primed letters indicate the number of subjects who did not employ the stated attribute in their sorting. Considering Rural Test Four on colour sorting, the table

	C	C'
R	35	4
U	29	0

should be read as follows: In sorting the lamps according to colour, 35 rural subjects used colour while four did not. Of the urban pupils 29 used colour in classifying the lamps, that is every urban child used colour and none failed. All these tables should be read similarly noting the attributes used.

(ii) Urban Tests

(i) Test One: Bulbs (vi)

Colour

	C	C'
U	30	10
R	38	1

(A)

Size

	S	S'
U	27	3
R	33	6

(B)

Shape

	Sh	Sh'
U	5	25
R	2	37

(C)

Weight

	W	W'
U	3	27
R	6	33

(D)

(ii) Test Two: Rubber Foams (U2)

Colour

	C	C'
U	28	2
R	34	5

(A)

Thickness

	T	T'
U	26	4
R	29	10

(B)

Length

	L	L'
U	16	14
R	16	23

(C)

Weight

	W	W'
U	3	27
R	10	29

(D)

(iii) Test Three: Balls (U3)

Colour

	C	C'
U	29	1
R	36	3

(A)

Bigness

	B	B'
U	25	5
R	36	3

(B)

Pattern

	P	P'
U	23	7
R	4	35

(C)

Bouncing/Softness

	B/S	B/S'
U	22	8
R	4	35

(D)

Weight

	W	W'
U	0	30
R	6	33

(E)

(iv) Test Four: Geometric Shapes (U4)

Colour

	C	C'
U	22	8
R	28	11

(A

Thickness

	T	T'
U	9	21
R	9	30

(B)

Transparency

	Tr	Tr'
U	8	22
R	1	38

(C)

Weight

	W	W'
U	7	23
R	12	27

(D)

To facilitate quick reference to all the contingency tables the following reference symbols are used in the description of the tables:

R1,R2,R3,R4. These refer to Rural Tests One, Two, Three and Four respectively.

U1, U2, U3, U4. These refer to Urban Tests One, Two, Three and Four respectively.

A,B,C,D,E. These apply to various attributes used. For example RIA refers to rural test one, colour being used as a base for categorization, and so on.

(c) Calculations from contingency tables:

Calculation of x^2 values were made for all the contingency tables drawn to test for differences between rural and urban subjects in sorting according to an identified attribute. As an example, the x^2 test on RIA (Rural Test One, Colour)

$$\begin{array}{c} \\ U \\ R \end{array}\begin{bmatrix} C & C' \\ 22 & 17 \\ 15 & 14 \end{bmatrix}$$ yielded a x^2 value,

of 0.148; 1 df, critical value = 3.84 for a two tailed test. Result was not significant at $\alpha = 0.05$. Tables Five and Six give the X^2 value for all the attributes in both Rural and Urban Tests.

Table V: X^2 Test on various attributes using rural test materials

TEST	X^2 VALUE	SIGNIFICANCE	TEST	X^2 VALUE	SIGNIFICANCE
R1A	0.148	NS	R3A	0.04	NS
R1B	0.677	NS	R3B	0.04	NS
R1C	0.934	NS	R3C	0.04	NS
R1D	2.01	NS	R3D	0.76	NS
R2A	0.89	NS	R4A	1.13	NS
R2B	0.04	NS	R4B	3.21	NS
R2C	1.58	NS	R4C	0.10	NS
R2D	0.14	NS			

Table VI: X^2 Test on various attributes using urban test materials

TEST	X^2 VALUE	SIGNIFICANCE	TEST	X^2 VALUE	SIGNIFICANCE
U1A	0.03	NS	U3A	0.59	NS
U1B	0.43	NS	U3B	1.34	NS
U1C	2.48	NS	U3C	31.4	S
U1D	0.43	NS	U3D	28.8	S
			U3E	2.70	NS
U2A	0.70	NS	U4A	0.07	NS
U2B	1.58	NS	U4B	0.47	NS
U2C	1.03	NS	U4C	8.68	S
U2D	2.7	NS	U4D	0.47	NS

Note - S refers to significant result.
-NS refers to not significant result.

Calculation of percentages

Percentage of pupils who used a certain attribute were calculated for both rural and urban tests respectively. Tables seven and eight give the percentage of pupils who employed a stated attribute in their sorting for rural as well as urban materials.

Table VII: Percentage of Attribute Sortings made by Subjects in Rural Tests

ATTRIBUTE	PERCENTAGE URBAN	PERCENTAGE RURAL
R1A	51.7	56.4
R2A	55.2	43.6
R3A	32.1	33.3
R4A	100	89.8
R1B	75.9	66.7
R1D	55.2	42.4
R2B	69	66.7
R2D	89.7	92.3
R3B	85.7	84.6
R4B	93.1	76.9
R4C	65.5	69.3
R3C	71.4	61.7
R1C	44.8	33.3
R2C	31.0	46.3
R3D	53.5	38.5

Table VIII: Percentage of attribute sortings by the Subjects in Urban Tests

ATTRIBUTE	PERCENTAGE URBAN	PERCENTAGE RURAL
U1A	100	97.4
U2A	93.0	87.2
U3A	96.7	92.3
U4A	73.3	71.8
U1B	93.0	84.6
U2B	53.3	41.0
U2C	87.0	74.0
U3B	83.3	92.3
U4B	30.0	23.0
U1C	17.0	5.0
U3C	76.7	10.2
U3D	73.3	10.2
U4C	26.7	2.6
U3E	0 *	14.8 *
U4D	23.3 *	30 *
U1D	10.0 *	14.8 *
U2D	10.0 *	24.9 *

The mean number of sortings per set of materials was calculated for both groups of subjects. A test of significance between two independent means was performed to find whether or not there was a difference between the categories of pupils. Table Nine is a summary of the results.

