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CANADIAN THESES ON MICROFICHE | THÈSES CANADIENNES SUR MICROFICHE

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TITLE OF THESIS/*TITRE DE LA THÈSE* MACRO-MICRO EXAMINATION OF ACHIEVEMENT OF SIXTH GRADERS IN NIGERIA

UNIVERSITY/*UNIVERSITÉ* UNIVERSITY OF ALBERTA

DEGREE FOR WHICH THESIS WAS PRESENTED/ *GRADE POUR LEQUEL CETTE THÈSE FUT PRÉSENTÉE* Ph. D

YEAR THIS DEGREE CONFERRED/*ANNÉE D'OBTENTION DE CE GRADE* 1978

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THE UNIVERSITY OF ALBERTA

MACRO-MICRO EXAMINATION OF ACHIEVEMENT OF SIXTH GRADERS IN NIGERIA

by

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF EDUCATIONAL PSYCHOLOGY

EDMONTON, ALBERTA

FALL, 1978

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE SUTDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a Thesis entitled

MACRO-MICRO EXAMINATION OF ACHIEVEMENT OF SIXTH GRADERS IN NIGERIA

submitted by CLEMENT C. NWIGWE in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

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Date

External Examiner

DEDICATION

To my wife Ulonma

and

my children Ozi
Ada
Chidi
Chinasa

ABSTRACT

The purpose of the present study was to use repeated measurements design to examine achievement with a view to investigating the differences between rural-urban environments and also between males and females. Sixth graders in Nigeria were asked to answer newly made tests in Mathematics and English at the first three levels of Bloom's Taxonomy of Educational objectives, Handbook I, Cognitive Domain. These were: Knowledge, Comprehension and Application.

Bearing in mind the assertion of Bruner and his associates, that rural life is not conducive to symbolic representation and abstraction, it was expected:

1. That differences in performance between the two environmental groups would become more conspicuous as the level of cognitive functioning became more complex.
2. That differences due to sex would favour boys in Mathematics and girls in English.

The sample consisted of 292 boys and girls from two urban and three rural schools. The five schools were randomly selected from a population of 452 schools in parts of Eastern Nigeria. Coincidentally, there were equal numbers of boys and girls from the rural, as well as from the urban schools. Two tests, one in Mathematics, the other in English, were administered to the children. A questionnaire was also administered, but the responses were used for descriptive

purposes only.

The design contained four factors, two of them providing repeated measures. They were:

(a) Rural-Urban environments.

(b) Sex.

(c) Cognitive levels, comprehension and application as expounded by Bloom et al.

(d) Items based on levels of C.

Factors A and B were classificatory, while factors C and D provided the repeated measures.

The major findings of the study were as follows:

1. There was significant difference due to environment. The differences increased as levels of cognitition became more complex. This was so both in Mathematics and English.
2. There was no significant sex difference in Mathematics, but in English, girls did better.
3. There was interaction between environment and levels of cognition in both the subject matter areas.
4. Certain items in Mathematics as well as English were found to interact with environment. Fractions in Mathematics, and Comprehension items in English were highly significant in favour of urbanites.

Some implications of the study for teaching were discussed. Suggestions for further research were made.

ACKNOWLEDGEMENTS

The preparation of this thesis involved the devoted labours and helpful suggestions of many people. I would like all those mentioned here to accept it as a sincere expression of my appreciation and indebtedness for the parts they played to make this study possible.

My Wife Ulomma, whose thoughtfulness and support encouraged me to undertake this study.

My Supervisor, Dr. R.K. Gupta, for his constructive criticism and direction at every stage of the study.

The members of my Committee, Dr. V. Nyberg, Dr. B. Sinha, Dr. W.H.O. Schmidt and Dr. C. Yewchuk for their very useful suggestions, and Dr. Mary T. Howard, of the University of Minnesota, for consenting to be my external examiner.

The Ministry of Education, Imo State, Nigeria and the Department of Educational Psychology, University of Alberta, for financial assistance.

Mr. T.C.U. Agu, Principal of Uwani Secondary School, Enugu, Mr. S.C. Nwabeze of the Ministry of Education, Owerri, and the staff and students of the participating schools for helping with the data.

Rev. Father G. Ochiagha, Ph.D.; my parents, Matthew and Catherine; parents-in-law, Patrick and Gertrude Omenukor for their constant prayers and encouragement.

Finally, my children, Ozi, Ada, Chidi and Chinasa who

'stood and waited'. My little darlings the work has been completed.

From me to all of you, it is thanks and God bless.

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CHAPTER I

INTRODUCTION

Background to the Study

Over the years, research psychologists have been investigating cognitive and non-cognitive variables in relation to students' academic achievement. In the former category, emphasis has been largely on ability measures as predictors of achievement. Lately, however, several studies seem to have been directed to non-cognitive variables in the continuing effort to explain differences in achievement.

Several researchers, for example, have found that differences in school achievement are partly attributable to sex (Brimer, 1969; Carey, 1958). Others have come to similar conclusions about rural-urban environment. In this respect, Bruner and his co-researchers argue that the difference lies mainly in symbolic representation. Rural life is conducive neither to the development of symbolic representation nor to abstract thinking (Bruner, et al., 1966; Price-Williams, 1962).

One can easily examine differences in academic achievement between defined groups when the criterion used is "macro achievement" or total test scores of the groups being compared. This is what most researchers have done so far. Probably different or more informative conclusions can be arrived at, by using "micro achievement" of the same

groups on the same tests. For example, the experimenter could investigate achievement differences by using "sub scores" and "item responses" on the test as his criterion measures, instead of total scores.

Furthermore, certain non-cognitive variables likely to have bearing upon achievement could be investigated. These variables include parental, peer and teacher relationships, motivational variables and school and environmental facilities.

In fact, further refinement in analytical procedures can be attempted. For example, using individual item responses rather than the total or sub-scores, one can also examine item interactions. These additional findings may enrich our understanding of achievement differences.

A major objective of this study is to improve upon the work of previous researchers who limited the application of analysis of variance to total test scores. Since achievement is a very complex variable and there are various ways to describe it, one of them being the six levels expounded in Bloom's (1956) Taxonomy, researches need to be directed to the examination of achievement differences on each of these levels, rather than consider achievement as a single, simple, global variable.

Another possible contribution of this study may be the fact that it is being conducted on a Nigerian population. Previous studies by Gay and Cole (1967) on learning among the Kpelle in Liberia, Price-Williams with

Tiv children in Nigeria (1961, 1962), Schmidt and Nzimande among the Zulus (1970), and Greenfield among Wolof children in Senegal (1966), emphasize the desirability of cross-validating research findings from Western cultures on populations from developing countries.

The Problem

In view of the cultural, economic and other differences between urban and rural communities and their relevance to school facilities, learning opportunities and student expectations, as well as teacher competencies, students in rural areas may perform differentially as compared to those in urban areas at the various levels of Bloom's Taxonomy. This may specially be the case in Nigeria, where the contrast between urban and rural life is great. In the city,

> one can find the accoutrements of Western industrial life; in the rural village, no matter how close, there is virtually none. School represents a new world of culture, of thinking and behaviour and even of religion (Greenfield, 1966, p. 227).

The writer is not aware of any study which may have been undertaken to find achievement differences at different levels of Bloom's Taxonomy, related to sex and interaction of these variables with achievement, as far as Nigeria is concerned. The present study may be the first in this respect.

The study may also generate interest in two other aspects. One is the application of repeated measurements design to individual test items, whereby each item is used as

a criterion variable. Gupta's study (1967) illustrated the potential of this approach. Other researchers whose studies have incorporated this idea include Eysenck (1967), Cole and Bruner (1971), Estes (1974) and Angoff and Ford (1971). These researchers have emphasized that analyses of total test scores do not adequately explain differences in achievement.

The second is the application of repeated measurements design to sub-scores, whereby sub-scores on selected levels of Bloom's Taxonomy will provide the criterion measures. Support for this procedure can also be found in the above quoted studies, as well as in that of Cochran (1950).

The present study incorporated the following classificatory factors in the design.

A. Environment: rural-urban.

B. Sex: males and females in Grade six in Nigeria.

C. Scores on Knowledge, Comprehension and Application (Bloom's Taxonomy), furnishing repeated measurements at the intermediate level.

D. Items at each of the three levels of C, used as repeated measures at the most elemental or micro level.

Achievement was in the areas of English and Mathematics. Separate but parallel analyses were done for the two subjects. Using the above variables, the study sought to provide answers to questions such as:

1. Are there sex and rural-urban differences when "total," "sub-total" and "item-scores" are used as criteria for measuring achievement in Mathematics?
2. Are there similar differences in English?
3. Do these variables (sex and rural-urban environment) interact with achievement examined in three different ways?

The scope of the research was widened by using a questionnaire. Family background, school facilities and motivational variables have been found by earlier researchers to impinge on students' achievement (Douvan, 1956; Empey, 1956; Alexander, 1964; Brantley, 1969; Bush, 1954). These variables were included in the questionnaire and the results used descriptively to elaborate on the results of the main analyses.