Table IX: Comparison of Mean number of sortings

	RURAL		TESTS		URBAN		TESTS	
	Mr	Mu	Z	Significance	Mr	Mu	Z	Significance
1	2.03	2.27	0.87	NS	2.15	2.43	0.14	NS
2	2.51	2.48	1.18	NS	2.18	3.30	1.42	NS
3	2.22	2.46	1.27	NS	2.22	2.43	0.58	NS
4	3.10	2.98	0.62	NS	2.13	2.27	1.46	NS

Mr = Rural Mean

Mu = Urban Mean

A x^2 test was performed to find if there was a significant difference between the two groups with respect to their ability to use three or more bases per set of test materials in their sortings.

Table X: Comparison of Subjects in the use of three or more bases per set of test materials

TEST	R1	R2	R3	R4	U1	U2	U3	U4
Rural frequency	8	18	15	30	9	17	10	9
Urban frequency	12	15	15	20	7	15	26	13
X^2 Value	0.67	7.3	1.2	0.5	0.0006	0.55	25.4	1.08
Significance	NS	S	NS	NS	NS	NS	S	NS

RESULT FINDINGS

RURAL MATERIALS

(1) Colour All the four rural test items tested childrens' ability to sort by colour. Sorting by colour requires the use of a single hue. Colour hue was used more prominently in urban tasks than rural tasks. This was evidenced by a lower percentage in both cases who sorted rural objects by colour compared with the urban objects.

Sorting 'kal' (finger millet), 'odundu' (reeds), Nyatieng' (grinding stones) and Tache (local lamps) all yielded results which were not statistically significant in comparing the two groups use of colour as a sorting base.

Size:

In sorting materials according to size, a number of hues can be used. Some of the hues used were bigness, length, thickness all referring to size. In the tasks that were given in which millet was sorted according to stem length (R1D) and bigness (R1B); 'Nyatieng' (Stones) according to bigness (R3B); odundu (reeds) according to length (R2B) and thickness (R2C), Nyangile (lamps) according to size of lamps and size of flame, a total of eight sorting bases all yielded results which showed no statistical difference between the groups of subjects.

Shape:

One task (R3C) tested subjects ability to use the attribute of sorting Nyatieng (stones) by shape. No difference was observed between the two groups in sorting by shape.

Rare Attributes:

The most salient properties of physical objects are those of colour, shape and size. These can appropriately be referred to as the common attributes. Other properties for example weight and number are not as common and are referred herein as 'rare' attributes.

Number:

'Kal' and odundu tests could be sorted according to number of strands (fingers) and number of internodes or nodes (R1C and R2C). Similar to the other findings aforementioned, there was no difference of statistical significance between the groups.

Weight:

In all the rural sorting tasks, no statistically significant differences were observed irrespective of the sorting base used.

Comparison of means:

A test of comparison between two means was made in all four rural tasks. No differences were observed between the two groups of test subjects.

Comparison of the number of shifts per set:

The two groups were compared in their ability to use three or more bases in classificatory tasks. Except for one rural material test set (odundu test) where a significant difference was obtained in favour of the rural subjects, the rest of the results yielded no significant differences.

Urban Materials

Colour: All the four urban test materials tested the subjects use of colour to classify the materials. Colour was much more prominent in urban materials than rural materials.

The Bulbs, foam, Balls and Geometric shape sets showed no significant difference between the groups.

Size: Five Urban tasks tested subjects ability to sort by size. These were the bulbs (U1B), foams by length and thickness (U2C and U2B), Balls by bigness (U3B) and Geometric shapes by thickness (U4B). In all these tests, no differences were observed between the test groups.

Shape: Only one Urban Test (Bulbs) tested subjects sorting by shape (U1C).

No statistically significant results were observed. In the use of the 'rare' attributes (the non colour, size, shape, attributes) statististically significant differences were observed between the two groups in their use of 'pattern', bouncing or 'softness' 'transparency' in favour of urban subjects. The difference in sorting by weight was rather doubtful since the urban tests were not designed to test sorting by weight. Yet the number of rural subjects who 'felt' the weight of various items and sorted them by weight was substantial compared to urban subjects. This refers to sorting bulbs, foams, balls and transparencies by weight.

Percentage of attribute sortings:

The total number of dimensional sortings using urban materials was seventeen. Urban subjects obtained higher percentage sortings in thirteen sorting dimensions. In only four dimensions all on weight were rural percentages higher.

Comparison of means:

In comparing the mean number of sortings per test item, there were no differences between the groups in the use of urban materials.

Comparison of number of shifts per set:

In comparing the subjects in the use of three or more attributes to sort the materials, there were no observed differences between the groups in three of the test materials. Only in one urban test (foams) was the result obtained statistically significant in favour of the urban subjects.

Summary of the results:

The results obtained from the study were analyzed attribute by attribute. No differences were observed between the subjects in the use of the common attributes (colour, size, shape) to classify the materials. This was independent of the materials familiarity.

Where rural materials were used to test both groups of subjects, no differences were observed even in the use of 'rare' attributes of number and weight. But in comparing the subjects abilities in the use of 'rare' attributes such as pattern, bouncing, transparency there were differences favouring urban children except for weight. In comparing the subjects ability to classify and reclassify, that is, their ability to use three or more bases in their sorting a given set of test materials, urban subjects performed better than their rural counterparts in only one urban test (Foam Test).

Similarly rural subjects did better than urban subjects in one rural test (Nyatleng - stones). In the fifteen rural sorting bases used, rural subjects obtained higher percentages in only five of the bases. However in considering urban materials, urban subjects obtained higher percentages in thirteen of the seventeen bases. Finally no differences were obtained in the comparison of mean scores per test item between rural and urban subjects.