Significance of the Study

Earlier studies, especially of twins and siblings, crosscultural studies of groups of individuals under contrasting conditions, have yielded evidence in support of the influences of environment on the development of cognitive behaviour. Others failed to substantiate the same (Price-Williams, 1962). These conflicting results may be due to locale and the type of measuring instruments used by the experimenter.

Also, studies which used ANOVA as their basic tool, used total test scores as the criterion. The major contributions of the present study may be stated as follows:

1. This is the first study of its kind to be conducted on a Nigerian population. As one connected with the educational system of Nigeria, the writer hopes that the findings will help educators in that country.
2. The study investigated the interaction of environment and sex with the first three levels of achievement as expounded in Bloom's Taxonomy. The findings may lend support to Bruner's, et al., theory of cognitive development.
3. It may lead to certain findings which may have educational implications in Nigeria. It is hoped that such findings will be useful to curriculum builders, teacher educators and educational administrators.
4. The study may enhance the understanding of student achievement through the use of methodological refinements in examining achievement. This is accomplished by the application of repeated measurements design to individual test items and sub-scores at the first three levels of Bloom's Taxonomy.
5. As a corollary from No. 4 above, the findings will have a direct bearing on test development. In order to construct achievement tests, repeated measurements design applied to individual test items could be utilized to select suitable test

items which are relevant to the socio-economic level and environment of school children in Nigeria.

6. Within the area of objective testing, multiple choice questioning is receiving increased attention. The teacher can develop this aspect of his testing program by using the findings of this study to increase the accuracy, discriminating power and validity of each test item that he uses.

The next chapter reviews relevant literature on cognition and cognitive development.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

The first chapter presented the background to the study. It was suggested there that sex and environment could be valuable predictors of academic achievement, and that repeated measurements designs are superior to randomized block designs for exploring differences in achievement.

The present chapter is divided into two major sections. The first reviews the literature on cognitive development with reference to Bruner's, et al., theory, and certain non-cognitive variables presumed to influence academic achievement. The second deals with repeated measurements designs and their applications.

Section I:
Cognitive Development, Achievement and Associated Variables

The Nature of Cognition

George (1962) described cognition as the whole of the foundation of normal intellectual behaviour, which includes the way human beings perceive and learn, how they reason and think as well as how they remember and imagine (Drever, 1952). Schmidt (1973, p. 107), however, adds that cognition does not confine itself to activities usually called

intellectual or conceptual such as categorizing,

> classifying, generalizing and engaging in deductive thinking . . . it includes also affective or emotional awareness.

Bloom, et al., (1956), recognized these various phases of cognition when they developed and described a taxonomy of educational objectives in the cognitive domain, for classifying and assessing learners' thinking skills, and for evaluating learning in terms of students' changes in behaviour. Similar work was done by Krathwohl, (1964) in the affective domain. These two domains plus the psychomotor are not mutually exclusive as Tyler (1973) pointed out. Academic achievement reflects all three of them (Wood, 1968; Tyler, 1973).

Environment and Cognitive Development

Traditionally, there appear to be two major viewpoints in the explanation of the processes of cognitive development, and in accounting for the course children go through to acquire complex learnings. One is biological and seems to postulate that intelligence and cognitive abilities are inherited (Jensen, 1969, 1970). Under this view, intelligence and cognitive abilities emerge through a process of unfolding along a growth continuum in several ordered stages of maturation (Fowler, 1962; Lenneberg, 1967; Piaget, 1952). The implication of this view is that achievement and all measures of intellectual behaviour would be very little affected by environment and other non-cognitive variables, as claimed by Jensen and his associates.

The second is represented by those who emphasize environmental variables as predictors of cognitive patterns and achievement. They point out, for example, that I.Q. correlates with a multiplicity of environmental indices (Kemp, 1955; Bruner, et al., 1956; Vernon, 1965). These two views are in line with the well-known nature-nurture controversy.

By and large, it would appear almost futile, if not impossible, at the present time to try to prove that environment alone determines academic achievement. Several researchers, (Anastasi, 1958; Coleman, 1969; Price-Williams, 1961; Vernon, 1965, 1969; Cole and Bruner, 1971; Estes, 1974; Schmidt, 1973; Bruner, et al., 1966) to mention a few, are eloquent on this point.

In a theoretical presentation, the Harvard Centre for cognitive studies under the direction of Jerome Bruner, consistently maintained that cognitive development is achieved through three stages: the enactive, the ikonic and the symbolic representation stage,

> each of which places a powerful impress on the mental life of human beings at different ages, and their interplay persists as one of the major features of adult intellectual life (Bruner, et al., 1966, p. 1).

These three techniques are reflected in the changing ways that children have for imposing equivalence on the things of their world, and each can be expected to emphasize different features of the environment as basis for establishing equivalence (Olver and Hornsby, 1966).

Most of their researches have been based on the above theory, and they have tried to establish that cultural and/or

environmental differences in cognitive growth and achievement by and large depend on the

> shaping influences of culture on thought: that culture provides amplifiers in the form of technologies to empower human cognitive capacities (Bruner, et al., 1966, p. xii).

Particularly with the development of symbolic representation, the child masters higher order techniques for processing information by conservative inferential steps, "that take one beyond what can be pointed at" (Bruner, 1964). The most specialized natural system of symbolic activity is language (Bruner, 1966), hence whatever difference exists between a city child and a rural one is reflected in their language, because they differ in symbolic representation. The child in an urban school in Nigeria is more likely to learn to manipulate concepts, to use his knowledge beyond the school. He is not only taught things, but is also taught what to do with things. His language is functional because he uses the same language at school, at home and in his environment. He learns to think and express his ideas in the language.

In Mathematics, he learns some concepts, such as triangles, circles, cones, and finds them used in road signs, in building constructions, and in furniture. He realizes that these concepts have meaning outside the classroom, and that the school is an extension of the home and the environment. For the rural school child, school life is not related to the community life in which he lives, and most of the skills and rules he learns at school are never taken

seriously because they are isolated from what he sees, hears and practices at home. The language he learns at school is not functional. This may affect his cognitive development because "language not only follows but also anticipates and guides cognitive activity" (Schmidt, 1973, p. 62; Greenfield, 1968).

Rural and urban children also differ in "affect," which is an important aspect of cognition. "Whatever is cognized, is something that in some way affects the 'infant' closely and arouses affect or emotion" (Schmidt, 1973, p. 113). Rural and urban children are likely to have different degrees of attachment to certain school subjects, such as English and Mathematics. The rural school child in Nigeria may have less "affect" for English because he has another language which is functional. There are no "meaningful objects" in his home or surroundings to arouse "affect" for mathematics. The concept of geometrical figures completely abstracted from the objects, with properties about which one can reflect within a whole symbolic system of mathematics is entirely missing. The urban child, on the other hand, can find "affect" for certain subjects through his father's work tools, his books, and his job satisfaction or lack of it. Without affect whatever is learned at school does not seem to have meaning for the child (Schmidt, 1973).

In Bruner, et al., (1966), the difference between urban and rural children was most compactly described as a difference between abstractness and concreteness. The authors believe that the difference derives from differential

exposure to problem solving and communication in situations that are not supported by context. Rural life is somewhat less conducive to the development of abstraction. In rural Nigeria, children do not participate in adult conversation, or ask for reasons for things. Often, children are reminded that they are supposed to be seen and not heard. The behaviour acquired by this type of training is likely to be carried into the school and may be reflected in their cognitive development.

Schmidt (1973) confirmed that the direction cognitive development takes is strongly dependent on the ways of perceiving and thinking and symbolically elaborating that are induced and encouraged in the child by the parents and by the pressure of his social group. He might do well in measured scholastic performance within the first few years at school. However, when schooling begins to demand a more abstract, symbolic approach, he tends to lose all interest (Schmidt, 1973, p. 134). (This view has been confirmed also by Cibrowski, 1971; Dempsey, 1971; Furly, 1971 and Lloyd, 1971.

From the foregoing, it would appear that differences in performance between urban and rural children would increase as the mental activities become more complex, more abstract and more symbolic as in Bloom's Taxonomy. As one proceeds from the first level (knowledge) to the other levels, one would expect the difference in performance between urban and rural children to increase in that manner, hence supporting the view of Bruner and his colleagues.

Environment, Achievement and Associated Variables

Studies which investigated environmental influences on academic achievement seem to be fairly consistent in their finding that certain aspects of the environment are conducive to achievement while others are not (Dentler and Mackler, 1962). For the sake of convenience, Mohan (1971) grouped those aspects under two headings - social and physical. The social aspect may represent those stimuli which Schaefer and Bayley (1963) referred to as family dynamics, and which Vernon (1965) called child rearing practices. One may also include such variables as teacher and peer relationships (Bereiter, et al., 1966; McDonald, et al., 1971), and some cultural practices under this heading. The physical aspect of environment may include those conditions in which no "significant others" are present, such as school and playground facilities, and some other related variables.

Family Dynamics

Family dynamics include all influences arising from the child's immediate family, such as friendliness (Berepiki, 1973), conformity with tradition and cultural norms, parents' cognitive and linguistic styles (Vernon, 1965, 1969), family unity, and parents' educational status. The last mentioned variable can relate to the academic motivation of children, particularly if parents' educational status is high. Children in highly educated families read books, magazines and newspapers, watch T.V. programs, listen

to radio broadcasts and discuss intelligently with their parents even before they are ready for school. At school, these opportunities enrich their language, their concepts and cognitive development and consequently lead them to higher educational goals. Children in rural Nigeria, naturally, do not have such opportunities.

One of the most important factors contributing to family unity is friendliness. Friendliness between parents and children contributes largely to parental understanding and freedom for the children. A child in a democratic family feels accepted and less restrained.

Rosenberg, (1965), for example, studied self-concept among high school juniors. Those of them who reported punitive responses tended to have lower self-acceptance than others who gave non-punitive responses. Bronfenbrenner (1961), Rosen (1961), and Helper (1955) have separately confirmed this finding. Children who have low self-acceptance do not aspire towards high achievement and may reflect this in their academic achievement.

Where the relationship between children and parents is unfriendly, the children do not aspire for higher education, nor for jobs requiring such education (Baldwin, et al., 1945; Bloom, 1964, Vernon, 1969). Consequently, their expectations are low and their achievement poor. In such families, children are not encouraged to be curious, nor are they provided with books and other forms of learning experience and plays (Bloom, 1964; Alexander, 1973).

This is often the case with families where there is

financial insecurity and lack of planning. Financial insecurity may lead to anxiety. In this respect, rural people seem to have more anxiety than urbanites. Barry (1959) discovered that subsistence economy affects child training and development. Barry's study is particularly relevant to the present study, because subsistence economy is characteristic of rural Nigeria.

Size of family seems to be related to academic achievement and aspiration of children. In small families, children get more individual attention. In rural Nigeria, where the average number of children in a family is about eight or more, and where the number of children is likely to determine the aspiration, motivation, and academic achievement of the older ones, children may not get all the attention that they need. Where large family size is coupled with low socio-economic status, the older children are expected to work and help their parents bring up the younger ones. Consequently, from the onset, they are aware of their academic limitations and do not strive for high scholarship. If they go to school at all, they are there only to learn how to write and sign their names. In the cities, families are forced by lack of accommodation to be small in size, hence certain limitations often associated with large-sized families are eliminated.

Generally speaking, children in rural areas do not have much to aspire for in the form of high status occupations, and disadvantaged families do not have any incentive in this direction for their children, hence their

achievement and aspiration are often low (Gottlieb, 1964). Families in the rural areas are also more economically unstable than their counterparts in urban areas, because in the former the main source of income is subsistence farming, while in the latter, there is a variety of jobs, needing substantial competition.

Cultural Influences

Parents who adhere strictly to traditional ways of child-rearing are likely to be repressive and overprotective of their children. In the rural areas, this is often the case. Since the people are more homogeneous and have common ancestry, they tend to preserve their culture. As a result of the heterogeneous origin of people in urban areas, they rarely keep to their ancestral or homeland practices. Children have more freedom and greater opportunity to be more curious, active and exploratory than their counterparts in the rural area: influences favoring achievement (Baldwin, 1945; Bing, 1963; Bloom, 1965; Lesser et al., 1965).

Children whose mental development is handicapped by poor socio-economic, cultural and linguistic environment perform lower in practical-spatial, and some abstract non-verbal abilities. This was the finding of Vernon (1965) from his study of West Indian urban-rural sub-groups and later confirmed by Dart and Pradhan (1967) from their study of the cognitive behaviour of urban and rural Hawaiian school children. These studies revealed that urban school children are better in practical-spatial and abstract abilities than

rural children. Semler (1963), Witkin, et al., (1962), have all discovered these differences too, by studying rural and urban communities from different countries. Consequently, it would appear that urban children would do better on tasks graded according to the levels of cognition in Bloom's Taxonomy.

Teacher and Peer Relationships

School problems are connected primarily to academics and secondarily to classroom relationships (Bush, 1954). Lack of adequate school equipment and facilities tends to make the rural school teacher less competent in his job. The absence of electricity makes the use of audio-visual aids and television practically impossible. The children are often encouraged to practice rote-learning. Consequently, the chances for academic achievement are, to a large extent, limited to the first few levels of Bloom's Taxonomy. Added to this is the awe with which the rural school child regards his classroom teacher, resulting in his acceptance of whatever the teacher says without question. Children who are brought up in the cities are bolder and more likely to question their teachers and to be inquisitive. They know early enough what they intend to pursue and this improves their motivation to achieve.

Peer Competition

Competition among school peers favours academic achievement. Children who are brought up in a less competitive environment are not likely to concentrate on an abstract

task, nor are they likely to desire very strongly to succeed in it (Vernon, 1965). Moreover, lack of competition restricts the development of speed in solving problems and tasks. Eysenck (1967) has drawn attention to the finding by Furneaux (1960) that speed in attaining the correct answer to a problem is one of the individual differences in measured achievement. Since the expectations of children in rural communities are not high, there is no incentive to compete. Consequently, their achievement may be lower as compared to that of urban peers.

Urban schools in Nigeria have higher enrolment per class than rural schools. Large enrolment leads to 'streaming' of classes. Consequently, pupils struggle to remain in the upper streams. This stimulates competition and better achievement. Studies by Hargreaves (1967), Hansen (1967), Kelly (1971), Williams and Cole (1968), Lippitt (1959) have confirmed that ability grouping has a healthy effect on self concept and achievement.

School and Playground Facilities

Piaget and Montessori devoted most of their writings to the psychology of child development. In their opinion, play helps in the development of the child cognitively (Piaget, 1951; Montessori, 1964). Their opinion has been sporadically echoed by several researchers: Pitcher, et al., (1966); Winn and Porcher (1967); Edgington (1968); Cass (1971); Dienhes (1970); and Piers (1972).

According to Piaget, play occurs when a child

transforms reality by assimilation to meet his needs. Often, he plays with, manipulates and remodels what is available to him in his immediate vicinity. By doing so, he develops his cognitive abilities.

Rural-urban environments offer different opportunities for play. The child in a rural community has a wider area to explore, more natural surroundings to utilize for adventure plays and, if not restrained by parents, enjoys greater safety and interaction with his neighborhood. What he lacks, though, is variety and quality in his games. Whereas a child in an urban community has access to a variety of games due to the heterogeneous character of his playmates and surrounding, the rural child is limited in his choice. However, his freedom to play anywhere within his vicinity gives him an edge over his counterpart in the urban areas and he is likely to develop better cognitively through play than urban children. This development may be manifested in the production and use of memory strategies which, in turn, help in remembering and achievement (Brown, 1974; Flavell, 1970; Birch, et al., 1965; Dornbush, et al., 1970).

In general, the main differences between urban and rural communities with respect to their influence on children's achievement boil down to the presence or absence of modern amenities, such as electricity, and between cultural tradition and modernity. Where there are mod amenities and acceptance, there is stronger incenti to learn. This is characteristic of urban communities. the

other hand, where old ways persist, there is little motivation to achieve. This is the fate of rural communities.

Interaction of Environment, Sex and Achievement

Some researches on sex differences have demonstrated with reasonable consistency that such differences in learning are many and significant. Equally true is the finding that where those differences exist, they are related to roles that males and females are ordinarily expected to play in a given society (Kolesnik, 1969). This is equivalent to saying that achievement differences related to sex are a result of the interaction between the person and his environment or culture (Lewin, 1939; Murphy, 1947; Brunswik, 1965; Sherif and Sherif, 1956; and Helson, 1959), for there are differences in privileges, rewards and expectations that the society affords to each sex typical of this adult role functioning (Selles, 1963; Anderson, 1972).

It is in this respect that rural communities differ from urban in the opportunities they offer to each sex to achieve. In the rural areas, parents are inclined to segregate children according to their sex, with girls more restrained and protected so that they can be good future wives. They are directed to play roles appropriate to their sex - learning good housekeeping techniques and child rearing practices. They are more dependent than the boys and are more prepared to accept the status-quo. There isn't

much motivation to achieve. Since they have learned to obey, they may do more poorly at second and third levels of the Taxonomy.

It may be different for urban girls. They are more exposed to doctrines and practices which emphasize sex equality. They tend to compete more vigorously with boys. They have greater expectations and higher aspirations. They have, therefore, greater motivation to achieve and are expected to do better in academic achievement than their rural counterparts.

Although most of the reported sex differences in learning favour girls in verbal abilities and practically in every aspect of linguistic development (Kolesnik, 1969), and boys in some tasks requiring speed (Anastasi, 1958(a), Lewis, 1968), mechanical comprehension (Terman and Tyler, 1956; Haan, 1963), spatial orientation and analytical ability (Witkin et al., 1962) and quantitative reasoning (Tyler, 1968), this is likely to be so in the rural rather than in the urban community.

Researches on Bloom's Taxonomy

Bloom (1956) postulated a Taxonomy of educational objectives, cognitive domain, consisting of six levels assumed to possess a cumulative hierarchical structure. Since then, several studies have been directed to it. Those falling into the following two categories are of special interest to the present study:

1. Those attempting to investigate the cumulative

hierarchical structure of the Taxonomy.