CHAPTER FIVE

DISCUSSION AND CONCLUSIONS

As mentioned in Chapter One, the study reported here was science - oriented and as such its objective differed from most of the studies reviewed in the thesis. These studies had their interests focused primarily on the development of classificatory abilities as well as in childrens' use of the attributes of colour, shape and size in their sortings. Besides investigating childrens' use of the three 'common' attributes in classification, other interesting classificatory dimensions used by children were considered worthwhile to warrant investigation through the use of the selected sets of test materials. Thus although a test of childrens' use of sorting dimensions like 'softness' or 'weight' may not make significant contributions towards the understanding of the development of classification, none the less their use or non use by children in their sorting tasks will help to identify the differing strategies employed by children from various backgrounds. Therefore in analyzing the results and in the discussion that followed it was found convenient to subdivide the sorting bases into two categories namely the common attributes and the rare attributes.

In view of the above statement, the hypotheses advanced in the study were supported or rejected on the basis of analyzing the performance between the groups in each attribute. The hypothesis that there would be no significant differences between rural and urban children in the use of colour, shape and size in categorizing was confirmed.

One important conclusion which arises from this study is that irrespective of materials familiarity, rural and urban children do not significantly differ in classifying concrete materials by colour, shape or size. This finding confirms those in other studies already mentioned concerning rural-urban differences in classification. The differences which were noted in these studies between children of differing backgrounds concerned the progression of classification from the perceptive towards the conceptual level.

An interesting point worth discussing is one concerning the use of colour as a base for classification. The studies of Deregowski and Serpell, Greenfield and others stressed the preponderance of colour as a sorting base amongst African children. But the study of Otaala with Teso children showed that colour did not seem to be a preponderant sorting base among the subjects to whom he administered the test. This study tends to support Otaala's conclusion. The preponderance of colour as a sorting base was found to be dependent on its prominence. Considering the use of colour in sorting urban test materials, colour, it is true, was the most salient attribute in childrens' sortings (urban: 100, 93, 96.7, 73.3%; Rural: 97.4, 87.2, 92.3, 71.8%). Even then, there were two urban tasks, sorting bulbs by size (Urban 93%, Rural 87.7%) and sorting foams by thickness (Urban 87%, Rural 74%) which had in fact higher percentages than in sorting one urban task (Geometric shapes) by colour.

Moreover performance by both groups of children in the use of colour in sorting rural materials goes on to confirm the aforementioned. Except for one rural task R4A (sorting Nyangile by colour) where percentages were (Urban 100%, Rural 89.8%) the remaining three colour sorting bases had in fact lower percentages than sorting by shape or size. In fact the only exception to this is the rural task R2D (Finger millet test) which required sorting the stems by length. It is important to point out that compared with the brightly coloured urban materials, the colour of most rural materials was considered 'dull'. It would appear that where the children do not find colour to be clearly prominent, other sorting strategies will be searched for and colour may be neglected. In other words where fine discrimination may be required in sorting objects, colour might not be identified altogether as an attribute.

In considering the use of 'rare' attributes that is the non colour-shape-size attributes in sorting both rural and urban materials, there were no differences between the groups in as far as the use of rural materials were concerned. Unfortunately only two attributes (number and weight) could be identified from the given sets of rural materials as 'rare'. No differences were noted in the use of these attributes. It may be that 'number' is not a 'rare' attribute as such since schooling influence cannot be neglected in considering childrens' use of number as a basis for classifying.

It is also possible that in learning about number and operating with numbers, both groups of children have acquired due to their schooling equal sensitivity to number as a sorting strategy, hence the reason for no observed differences.

The use of weight as a sorting base deserves some discussion too. Although a statistically significant result was not obtained in the use of weight as a sorting base except in one task, rural subjects were found to be very sensitive to weight as a sorting base. Even where the tester did not contemplate the use of weight as a sorting base, a number of rural pupils still 'sensed' weight in their sortings. For example, weight was not planned as a major sorting base in the Balls Test as well as the Foams Test. Yet in the Foams test, not only was it used as a sorting base, the result favoured rural boys! But in the rural test (The stones test) which was intentionally designed to test childrens' choice of weight as a sorting strategy, there was in fact no significant difference in performance! What might be said about this is that rural subjects seem to be more sensitive to situations where objects are compared on the basis of their weights. However, weight seems to be a phenomenon which is experienced by children from both environments as they handle, lift and move objects. It is probable therefore that due to experiences offered by their environments in manipulating objects, weight though 'rare' in the sense described here is not a sorting strategy confined to one particular environment, but it is apparent that rural subjects are more sensitive to it.

Childrens' performance in the use of 'rare' attributes to sort urban materials yielded interesting results. The rare bases were 'pattern', 'transparency' , 'bouncability' or softness. Use of these attributes in the classificatory task yielded significant differences in favour of urban subjects. The fact that urban subjects performed better than their rural counterparts in the use of these 'rare' attributes might be attributed to the fact that urban children 'tapped' their environmental experiences in their search for categorizing strategies because they had more contact with these materials and their like compared with rural children. Incidentally, rural subjects' use of these attributes scored the lowest percentages (See Table VII). A contributory factor may well be less familiarity with the materials compared with urban subjects, hence inability to exhaust all sorting bases. It is suggested that had the selection of rural materials been made which utilized many more sorting bases apart from 'number' and 'weight', differences might have been observed in the use of 'rare' attributes in favour of rural children. The findings on differences in the use of rare attributes supports the conclusion made by Dietz and George in their study on how children classify objects in which they concluded that children of differing environmental settings employed differing strategies in their classificatory tasks.