2. Those attempting to see whether items at higher levels show better discrimination than those at lower levels.

The most comprehensive study so far in the first category appears to be that of Kropp and Stoker (1966). They designed tests defining operationally the six levels of the Taxonomy in two content areas: social science and science. On the basis of both mean performance analysis and simplex analysis of these tests, they discovered that empirical data by and large supported the structure of the Taxonomy. Madaus et al., (1973), replicated their study with slight modifications in technique and used a causal model approach rather than the "simplex model approach" of Kropp and his companion. The causal approach was intended to reveal not only the proportion of variance in each level explained directly by the preceding adjacent level, but also any proportion of variance explained indirectly by non-adjacent levels. Their findings were similar to those of Kropp and his colleague.

Studies in the second category include those of Fast (1970), Farley (1968), Schlicter (1971) and Throop (1971). Fast, for example, concluded from his study that application items of ACS-NSTA High School Chemistry achievement tests (1957-1971) were the most discriminatory. Naturally one would expect this conclusion because most science subjects pay substantial attention to application.

Schlicter (1971) derived some interesting

conclusions from her study of application of the Taxonomy with fifth graders. She discovered that at the knowledge and comprehension levels, fifth graders increased in accuracy over time in identifying and interpreting synonyms for the Taxonomy. At the application level, they were more accurate in coding oral interaction situations than in coding written research structured activities. Poole (1969), Danzel (1972), Groves and Kohalas (1975), had similar findings. It should be noted, however, that for the present study, it is immaterial whether the cumulative hierarchical structure of the Taxonomy existed or not.

Conclusion

In concluding this section, one could summarize as follows:

1. Since rural community is not conducive to abstract thinking, and solving complex tasks, children in rural school may perform poorly in tasks requiring abstraction. Bloom's Taxonomy provides such tasks.
2. City life tends to minimize sex differences in achievement, because there boys and girls are given equal opportunity and grow up together, without strict conformity with stereo-typed sex roles.
3. That researches on Bloom's Taxonomy seem to confirm the cumulative hierarchical structure and discrimination of the Taxonomy.

Section II:
Repeated Measurements Designs

Repeated measurements designs have been known by different names in the literature for quite some years. Minium, for example, has used the term "dependent sample means." He said that sampling distribution of differences between the means are dependent

> when the same subjects are used for both conditions of the study or, if they are matched on some variable related to performance on the variable being observed (1970, pp. 274-75).

Edwards (1965) devoted most of his chapter of "Trend Analysis" to repeated measurements design. "Split-plot design" is often used interchangeably with repeated measurements design (Winer, 1971). The former term seems to have originated from the field of agriculture where "sub-plots" or "split-plots" within "whole plots" are the terms in vogue (Winer, 1971, p. 367). The Table of Winer (p. 370), expounding the analyses, makes it clear that "repeated measurements" and "split-plot designs are synonymous.

Purpose of Repeated Measurements Design

Keith (1972) considered these designs as a method of decreasing error variance or increasing precision, whereby different treatments can be administered to the same subjects as long as the results of any one treatment does not influence those of the others.

Because of large differences in experience and background, people show relatively large variability in their

responses to the same experimental treatment. Repeated measurements designs are a device to separate differences due to experience and background from those due to treatment effects, thereby increasing the sensitivity of the experiment. This is accomplished due to the simple reason that human characteristics are often positively correlated (Winer, 1971, p. 262).

Research Studies with Repeated Measurements Design.

There seem to be two broad classifications of publications on repeated measurements designs prior to the 1950's:

1. Those which dealt with repeated measurements as used in educational and psychological research. In this group are included those studies which, according to Kogan, (1953), examined learning curves of various experimental groups on the same task. The present study fits into this category for examining the performance of the subjects at the first three levels of Bloom's Taxonomy. The same holds true if the individual items within each level are used as furnishing repeated measures.
2. "Those which paid explicit attention to the description of the underlying assumptions but which did not indicate the methods for examining the data for conformity to these assumptions and

for handling them in the event of pronounced departures from the assumptions." (Gupta, 1967, p. 20).

At this juncture, mention must be made of Collier's (1956) work. He summarized earlier researches on the assumptions and other considerations of the design. Collier not only put the work on a systematic and mathematical footing, but also "extended it to as many as five dimensional experiments, having varying amounts of complexities, with repetitions on one factor only, or on as many as all the five" (Gupta, p. 23). It appears appropriate, therefore, to apply repeated measurements designs to the data of the present study, using four factors with repetitions on two.

The potential of repeated measurements design was highlighted by Moonan's studies (1955, 1956, 1957) and applied by Hansen (1962) and Olstad (1963) in their doctoral dissertations. According to Gupta, quoted above, these researchers, as well as Furchtgott (1947) and Liberman (1951), did not interpret the finding related to significant interaction. They thus failed to take full advantage accruing from the use of repeated measurements design (p. 8).

Gupta applied the design to the responses to individual items of an objective test with valuable findings. Using 50 test items of STEP-Mathematics 2A, he was able to identify items on which sub-groups of students exposed to different educational experiences performed differentially. His findings have specifically inspired the present study.

Summary

This chapter first presented and described certain aspects of cognitive development in which rural and urban children differ. These are the ones expounded by Bruner and his companions, as well as 'symbolic representation' (Bruner) 'affect' (Schmidt) and 'abstract thinking' (Price-Williams). It was suggested that these differences may influence performances on the levels of Bloom's Taxonomy. Certain other variables likely to arise from type of environment, such as family dynamics, peer and teacher relationships and motivational variables were examined as they relate to achievement and it was suggested that differences between urban and rural children in achievement will increase as one proceeds to the more complex levels of Bloom's Taxonomy.

Evidence was also produced from past studies and cultural practices to show that certain environmental variables may have differential effects on boys and girls and on levels of achievement as measured by Bloom's Taxonomy. Literature on repeated measurements design and its contribution to examining treatment differences was then reviewed.

The next chapter deals with the procedure methodology and design of the study.

CHAPTER III

PROCEDURE, METHODOLOGY AND DESIGN

Introduction

This chapter presents the design of the study and the experiment that was conducted. The population and the sampling procedure are described first, followed by a description of the measuring instrument. The design and hypotheses then follow.

Population

The population for the study was the primary school children of sixth grade in Eastern Nigeria. Primary schools (Grades 1-6) are available throughout that country according to local needs. In the urban areas, schools are naturally much closer to the child than in the rural areas. Until the late 1960's, schools were owned and administered by different religious groups and private individuals. Very few were provided by the government. In the cities, therefore, one can find, side by side, two schools belonging to different denominations.

In the rural areas, communities are more homogeneous and closely knit together by similarity of interests and common ancestry. They often belong to the same denomination and this fact, sometimes, results in the existence of only one school for a very large community. It is not unusual to find children living two to three miles away from the nearest

school in the rural areas, whereas half-a-mile may be the maximum distance between two schools in a city. The rural population is rather homogeneous with respect to socio-economic status and the school children there normally come from less affluent parents. In the cities, socio-economic diversity is naturally larger.

Primary schools are co-educational, especially in the cities. Table 3.1 gives the distribution by sex of the school population in the three provinces of Eastern Nigeria. The average age of sixth graders in urban and rural is a little over eleven years.

A perusal of Table 3.1 shows that the percentage of boys is larger than that of girls, both in the urban and the rural areas, but it is much more so in the latter. The ratio of boys to girls is approximately 3:2 in urban and 2:1 in rural areas. The average enrol[illegible] of female sixth graders per school is higher in urban than in the rural areas (13 per school vs. 7).

The main differences between the urban and the rural areas may be summarized briefly as follows: in the rural areas, there are no regular means of transportation, running water or electricity. Most homes lack those modern amenities which are so common in urban areas. Even where a family in the urban area has no radio or T.V., they are accessible to the child, either in his school, or in his friend's house or in children's libraries. More time is devoted to studies or to games of different kinds or to

TABLE 3.1

Enrolments in Grade 6 in Three Provinces
in Eastern Nigeria Classified by Sex

(Ministry of Education, Enugu, Annual Report, 1974)

	URBAN				RURAL			
	No. of Schools	Boys	Girls	Total	No. of Schools	Boys	Girls	Total
1	31	447	232	679	173	2,605	1,763	4,368
2	39	1,099	778	1,877	44	377	97	474
3	31	502	430	932	134	1,719	585	2,304
Total	101	2,048	1,440	3,488	351	4,701	2,445	7,146
%		58.7	41.3			65.8	34.2	

visiting libraries and other information centres in the urban areas. Rural children spend more time in doing household chores for their parents. Play, which forms an important element in child development (Piaget, 1951), is limited to local games of hide-and-seek and to symbolic cooking with sand.

Although the curriculum is the same throughout the country, strict adherence to it is largely the responsibility of each school. The Ministry of Education is responsible for the maintenance of standards and evaluation, but it is difficult for it to keep close watch on the schools in the remote rural areas.

Sampling Procedure

From the above population of schools (N = 101 for urban, N = 351 for rural), random sampling procedure was employed to select schools for the experiment. For this purpose, the total population of schools (N = 452) was numbered serially from 001-452. Using a table of random numbers, those which fell within the above range were listed. From this list two urban and three rural schools were drawn. The actual breakdown of the sample is given in Table 3.2. It was assumed that the subjects obtained through this procedure constituted the best approximation to a random sample from the population of sixth graders in the country even though random sampling was done from the population of schools.

Four boys from the urban schools did not complete the tests. They asked for permission to drop out and were

TABLE 3.2

Rural and Urban Schools Selected for the Study

Rural	Boys	Girls	Urban	Boys	Girls
Nsude Community School	40	40	Zik Avenue Primary School	42	41
Central School Umuokrika	14	14	Ogui Road Primary School	35	32
Eziama Central School	21	21			
Total	75	75		77	73

allowed to do so. Similarly, two boys and two girls from the rural schools dropped out. Hence, out of the 150 sixth graders from the urban schools, 73 were boys and 73 were girls. Similarly, there were 73 boys and 73 girls from the rural schools. The occurrence of equal numbers in the groups was therefore coincidental.

The Instruments

The following instruments were designed by the writer, since ready-made tests were not available.

Mathematics and English Achievement Tests

Mathematics and English were chosen because they were the most important subjects in primary schools in Nigeria. No candidate is considered qualified to receive the first school leaving certificate unless he attains at least a pass level in them. Consequently, Mathematics and English receive the greatest attention from the students and the teachers in the primary schools.

The six levels of cognition in Bloom's Taxonomy represent increasing degrees of complexity in cognitive functioning, starting from the most simple (knowledge) to the most complex (evaluation). The first three levels are not too complex for sixth graders. Actual instruction is mostly limited to these levels anyway. For these reasons, items based on the first three levels of the taxonomy provided the criterion measures for the study.

The items of these achievement tests were styled

after available questions from the First School Leaving Certificate examination (F.S.L.C.) and the Common Entrance Examination (C.E.E.) for entry into secondary, grammar and technical schools in the state. This was done to ensure close adherence to the syllabus.

The F.S.L.C. examination is usually taken at the end of the grade six school year, after which successful candidates either get into the job market, or go for further studies. The questions cover the three levels of cognitive domain and are constructed by subject-matter specialists from the Ministry of Education.

The instruments had multiple choice items, each item having four possible answers. Table 3.3 indicates the number of items at each level in the two academic areas. Before the tests were administered to the children, the items were grouped into the three categories of knowledge, comprehension and application by four subject matter specialists working independently of one another and of the writer. Only those items on which there was unanimous agreement were used for the test.

The Questionnaire

The questionnaire contained 20 items, phrased to suit the educational level of the children. Items were aimed at knowing the educational status of the parents, children's motivational levels and a few school and environmental data.

Most of the items were borrowed from Strommen and Gupta (1971). The purpose of the questionnaire was to widen

TABLE 3.3

Number of Items Classified by Subject-Matter and Levels in Bloom's Taxonomy

Subject	Level	Number of Items
Mathematics	Knowledge	10
	Comprehension	10
	Application	10
English	Knowledge	10
	Comprehension	8
	Application	7

the scope of the research, by examining the relationship of certain non-cognitive variables with the performance of the children on the criterion measures. There were no formal hypotheses relating to the items or their sub-groups. They were used descriptively to explore whether they were related to achievement. The Mathematics and English achievement tests and the questionnaire are given in Appendix A.

Administration of the Instruments - The Urban Schools in the Sample

The two urban schools (Zik Avenue Primary School and Ogui Road Primary School) are within Enugu township. They are close to one another, hence the tests were administered at one centre. Enugu is the capital of Anambra State of Nigeria and the seat of the State Government. The population comprises civil servants, technicians, teachers, and people who represent various commercial interests.

The Rural Schools in the Sample

Each of the three rural schools is at least 40 kilometers from the nearest urban community, but is accessible by road.

The Testing

The achievement tests and the questionnaire were administered to the pupils between the 15th and 19th of December, 1977. The writer was helped by a Secondary School principal from Enugu.

The students from Enugu urban schools were examined

on the 16th of December at Zik Avenue Primary School. The rural students were tested in their own schools. Since the selected schools are far from each other, a full day was set aside for each school. Normal F.S.L.C. examination regulations were observed throughout the administration of the tests.

Scoring

The Mathematics and English test items were scored '1' for correct answers and '0' for incorrect ones. Responses to the items of the questionnaire were arranged (a) through (d) and frequencies for each response were counted for chi-square analyses.

Analyses of Responses by Students for Refining the Instruments

1. Item Analysis of Objective Tests

TEST04, a computer program at the University of Alberta (Program Documentation 360/67) was used to item-analyze the Mathematics and English tests. Item difficulty, corrected point biserial, corrected biserial, and item reliability index were calculated for each item. Results are shown in Tables 3.4 and 3.5 respectively. Most of the items appeared to discriminate fairly well. The KR-20 for the Mathematics test was .75, while that for the English test was .64 at the first run of the item analyses program.

Tables 3.4 and 3.5 show that some of the items in both subjects had negative corrected point biserial correlation. These were items 6 and 14 in Mathematics and 10 in English. When the program was rerun after dropping

TABLE 3.4

Results of Item Analysis - Mathematics Test

Item	DIFF	CRPB	RBIS	CRBIS	IRI
1	.673	.342	.575	.444	.207
2	.463	.256	.456	.322	.181
3	.883	.250	.522	.409	.102
4	.250	.285	.515	.389	.164
5	.917	.177	.426	.318	.065
6	.290	-.170	.052	.077	.018
7	.480	.167	.344	.210	.137
8	.707	.275	.493	.363	.170
9	.603	.260	.475	.341	.183
10	.560	.345	.569	.435	.224
11	.893	.240	.515	.403	.095
12	.760	.215	.422	.296	.131
13	.180	.235	.465	.344	.122
14	.053	-.031	.037	.063	.004
15	.883	.241	.508	.395	.100
16	.407	.278	.485	.351	.188
17	.213	.366	.640	.516	.186
18	.440	.205	.392	.258	.155
19	.707	.354	.597	.468	.205
20	.783	.288	.528	.404	.155
21	.200	.432	.739	.617	.207
22	.553	.415	.655	.522	.259
23	.500	.320	.535	.401	.213
24	.430	.020	.160	.025	.063
25	.487	.369	.597	.463	.238
26	.713	.341	.581	.452	.198
27	.503	.170	.348	.213	.139
28	.533	.160	.335	.201	.133
29	.669	.369	.609	.478	.221
30	.543	.257	.458	.323	.181

TABLE 3.5

Results of Item Analysis - English Test

Item	DIFF	CRPB	RBIS	CRBIS	IRI
1	.653	.098	.312	.127	.115
2	.873	.296	.634	.474	.132
3	.663	.193	.434	.249	.158
4	.910	.125	.373	.221	.061
5	.490	.149	.376	.187	.150
6	.377	.127	.349	.162	.132
7	.413	.127	.348	.161	.136
8	.687	.114	.332	.149	.118
9	.443	.189	.427	.239	.168
10	.670	-.008	.174	.010	.063
11	.350	.243	.498	.313	.184
12	.857	.290	.612	.449	.138
13	.687	.251	.511	.328	.181
14	.607	.034	.231	.043	.089
15	.630	.052	.252	.066	.095
16	.890	.209	.504	.347	.095
17	.927	.135	.401	.254	.056
18	.413	.260	.516	.329	.201
19	.740	.181	.423	.245	.137
20	.227	.123	.347	.171	.105
21	.760	.223	.497	.320	.154
22	.780	.265	.545	.371	.161
23	.890	.328	.702	.546	.132
24	.847	.323	.658	.493	.156
25	.567	.247	.499	.311	.196

(DIFF = Difficulty; CRPB = Corrected Point Biserial; RBIS = Biserial Correlation; CRBIS = Corrected Biserial; IRI = Item Reliability Index)

these items, more items showed negative correlation, with little change in the KR-20 reliabilities. The results of the first item analyses were, therefore, considered acceptable for subsequent work. Results of the rerun are in Appendix B.

The Design

The design for the study had four factors, with repetitions on two factors.

A. Environment i = 1 - rural
i = 2 - urban

B. Sex j = 1 - male
j = 2 - female

C. Cognitive levels k = 1 - knowledge
k = 2 - comprehension
k = 3 - application

D. Items at each of the three levels of factor C.
Items on knowledge ran from m = 1,2 . . . item 10 in Mathematics,
m = 1,2 . . . item 10 in English;
items on comprehension ran from m = 11, 12 . . . item 20 in Mathematics,
m = 11, 12 . . . item 18 in English;
items on application ran from m = 21, 22 . . .

item 30 in Mathematics,

$$m = 19, 20 \ldots$$

item 25 in English.

The design was the same for Mathematics and English. The score of an individual pupil on the test item was either '1' or '0'. A diagramatic representation of the factors is shown in Figure 3.1.