A further interesting development arose when percentages of sortings were calculated from all dimensional sortings. Although differences in percentage scores had been found to be non significant as evidenced by the x^2 test, the fact that urban percentage scores

were higher than rural in most tasks was unexpected. In classifying urban materials, urban subjects obtained higher percentages than rural pupils in most tasks (13 versus 4). This would be expected because it had been stated earlier that any differences noted would favour the subjects for whom the materials were more familiar. Consequently higher percentage scores would be expected in favour of urban subjects in sorting urban materials. This is what was found in comparing childrens' sorting of urban materials. However, when the percentage scores obtained by subjects were analyzed in their performance with rural materials, a different situation arose. Rural subjects would have been expected to obtain higher percentages than urban pupils in most rural sortings. Yet despite familiarity with three of the four rural test materials sets, rural subjects obtained higher percentages in only five of the tasks. A pertinent question arose: Why despite familiarity with rural materials were urban percentages still higher in ten out of the fifteen sorting dimension? This is a significant question to which a satisfactory answer is necessary. An attempt was made to answer this question. It is suggested that either the choice of rural materials was not as biased towards rural subjects as urban materials were towards urban subjects or else it would seem as if the urban environment inculcates into urban subjects certain experiences which the rural environment lacks which make urban children better sorters. Thus the overall better percentage scores in most sorting dimensions by urban subjects prompts the writer to state that even though no significant differences were observed between the groups in most

sorting dimensions, perhaps more sensitive test designs need to be undertaken to expose differences at a level other than the concrete level of classification. Assuming that urban subjects are overall better sorters, it appears that contact with the urban environment gives a child an additional 'something' which the rural environment might not give. The additional 'something' may be the ability to make finer discrimination when confronted with materials to sort. If rural pupils could be considered "culturally disadvantaged" in the sense that most products of western culture to which urban children are used are not readily available to them in number and variety, it may be said that they exhibit a recuced analytic power in analyzing categoric relationship, a hypothesis reported by Raven and attributed to Brown. However, it is premature to support such an hypothesis. What might be reasonably said from this study is that urban subjects seem to be better at sorting concrete materials even though this difference is not statistically significant.

A further test of comparison was made between the groups in their ability to classify and reclassify a given set of materials. It was felt appropriate to know whether the ability to search for sorting strategies differed between the groups and whether familiarity as a factor influenced it or not. Irwin and Maclaughlin had shown in their study of Mano people that familiarity with materials enhanced the ability to find other sorting bases. Rural Mano adults who were previously unable to find more than one sorting base in their sorting tasks, were able to reclassify because of familiarity with materials. In an attempt to find out in this study if familiarity or non-

familiarity had an influence in childrens' ability to reclassify, an arbitrary criterion of three or more sorting bases was set. The fact that nearly all the children found more than one sorting base implied that they were capable of reclassification. Working on the assumption that the criterion for testing childrens' reclassification was the use of three or more bases in a given set of test materials, the critical point was to find whether or not rural subjects differed from urban subjects in reclassification test. The reclassification test, it was felt, was a significant component of the study because it would give some indication about childrens' potential to extract details from their science activities. There were two guiding points in choosing at least three sorting dimension to test reclassification. First it was assumed that every subject was capable of using at least three attributes of colour, shape and size in their sortings. Secondly, when a look at the distribution of each pupil's total responses in each set was made, it was observed that only a few candidates had employed two or less attributes in their classification. At the other end, few pupils went beyond four attributes. For this reason it was felt appropriate to establish the criterion of at least three attributes. Looking at performance with rural materials, there was a significant difference in only one set of materials out of the total set of four. The difference was in favour of rural subjects. The set at issue was the 'odundu' set. On the other hand urban subjects performed significantly better than rural subjects in the Balls Set.

These results are not strong enough to base conclusions about the influence of materials familiarity on reclassification. But it would be reasonable to advance two main reasons for justification of the fact that in most of the material sets, no differences were observed. Either due to comparable schooling experience and its effect on reclassification, no differences were exposed or the type of tests given at the concrete mode were not sensitive enough to expose such differences. There is an inclination to express the feeling in concurrence with Greenfield's study of Wolof children that probably the influence of schooling becomes a significant factor making enormous contributions in shaping childrens' classificatory strategies. Belsheuvel also pointed out the role of schooling on childrens' performance in some formally administered tests.

In concluding the discussion, it is worth stating that no attempts were made to study the effect of familiarity on classification at the abstract level. This is an interesting aspect of the study of classification that could be undertaken. Its study may expose differences between children of the two environments in some aspects of classification. The overriding consideration here was to try to create an atmosphere as close as possible to childrens' involvement in a science activity. The basis for science in the primary school at the lower level is with playing, handling and manipulating materials.

Such childrens' practical activities are of great interest to science teachers and educators. Hence, studying children actually working with the materials was considered important.

IMPLICATIONS OF THE STUDY

Childrens' interaction with their environments forms the foundation of learning science. This view is stressed by Savory (1968, p 119) in the statement:

> All science in the Primary School should be essentially a practical investigation of the environment.

In the learning of science, the types of materials available in the childrens' environment contribute significantly towards their learning of science. It is apparent that children from differing environments use different classificatory strategies in their tasks. It is therefore important for class teachers to diversify the type of materials used in classification activities to make children search for unfamiliar sorting strategies. Although childrens' classification of real objects using the bases of colour, shape and size seems unaffected by the type of materials, the ability to search for 'rare' sorting strategies is likely to be improved when children are given 'rare' materials to sort. George and Dietz also attest to the view concerning differences in classificatory strategies. Hence the most appropriate procedure in furthering experiences in classification would be to ensure that locally based

materials are initially introduced and then followed by 'new' materials. Children are likely to utilize their experiences to the full when classifying materials they are familiar with at first than otherwise. But it is equally important to give children practical experience in the use of unfamiliar sorting bases irrespective of whether the type of environment they live in affords the opportunity to use such bases. Moreover, contrary to the belief held by many primary school teachers that the rural environment is not conducive to learning of science, it is important to point out that both categories of children are likely to perform equally well in one area of science activity namely classification if their respective environments are utilized. In other words, teachers particularly rural teachers should come to appreciate that lack of commercially produced apparatus is not a barrier to effective teaching of science. This is a cardinal point to be borne in mind by teachers.

RECOMMENDATIONS FOR FURTHER RESEARCH

In order to conduct the study reported here, some limitations were imposed. There were good reasons for such limitations although other educationally useful information might have been sacrificed by such restrictions. First the study was confined to one sex only, namely the boys. Secondly, the children were tested in classification at the concrete level. Thirdly, a particular age group was tested. Although through such restrictions some variables were controlled, it is suggested that follow up studies would be useful to science teachers to find out how various groups of children compare in their classificatory tasks.

Rural girls could be compared with urban girls in these tasks. Another interesting area would be to compare the performance of boys with that of girls. This should not be seen as mere academic exercise. The study of Roland (1968) for example observed that there were differences in science background experience between boys and girls with boys having a definite lead. It is equally important for improved science teaching in Kenya Primary Schools to find out how boys and girls compare in various areas of science experience. Differences (if any) revealed by such studies could be noted and steps taken to minimize them.

Observation and classification are two closely related cognitive processes. Classification of concrete materials cannot be effected without careful visual observation. The basis of science rests with the ability to observe as emphasized by Martin (1969,p.101) when he says "it is generally agreed that in teaching of science, observation is crucial". In view of this, the close association between observation and classification makes it worthwhile to study childrens' observation abilities.

CONCLUSION

Investigation of classification as a process skill in science was justified on the grounds that it is an important component of cognitive functioning. The findings of this study are in conformity with those of other investigators with the exception of a few variations. The choice of colour as the most widely used sorting attribute was found to be dependent on its prominence as shown by the urban materials.

However, it was also found that the likelihood of colour being the most widely used attribute was questionable as evidenced through classifying rural materials. In fact colour was likely to be neglected altogether in the search for other classificatory bases.

The factor of materials familiarity was found to be insignificant in sorting real physical objects by colour, shape and size. But where the search for 'rare' sorting strategies was required, it did seem that the ability to extract and to use such attributes for classification was intrinsically tied with the childrens' familiarity with the materials. Since the rare strategies identified from the given test materials were few, it would be beneficial for the cause of increased understanding of the concept of classification if further studies were conducted to find answers to such issues.

This study found that although in most of the sorting dimensions used, comparison of urban with rural subjects showed insignificant differences, urban children obtained marginally higher percentages in most sorting tests. This result was observed irrespective of whether the materials were urban or rural oriented. On this basis it was reasonable to conclude that urban children seemed to be better sorters even if this difference was not found to be significant. Finally the ability to reclassify based on the criterion of chosing at least three sorting dimensions was found too, to be unaffected by the types of material used. In only one set of materials was it found that one group did better than the other, and vice versa.

Kenyan children learning in differing environmental settings will constitute the scientists of to-morrow. The science activities they engage in should utilize their respective environments to the full. Considering the area of classification specifically, children need to be offered wide variety of materials to widen their classificatory experiences to include materials which challenge them to search 'hidden' sorting strategies. The environment is at the disposal of teachers, ready to be tapped to further childrens' learning. Lack of commercially produced materials (though they have a place in science) does not imply ineffective teaching. Only when the crucial role played by a child's environment in his learning is realized by both science educators and teachers, will the scientists of tomorrow be competently and effectively taught.

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ey, P.R., "A cross - [illegible]
ity in Australia" in [illegible]
ure and Cognition: [illegible]
, Methuen and Co. [illegible]

ey, W.H., A devel[illegible]
hildren. Child [illegible]

8. Dent, GR., "An investigation into applicability of certain performance and other mental tests to Zulu children Educational adaptation in a changing society". Quoted in Price Williams, DR. (Ed) Cross-Cultural Studies, 1969.

9. Deregowski,J.B and Serpell R, "Performance on a sorting task with various modes of presentation: A cross-cultural experiment". In Cole M and Scribner S., Culture and Thought, John Willey, 1964, New York. p. 115.

10. Evan, J. and Segall M., Learning to classify by colour and function: A study of concept discovery by Ganda children. Journal of Social Psychology, 1969 pp. 35 - 53.

11. Frazer, D. Home Environment and the School. University of London Press, 1973 (Third Imp.) London, pp. 1 - 7.

12. George D.K and Dietz M.A., How do children classify Objects. Journal of Research in Science Teaching Vol. 8 1971 (3), pp 277 - 282.

13. George D.K and Dietz M.A., An experimental Comparison of Urban with Suburban children in Eight tasks of basic skills, Journal of Research in Science Teaching, Vol 6; 1969 (3), pp. 224 - 233.

14. Greenfield P.M,Reich, E. and Olver R, "On culture and Equivalence II "In Bruner et al, Studies in Cognitive Growth, John Willey, 1966 pp.

5. Hedges, H.G. "The teaching of Science in Elementary School". Education Vol. 4, 1960 - 1962, pp 63 - 68.

6. Irwin, MM and MacLaughlin D.M; Ability and preference in category sorting by Mano School children and adults. Journal of Social Psychology, 1970 (82) pp. 15 - 24.

7. Johnson R., The process of categorizing in high and low socio - economic status children. Science Education, Vol. 57 (No.1), 1973, pp. 1 - 6.