The Present Data in Relation to the Assumptions Underlying the Design

Several assumptions underly repeated measurements designs. Some of them are discussed below in relation to the data:

1. Multivariate normality: The variables furnishing the repeated measures are assumed to be multivariate normal (Alexander, 1946). In this study, they were dichotomous for the "item hypotheses". Justification for the application of repeated measurements design to individual item responses, scored dichotomously, can be found in Cochran (1950), and in Godshalk and Swineford (1966). The distribution of the measure for testing the "score" and "sub-score" hypotheses may not have been normal either.
2. Practice and transfer effects: Since the items in the present study could be independently answered, practice or transfer effects were not relevant to this study. In this respect, therefore, the

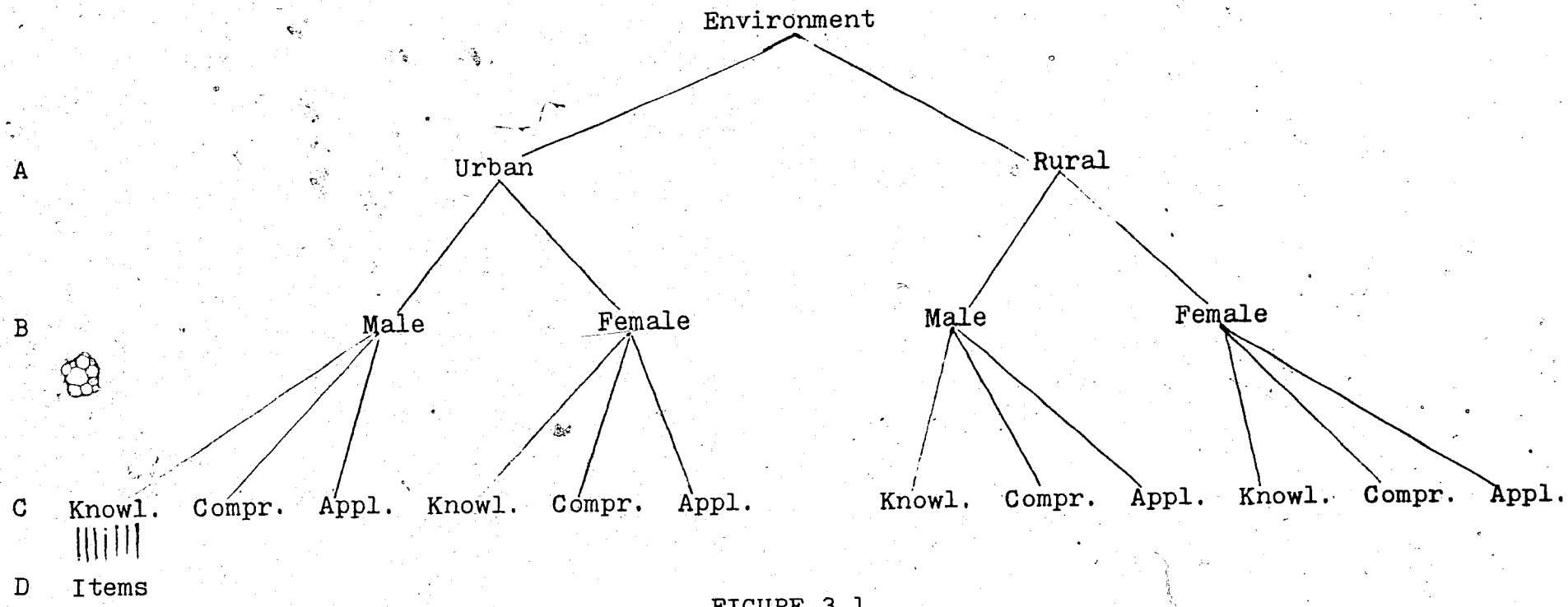

FIGURE 3.1

Diagramatic Representation of Four Factor Design

assumption was fully satisfied by the data.

3. Random selection of subjects: The subjects for the study were drawn in such a way that they should constitute as good as a random sample.
4. Homogeneity of variance-covariance matrix: A repeated measurements design "has implicit in it homogeneity assumptions on variance-covariance matrices associated with the repeated measures" (Winer, 1962, p. 338). It was assumed that the assumption was obeyed by the data.

The Hypotheses

There were three types of hypotheses:

(a) Those arising from the fact that the responses to every item constituted a criterion. These were referred to as "item hypotheses".

(b) Those arising from the fact that item responses were added to generate scores for each of the three levels of achievement, so that each student had three criterion measures, one from each level of Bloom's Taxonomy. These were called "sub-score" hypotheses.

(c) Scores arising from adding up the three sub-scores were called "score-hypotheses". They are the ones generally used by researchers using ANOVA.

Results from the first two types of hypotheses mentioned above can be considered to be the special

contribution made by the use of repeated measurements design. Table 3.6 presents the number and nature of the hypotheses that can be tested from (a), (b) and (c) above. It is obvious from that table that there were 15 hypotheses for English and another 15 for Mathematics.

Application of the Four-Factor Design, having Repetitions on Two Factors

The structural model of the four-way fixed factor design with repetitions on two factors has the following form:

$$Y = M + A + B + AB + \underline{EAB} + C + AC + BC + ABC + \underline{EABC} + D + DA + DC + DAB + DAC + DBC + DABC + \underline{EDABC}$$

where M is constant, analogous to the grand mean.

A: the main effect due to types of physical and social environment.

B: main effect due to sex of the learner.

AB: interaction of factors A and B.

EAB: mean sum of squares between subjects (error between)

C: main effect due to levels of achievement.

AC and BC: two-factor interactions of environment and levels of achievement; in the 'between-subjects" part of the analysis.

ABC: three factor interaction due to A, B, and C.

ECAB: mean sum of squares within subjects (error within).

TABLE 3.6

Number of "Score," "Sub-Score" and "Item Hypotheses" Classified by Nature of Effect and Number of Factors in the Design

Nature of Effect	Score-Hypo			Sub-Score Hypo			Item - Hypothesis		
	Factor	Notation		Factor	Notation		Factor	Notation	
Main Effects	2:	A,B	i,j	1:	C	k	1:	D	m
Two-factor Interaction	1:	AB	ij	2:	AC, BC	ik,jk	3:	AD BD CD	im jm km
Three-factor Interaction	-		-	1:	ABC	ijk	3:	ABD ACD BCD	ijm ikm jkm
Four-factor Interaction	-		-	-		-	1:	ABCD	ijkm
Total	3			4			8		

D: main effect due to items on levels of C, DA, DB, DC, DAB, DAC, DBC, DABC are interactions of the respective factors, in the "within-subjects" part of the analysis.

EDABC: mean sum of square within subjects (error within).

Factors A and B are fixed, factors C and D may be considered as fixed in the sense that neither the levels nor the items at any level were selected randomly.

EAB was the error for main effects A and B and interaction AB; ECAB that for main effect C and interactions AC, BC, and ABC; and EDABC that for main effect D and the remaining interactions. The level of significance for the tests was .05. Score hypotheses dealt with macro achievement.

Score Hypotheses

1. Main effect hypothesis for factor A. Achievement of sixth graders as reflected in the total score was the same whether they come from rural or urban environments. Stated as a null hypothesis, it states "There was no difference between the mean achievement of sixth graders from urban and rural areas, when achievement was taken as the sum of the sub-scores at the first three levels of Bloom's Taxonomy." A similar hypothesis can be stated for main effect due to factor B.
2. Interaction hypothesis: AB. This hypothesis is related to the interaction of environment with sex.

In the null form it can be stated as "there was no interaction between environment and the sex of sixth graders".

Sub-Score Hypotheses

To obtain greater insight into differences in achievement, the following hypotheses were set up:

3. Main effect hypothesis for factor C. This hypothesis stated that the achievement of all the sixth graders as given by the three sub-scores related to the first three levels of Bloom's Taxonomy did not differ from one another.
4. Two-factor interaction hypotheses AC, BC. There was no interaction between the two types of environment and the three levels of achievement (AC interaction was non-existent). Similarly, there was no interaction between the two levels of sex and the three levels of achievement (BC interaction was non-existent).
5. Three-factor interaction hypothesis ABC. There was no interaction between the two levels of environment, the two sexes and the three levels of achievement.

Item Hypotheses

The hypotheses under this heading provided the micro-examination of achievement.

6. Main effect hypothesis for factor D. "There was

no difference between the mean achievement of sixth graders measuring achievement by their performance on individual items related to a given level of Bloom's Taxonomy."

7. Two-factor interaction hypotheses. "There was no interaction between the environment and individual items of the test." (Interaction AD was null). Similar hypotheses can be stated in respect of BD and CD interaction.
8. Three-factor interaction hypotheses. "There was no interaction between environment, sex and individual test items" (Interaction ABD was null). Similar hypotheses can be stated in respect of interactions ACD and BCD.
9. Four-factor interaction hypotheses ABCD. "There was no interaction between environment, sex, levels of achievement and individual test items."

The subject-matter of this chapter has been the population, procedures and the design of the study. The instruments, their administration and their analyses were described, followed by the general outlay of the design. Finally, the hypotheses were stated.

The next chapter presents the results of the study.