8. Kenya Institute of Education, Guidelines for Teaching Science (Std. IV) 1974, Jomo Kenyatta Foundation, pp. 1 - 3.

9. Klein R.E and Lester B.M., The effect of stimulus familiarity on conservation performance of Rural Guatemalan children. Journal of Social Psychology, 1973 Vol. 90 pp. 197 - 205

10. Kofsky E., A scalogram study of classificatory Development. Child Development, 1966 Vol. 37, pp. 191 - 203.

11. Lee, E., New Developments in Science Teaching Wordsworth Publishing House Co, 1967 pp. 19 - 29.

12. Lewis J, and Potter., The Teaching of Science in Elementary School 1962.

13. Lloyd, B.B., Studies in conservation among the Yoruba children of differing ages and experiences. Child Development 1971, Vol. 42 pp. 415 - 428.

24. Maccoby,M. and Modiano,N. "On culture and Equivalence I" In Bruner et al. Studies in Cognitive Growth, John Willey 1966, pp. 257 - 269.

25. Martin M, Concepts of Science Education Scott, Foresman & Co. (1969) p. 101.

26. Okonji, O.M., "The effect of familiarity on classification". Berry J.W. and Dasen P.R. (Ed), Culture and Cognition, 1974

27. Otaala B., The Development of Operational Thinking in Primary School Children, 1973. Teachers College Press. Columbia University. New York.

28. Piaget, J. and Inhelder, B., The Pschology of the Child Translated by Hellen Weaver.Routledge and Kegan Paul 1969 p. 102 - 104.

29. Price William, D.R., Abstract and concrete modes of classification in a primitive society. British Journal of Educational Psychology. Vol. 32, 1962, pp. 50 - 61.

30. Raven R.J., The development of classification abilities in culturally disadvantaged children. Journal of Research in Science Teaching Vol. 5, 1967 - 68, pp. 224 - 229.

31. Sharp D.W. and Cole, M. (unpublished experiment) Reported in Cole, M., and Scribner, S. Culture and Thought. John Willey, 1964 pp. 106 - 107.

32. Science Education Programme for Africa. (1974) SEPA Publication pp. I - 7.

33. Serpell R., Selective attention in children, Bulletin of the Institute of Social Research, University of Zambia, 1966 pp. 37 - 41.

34. Shlomo, S. and Weller L. Classification patterns of underprevliedged children in Israel. Child Development 1971, Vol. 42 (2), pp. 581 - 592.

35. Suchmann R., Cultural differences in childrens' colour and form perception. Journal of Social Psychology, 1966, (70) pp. 3 - 20.

36. Tam, T., et al, Plagets concept of classification. A comparative study of socially disadvantaged and middle class young children. Child Development, 1971, Vol. 42 (No. 2), pp. 919 - 927.

37. Vygosky L.S. Thought and Language. Translated by E. Haufmann & Vakar G, MIT Press, 1962.

38. Weiss, J., Science in Africa, Africa Report, 1968.

APPENDIX

RESPONSES BY RURAL

PUPILS' NO	SET ONE C	S	N	L	SET TWO L	T	C	N	A
1		x			x	x	x		
2	x	x			x	x	x		
3		x	x		x			x	
4	x	x			x	x	x		
5			x		x	x			
6		x			x	x		x	
7		x			x	x		x	
8		x			x	x			
9		x			x	x			
10	x	x			x	x			
11	x	x			x	x	x		
12	x	x				x	x		
13	x						x		
14			x	x	x				
15	x	x	x		x	x		x	
16	x	x	x		x				
17	x	x		x	x		x		
18	x	x	x	x	x	x	x		
19		x		x	x	x			
20	x			x	x				

PUPILS' NO	SET ONE C	S	N	L	SET TWO L	T	C	N	W	SET THREE S	Sh.	C	W	SET FOUR W	C	S	F/S	W
21		×	×		×	×	×	×		×	×				×	×	×	
22		×	×	×	×			×		×	×				×	×	×	
23		×		×	×	×		×		×	×		×		×	×	×	×
24	×				×	×		×		×		×			×	×		
25	×			×	×	×		×		×					×	×	×	×
26		×			×			×		×	×		×		×		×	×
27					×	×				×					×	×	×	×
28	×	×	×		×	×	×			×	×	×			×			×
29	×	×	×	×	×			×	×	×	×	×					×	×
30	×	×			×	×				×		×			×	×		
31		×			×	×				×	×				×			
32							×	×		×					×	×		
33	×				×		×	×		×	×	×			×	×		
34	×		×		×				×	×	×				×	×	×	×
35		×	×		×	×	×			×	×	×			×	×	×	
36	×				×	×	×	×		×	×					×	×	×
37	×				×				×	×	×	×			×	×	×	
38	×		×		×				×	×	×		×		×	×	×	
39	×	×	×		×	×	×	×		×	×				×	×	×	

APPENDIX II

RESPONSES BY URBAN PUPILS IN RURAL TESTS

	SET ONE				SET TWO					SET THREE				SET FOUR				
PUPILS' NO	C	S	N	L	L	T	C	N	W	S	Sh.	C	W	W	C	S	F/S	Q
1	×			×	×	×		×		×					×	×		
2		×	×	×	×	×	×			×	×		×		×	×	×	×
3		×	×	×	×	×	×			×			×		×	×	×	×
4		×	×		×	✗	×			×	×		×		×	×		
5	×	×		×	×	×				×	×	×	×		×	×	×	
6	×	×		×	×	×		×		×	×	✗			×	×	×	
7	×	×		×	×	×	×			×	×		×		×	×	×	×
8	×	×	×				×					×			×	×		
9																		
10	×				×		×			×	×				×	×		
11	×	×		×			×	✗	×	×	×		×		×	×	×	×
12	×			×	×		×			×	×				×	×	×	×
13	×	×		×	×	✗				×	×		×		×	×		
14	×	×			×	×							×		×	×	×	×
15		×		×	×					×	×	×			×	×		
16		×		×	×	×									×	×		
17	×					✗	×			×	×	×			×	×		
18	×				×	×					×	×	×		×	×		
19	×	×			✗	×	✗			✗	×		✗		✗	×	×	
20				×	×	×	✗	✗		×	×		×			×	×	
21		×	×		×	×	×			×	×		×			×	×	

PUPILS' NO.	SET ONE C	S	N	L	SET TWO L	T	C	N	W	SET THREE S	Sh.	C	W	SET FOUR W	C	S	F/S	Q
22		×	×	×	×			✗		×	×				×	×	×	
23		×	×		×	×				×					×	×		
24		×	✗		×			✗		×					×	×		
25		×	✗		×	×	×	✗		×		×	×		×	×	×	×
26	×		×		×		×			×	×	×	×	✗	×	×		
27		×			×	×		✗		×	×				×		×	
28		×	×	×	×	×		✗		×	×				×	×		
29		×	×	×	×		×	×		×		×			×	×		
30	×	×	×	×	×	×	×				×		×		×		×	×

APPENDIX III

RESPONSES BY URBAN PUPILS IN URBAN TESTS

PUPILS'	SET ONE				SET TWO				SET THREE				SET FOUR				
NO	C	S	Sh.	Wt.So.	C	T	S	W	C	S	P	S/B	C	Sh/S	T	Tr.	W
1	×	×			×	×	×			×	×	×	×	×			
2	×	×			×	×			×	×	×	×	×	×		✘	
3	×	×			×	×	×		×	×		×		×		✘	×
4	×	×			×	×			×	×	×	×	×	×			
5	×	×			×	×			×	×		×	×	×	×		
6	×	×			×	×	×		×	×	×	×	×	×		✘	
7	×	×			×	×	×		×	×	×	×		×	×	×	×
8	×	×			×	×			×	×			×	×			
9	×	×	×			×			×	×			×				
10	×		×		×				×	×	×						
11	×	×		×	×	×		×	×	×	×	×		×		×	×
12	×	×	×		×				×		×	×	×	×			
13	×	×			×	×			×		×	×	×	×	×		
14	×	×			×	×	✘		×	×	×	×		×			
15	×	×			×	××			×	×		×	×	×	×	✘	×
16	×	×		×	×	×	×		×	×			×	×			×
17	×	×	×		×	×	×		×	×	×		×	×			
18	×	×			×	×	×	×	×	×	×	×	×	×			×
19	×	×			×	×	×		×	×	×	×	×	×			
20	×	×			×	×	×		×	×	×	×	×	×	×	✘	
21	×	×			×	×			×	×	×	×	×	×			×

	SET ONE					SET TWO				SET THREE				SET FOUR				
PUPILS' NO.	C	S	Sh.	Wt.	So.	C	T	S	W	C	S	P	S/B	C	Sh/S	T	Tr.	W
22	×							×		×		×	×	×	×			
23	×					×	×			×	×		×		×		×	
24	×	×				×	×			×		×		×				
25	×	×	×			×	×	×	×	×		×	×	×	×		×	
26	×	×			×	×	×	×		×	×	×	×	×	×			
27	×	×				×	×	×		×	×	×			×		×	
28	×	×				×	×			×	×	×			×			×
29	×	×				×	×			×	×	×	×	×	×			
30	×	×				×		×		×	×	×	×		×		×	

APPENDIX IV

Responses by Rural Pupils In Urban Tests

	SET ONE					SET TWO				SET THREE					SET FOUR				
PUPILS' NO	C	S	Sh.	W	Sn.	C	T	S	W	C	S	P	S/B	W	C	Sh/S	T	Tr.	W
1	×					×	×		×	×	×				×	×			
2	×				×	×	×	×	×	×	×			×	×	×			
3	×					×	×	×		×	×					×			×
4	×	×				×			×	×	×				×	×			×
5	×	×								×	×								
6	×	×			×	×	×		×	×	×					×			
7	×	×			×	×	×		×	×	×			×		×			×
8	×					×					×						×		
9	×	×				×				×	×					×	×		
10	×	×				×	×			×	×					×	×		
11	×	×				×		×		×	×				×	×			×
12	×	×				×	×			×	×					×			
13	×	×								×	×					×			
14		×			×		×			×	×					×		×	
15	×	×				×	×			×	×				×	×			
16	×	×				×	×			×	×				×	×			
17	×	×				×	×	×		×	×				×		×		
18	×	×			×	×	×				×				×	×			
19	×	×				×	×				×				×	×			
20	×	×		×		×	×			×	×	×			×	×			
21	×	×		×			×	×		×	×			×	×	×	×		

	SET ONE				SET TWO				SET THREE					SET FOUR				
PUPILS' NO.	C	S	Sh.	W	Sn.	C	T	S	W	C	S	P	S/B	W	C	Sh/S	T	Tr.	W
22	×	×		×		×	×		×	×	×			×		×			
23	×	×		×		×	×		×	×	×				×		×		
24	×	×				×	×	×		×	×				×	×	×		
25	×	×	×			×	×	×		×	×			×	×	×			×
26	×	×				×	×			×	×				×	×			×
27	×	×				×	×	×	×	×	×				×				×
28	×	×				×	×	×		×	×				×	×			
29	×	×	×				×	×		×	×				×	×			
30	×	×				×			×	×	×				×	×			×
31	×					×	×	×		×	×				×				×
32	×	×				×				×					×	×			
33	×	×		×		×	×	×	×	×		×	×	×	×	×			
34	×	×		×		×	×			×	×		×		×	×	×		×
35	×	×				×	×	×		×	×				×	×	×		
36	×					×				×		×	×		×				×
37	×	×				×		×		×	×	×			×	×			
38	×	×				×	×	×		×	×				×	×			×
39	×	×				×	×	×		×	×	×			×	×			