CHAPTER IV

ANALYSES OF DATA AND RESULTS

Analyses of Mathematics and English Data and Testing of Hypotheses

As described in Chapter III, the present study used a four-factor design (A,B,C,D), with factors C and D providing repeated measures. The design generated 15 hypotheses for Mathematics and as many for English. Tables 4.1 through 4.6 give the results of the analyses. Results related to Mathematics are given first, and then those for English.

Between Groups Hypotheses

The level of significance used for testing the hypotheses was .05. As will be recalled, the "between groups" hypotheses used total scores as criterion measures. The critical value for F (1,288) needed to reject HO is 3.84. The HO regarding factor A (rural-urban differences) was, therefore, rejected. Urban students had superior achievement, (mean achievement for rural = 14.7, that for urban = 19.07). Sex difference was non-significant, nor was there interaction between environment and sex (AB).

Within Subjects Hypotheses

Of the ten possible interactions in this part of the analysis, three were significant. These were:

(a) Interaction between environment and levels of

TABLE 4.1

Summary of Analysis of Variance - Mathematics

Hypotheses	Source of Variation	D.F.	Sum of Squares	Mean Square	F	P
	Between Subjects					
A	Rural-urban	1	745.29	745.29	156.73	.001
B	Sex	1	4.68	4.68	.98	NS
AB	R-U x Sex	1	4.96	4.96	1.04	NS
Error	Subject within group	288	1372.63	4.77		
	Total	291	2727.56			
	Within Subjects					
C	Levels of Cognition	2	79.00	39.5	23.64	.001
AC	R-U x levels	2	12.00	6.00	3.59	.02
BC	Sex x levels	2	.129	.064	.04	NS
ABC	R-U x sex x levels 1	2	7.86	3.93	2.35	NS
Error	Subjects w.g.	576	962.33	1.67		
D	Items	29	439.24	15.15	89.12	.001
AD	R-U x items	29	22.21	.77	4.53	.001
BD	Sex x items	29	3.48	.12	.71	NS
CD	Level of Cognition x items	58	23.43	.404	2.38	.02
ABD		29	5.39	.186	1.09	NS
ACD		58	9.69	.16	.94	NS
BCD		58	17.40	.30	1:76	NS
ABCD		58	9.28	.16	.94	NS
Error		8064	1393.51	.17		

cognition (AC).

(b) Interaction between environment and the items (AD).

(c) Interaction between levels of cognition and items (CD).

All other interactions, especially those involving B (sex) were non-significant, even though main effects for factor C (level of cognition) and D (items) were significant.

One cannot use these as final conclusions due to the presence of interactions. "Simple main effects" were therefore examined.

A_1C, A_2C Differences

Achievement of rural-urban at factor C was compared with the help of t-test:

$$t = \frac{X_1 - X_2}{\sqrt{MSW \times 2/N}}$$

There was significant difference in favour of urban children, ($t = 24.05$). This implied that at the sub-score level, urban children were superior. Simple main effects on different levels of cognition were, therefore examined.

Simple Main Effects for Rural-Urban Environment on Different Levels of Cognition AC_1, AC_2, AC_3 Differences

Comparing achievement at the two levels of factor A at each level of factor C, the results obtained are given in Table 4.2.

These means are shown graphically in Figure 4.1 also.

TABLE 4.2

Means and Sample Sizes for Rural-Urban Pupils on Each Level of Cognition

	Knowledge (C1)	Comprehension (C2)	Application (C3)
Rural (A1)	N = 146	N = 146	N = 146
	Mean = 6.25	Mean = 4.43	Mean = 4.06
Urban (A2)	N = 146	N = 146	N = 146
	Mean = 6.65	Mean = 6.19	Mean = 6.12
	t = 1.3	t = 5.9**	t = 7.2**

t (1,146) = 2.58

**Significant at .01 level

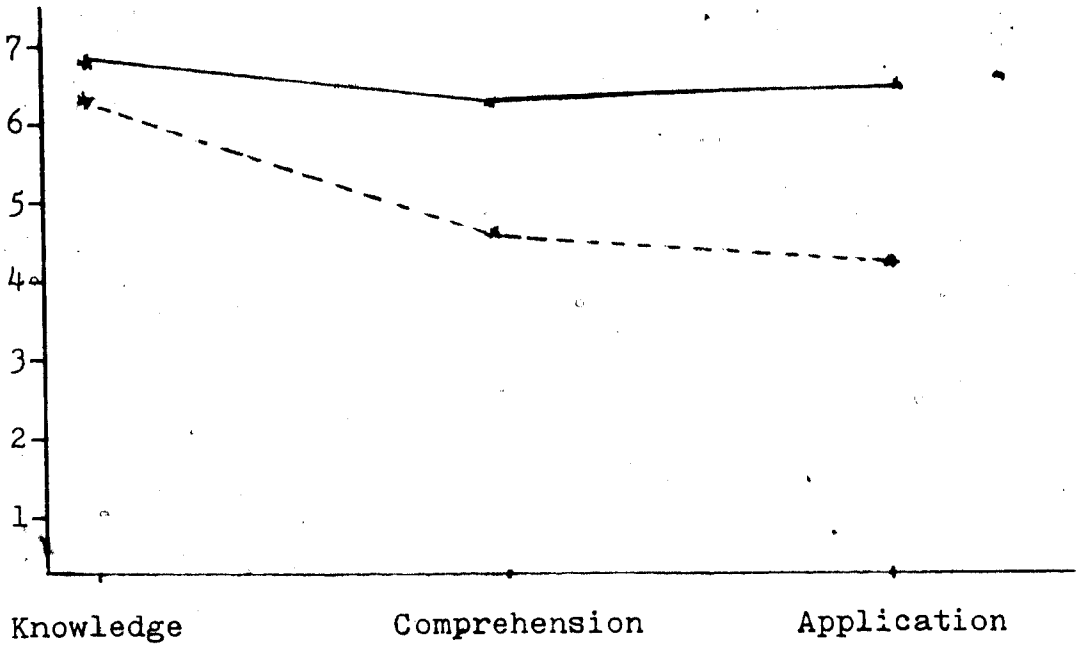

FIGURE 4.1

Graphic Representation of Differences in Means Classified by Environment and Levels of Cognition (Mathematics)

It can be seen both from the table and the figure that rural and urban differences became more and more conspicuous as one went from knowledge to comprehension to application. They were invariably in favour of urban children. Differences between means were also examined for statistical significance with the help of t-test. The results are shown in Table 4.3. From that table, it can be seen that there were significant differences in favour of urban pupils at the comprehension and application but not at the knowledge levels. In other words, as intellectual abilities and skills become more complex the difference between rural and urban children in Nigeria becomes more and more conspicuous, consistently favoring urban pupils.

Simple Main Effects for Rural-Urban Environments on the Items (AD_1, AD_2-----AD_{30})

Simple main effects for factor A on the items were also examined. The results are given in Table 4.4. A graphic representation of means is in Figure 4.3.

From the above-mentioned tables, one could see that there were no significant differences between the mean scores of urban and rural children on only ten of the items of the test. Six of these items belonged to the knowledge level; they were items 1, 2, 5, 6, 7 and 8. Two belonged to the comprehension level: 12 and 14; two to the application level: 27 and 28. All but one of the significant differences on the items were in favour of urban children irrespective of

TABLE 4.3

Item Mean Classified by Type of Environment

(N for each cell - 146)

Item	Mean			Item	Mean		
	A_1	A_2	t		A_1	A_2	t
1	.555	.597	1.4	16	.308	.507	6.6**
2	.260	.311	1.7	17	.082	.349	8.9**
3	.795	.973	5.9**	18	.363	.527	5.5**
4	.164	.336	5.8**	19	.582	.829	8.2**
5	.884	.911	0.9	20	.671	.911	8.0**
6	.278	.233	-1.5	21	.034	.313	9.3**
7	.459	.514	1.8	22	.377	.712	11.2**
8	.678	.714	1.2	23	.356	.651	9.8**
9	.473	.733	8.7**	24	.466	.384	-2.4*
10	.425	.699	9.1**	25	.295	.678	12.8**
11	.801	.979	5.9**	26	.548	.863	10.5**
12	.726	.765	1.3	27	.500	.507	.2
13	.103	.253	5.0**	28	.527	.541	.5
14	.068	.041	-0.9	29	.596	.733	4.5**
15	.767	.993	7.5**	30	.486	.610	4.1**