APPENDIX 5

RURAL MATERIALS

Subjects number of sortings per set of test materials

(Rural Materials)

	URBAN SUBJECTS				RURAL SUBJECTS			
NO	MATERIAL SETS				MATERIAL SETS			
	1	2	3	4	1	2	3	4
1	2	3	1	2	1	3	3	3
2	3	3	3	4	2	3	3	3
3	3	3	2	4	2	2	2	4
4	2	3	3	2	2	3	3	3
5	3	2	4	3	1	2	3	4
6	3	3	3	3	1	2	2	2
7	3	3	3	4	1	3	2	4
8	3	1	1	2	1	2	2	2
9	-	-	-	-	1	2	2	3
10	1	2	2	2	2	2	2	3
11	3	3	3	4	2	3	2	4
12	2	2	2	4	2	2	2	4
13	3	2	3	3	1	1	1	2
14	2	2	1	4	2	1	2	3
15	2	1	3	3	3	3	3	3
16	2	2	-	3	3	3	2	3
17	1	2	3	2	3	3	2	4
18	1	2	3	3	4	2	2	2
19	2	3	3	4	2	1	3	4
20	2	4	3	3	2	3	2	4
21	2	3	3	3	2	4	3	4

NO	URBAN SUBJECTS MATERIAL SETS				RURAL SUBJECTS MATERIAL SETS			
	1	2	3	4	1	2	3	4
22	3	2	2	3	3	2	2	3
23	2	2	1	2	2	3	3	4
24	1	2	1	2	1	4	2	2
25	2	3	3	4	2	3	1	4
26	2	2	4	2	1	2	3	3
27	1	3	2	2	-	2	1	4
28	3	3	2	3	3	3	3	2
29	3	3	2	3	4	3	3	3
30	4	3	2	3	2	2	2	2
31					1	2	2	2
32					-	2	1	2
33					1	3	3	3
34					2	2	2	4
35					2	3	3	3
36					1	4	2	3
37					1	2	3	4
38					2	2	3	4
39					4	4	2	3
40								

APPENDIX 6

URBAN MATERIALS

Subjects responses in each of the four urban tests

(Urban Materials)

NO	URBAN SUBJECTS MATERIAL SETS				RURAL SUBJECTS MATERIAL SETS			
	1	2	3	4	1	2	3	4
1	2	3	3	2	1	3	2	2
2	2	2	4	3	2	4	3	2
3	2	3	3	3	1	3	2	2
4	2	2	4	2	2	2	2	3
5	2	2	3	3	2	-	2	-
6	2	3	4	3	3	3	2	1
7	2	3	4	4	3	3	3	2
8	2	2	2	2	1	1	1	1
9	3	1	2	1	2	1	2	2
10	2	1	3	-	2	2	2	2
11	3	3	4	4	2	2	2	3
12	3	1	3	2	2	2	2	1
13	2	2	3	3	2	-	2	1
14	2	3	4	2	2	1	2	2
15	2	3	3	4	2	2	2	2
16	3	3	2	3	2	2	2	2
17	3	3	3	2	2	3	2	2
18	2	4	4	3	3	2	1	2
19	2	3	4	2	2	2	1	2

NO	URBAN SUBJECTS MATERIAL SETS				RURAL SUBJECTS MATERIAL SETS			
	1	2	3	4	1	2	3	4
20	2	3	4	4	3	2	3	2
21	2	2	4	3	3	2	3	3
22	1	1	3	2	3	3	3	1
23	1	2	3	2	3	3	2	2
24	2	2	2	1	2	3	2	3
25	3	4	3	3	3	3	3	3
26	3	3	4	2	2	2	2	3
27	2	3	3	2	2	4	2	2
28	2	2	3	2	2	3	2	2
29	2	2	4	2	3	2	2	2
30	2	2	4	2	2	2	2	3
31					1	3	2	2
32					2	1	1	2
33					3	4	4	2
34					3	2	3	4
35					2	3	2	3
36					1	1	3	2
37					2	2	3	2
38					2	3	2	3
39					2	3	3	2
40								

APPENDIX VII

Part One

(Test of familiarity procedure Translated from Luo)

Tester: (To the subjects): You have been looking and handling some of these materials for some minutes. May be you know some of them and may be you dont.

Let us start with this one (Tester points to an item such as Have you ever seen it? reed).

Subject: Yes or No

Tester: Is it easily found in your area at home or outside?

Subject: Yes or No

Tester: Do you know what this object is used for?

Subject: Yes or No

Tester: When did you last see, handle or use this thing? Yesterday? A long time ago?

Subject: Explains.

Part Two

Tester: I have brought some materials again I want you to play with them. All you need to do is to examine them carefully. Afterwards I shall call you one by one to ask you some questions about these things. You had of course seen them and stated whether they were easily available in your area or not. Right go on (Teacher goes round trying to learn the names of the pupils. Pupils continue examining the materials during the alloted time).

Part Three

Individual Testing

Testor: Right Nyadiera (attempts to call subject by name) I have three things and I want to give you a short time in which to handle them. Go on! Touch them, feel them. Allow a brief pause I want you to put any two of the three things together and to state why you put the two together. (Tester demonstrates with geometric shapes and asks the subject to state reason why the tester put the two together). Subject tries. Now then, use those three things (stones) by putting any two together according to your own way, not what I want. Do it the way you see them not how I see them.

Subject: makes an attempt.

Tester: Why have you put those two together?

Subject: responds

Tester: Lets put the three object together again,
Now think of another way of putting any two of the objects.

Subject: responds

Tester: Find as many other ways as possible

Subject: proceeds