A_1 = rural

A_2 = urban

*Significant at .05 level

**Significant at .01 level

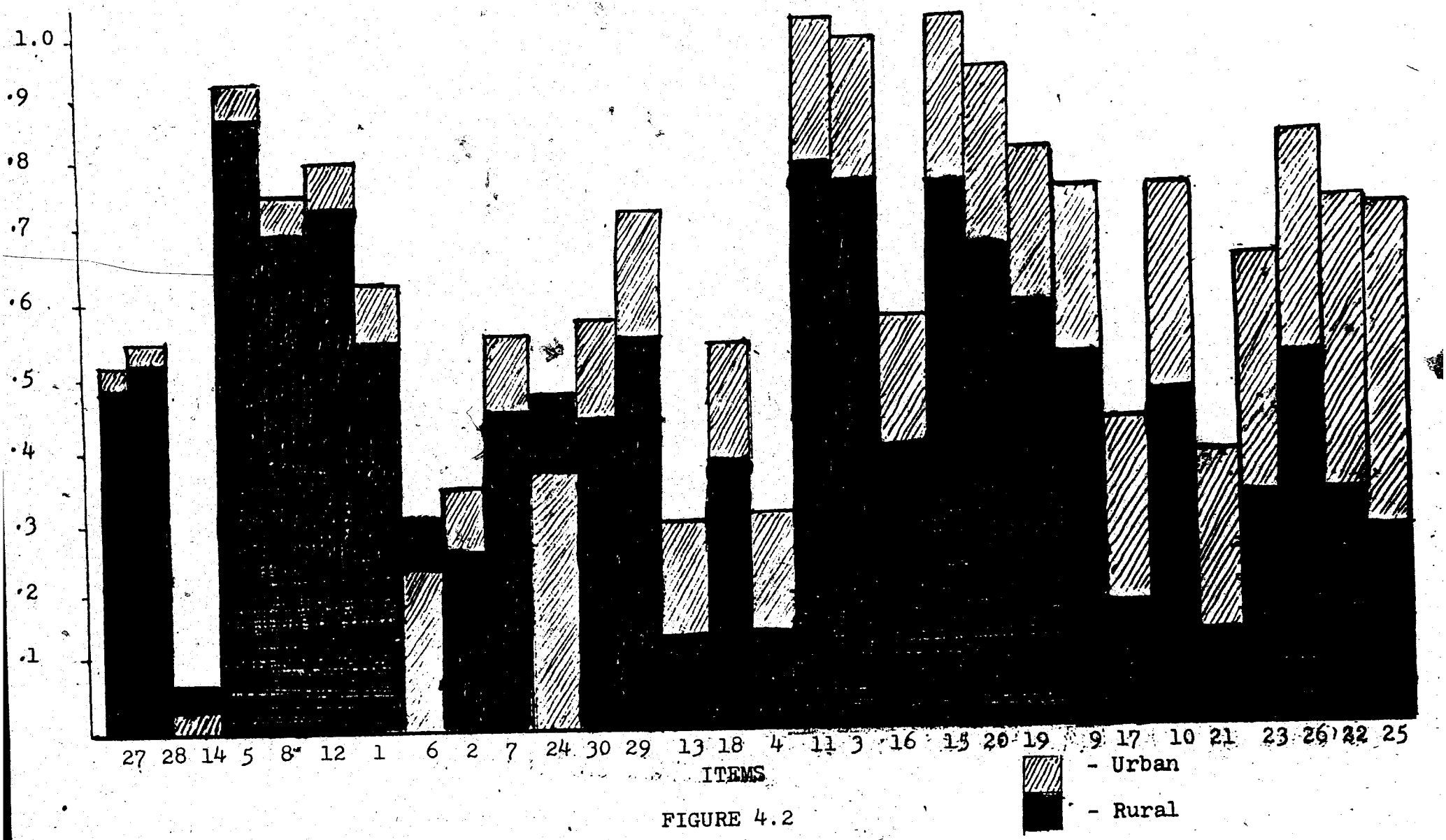

FIGURE 4.2

Graphic Representation of Differences Between Means in Order of Magnitude (Mathematics)

the level of cognition. The exception was item 24.

Reference to the test itself showed much difference between the two groups of children on items requiring the manipulation of fractions. Eight items on fractions were selected and compared. These were items 1, 4, 8, 10, 14, 19, 21 and 30. Item-mean for this group was: rural, .37, urban, .52, ($t = 4.78$, significant at .01 level). Rural children were found to be weaker than urban ones in this area of mathematics.

CD Interaction

CD interaction was significant ($F = 2.38$). This meant that items interacted with levels of cognition. Simple main effects for C and D were not examined however, since they will state the obvious truth that the difficulty level of items does not depend upon the level of cognition and vice versa.

Summary of Results for Mathematics Data

This summary brings together the results relating to the 15 null hypotheses for mathematics. The analyses showed significant differences due to factors A (rural-urban), C (level of cognition) and D (items) in the area of mathematics. Factor B (sex) was non-significant. The null hypotheses for factors A, C and D were, therefore, rejected. Environment was found to relate to the overall performance of sixth graders in mathematics, always favoring urban students.

The test of simple main effects was made where

applicable by the help of t-test. Examination of simple main effects for A showed that difference related to rural-urban environments became more conspicuous as intellectual abilities became more complex. The difference at the knowledge level was non-significant. Those at the other two levels were in favour of urbanites.

Simple main effects were also examined for factor A using different levels of factor D. Six of the ten items at the knowledge level showed no significant difference, whereas there were only two such items at each of the other two levels: comprehension and application.

Items in which there were significant differences included those on simple proportion, percentage, fractions, factorization and changing money. Naturally, children in urban areas handle money more frequently than those in the rural. Another characteristic of these items was that they related to practical experience. Items 9, 11, 22, 24 and 29 are examples of some of the practical experiences to which urban pupils are more likely to be exposed.

Of the 11 interactions in the analysis of mathematics data, only 3 were significant. These were:

(a) Rural-urban x levels of cognition (AC).

(b) Rural-urban x items (AD).

(c) Levels of cognition x items (CD).

The results were, thus, in the predicted direction.

Summary of Analysis of Variance (English)

Fifteen hypotheses were tested, using English test data. The results from the analysis of variance are shown in Table 4.4. Results of tests for simple main effects are presented in Tables 4.5 and 4.6.

Between Subjects Hypotheses

The analysis of variance table showed that main effects for factors A (rural-urban) and B (sex) were significant. This was consistent with what was predicted. Urban children performed better than rural ones, while girls were superior to boys; (mean achievement for rural and urban were 15.8 and 16.7 respectively; and those for boys and girls were 15.6 and 17.1 respectively). The null hypotheses of no difference between urban and rural students and also between boys and girls were, therefore, rejected. AB interaction was non-significant.

Within Subjects Hypotheses

ABC and ABD Interactions

ABC and ABD interactions were found to be significant. No further analyses were attempted since the results of such analysis are often very difficult to interpret and apply. The results presented below were obtained using procedures one will normally use when the higher order interactions are not present.

TABLE 4.4

Summary Analysis of Variance - English

Hypo-theses	Source of Variation	D.F.	Sum of Squares	Mean Square	F	P
	Between Subjects					
A	R-U	1	56.78	56.78	16.22	.001
B	Sex	1	13.57	13.57	3.88	.05
AB	R-U x Sex	1	10.73	10.73	3.07	NS
	Subject w.g.	288	1008.05	3.50		
	Within Subjects					
C	Levels of Cognition	2	275.67	137.83	79.10	.001
AC	R-U x levels	2	17.20	8.60	4.93	.007
BC	Sex x levels	2	1.98	.99	.57	NS
ABC		2	12.06	6.03	3.46	.03
C	x Subjects w.g.	576	1003.75	1.74		
D	Items	24	259.55	10.80	63.53	.001
AD	R-U x items	24	48.88	2.04	12.00	.04
BD	Sex x items	24	7.31	.3	1.76	NS
CD	Levels x items	48	12.48	.26	1.53	NS
ABD		24	11.71	.49	2.9	.01
ACD		48	5.9	.12	.71	NS
BCD		48	9.6	.20	1.2	NS
ABCD		48	8.16	.16	.94	NS
D	x Subjects w.g.	6624	1116.24	.17		

AC Interaction

Since there was significant interaction between rural-urban environments and levels of cognition simple main effects for A and C were examined.

Simple Main Effects for A on Levels of Cognition AC_1, AC_2, AC_3

Tests of simple main effects were done, using t-test. The critical value for this test was $t_{.01}(1,292) = 2.58$ at .01 level. The results are given in Table 4.5. A graphic representation of the results is shown in Figure 4.3.

There was no significant difference between rural and urban children at the knowledge level ($t = 0.9$). But at the Comprehension and Application levels, the differences were significant. The differences became larger as the level of cognition became higher, ($t = 4.13$ for Comprehension, and 5.2 for Application). These were significant at the .01 level. It will be recalled that the results for mathematics reported earlier were similar.

Tests of Simple Main Effects for Factor A: Using Different Levels of Factor D (AD_1, AD_2----AD_{25})

Since AD interaction was significant, simple main effects for rural-urban environments were examined at each level of factor D, to enable one to study the association of environment with types of items. Table 4.6 shows the means and sample sizes for each item for rural and urban children, and the t-values.

TABLE 4.5

Achievement Means Classified by Environment and Levels of Cognition

	Knowledge (C1)	Comprehension (C2)	Application (C3)
Rural	N = 146	N = 146	N = 146
	Mean = 6.11	Mean = 5.03	Mean = 4.42
Urban	N = 146	N = 146	N = 146
	Mean = 6.23	Mean = 5.65	Mean = 5.2
	t = .9	t = 4.13**	t = 5.2**

**Significant at .01 level

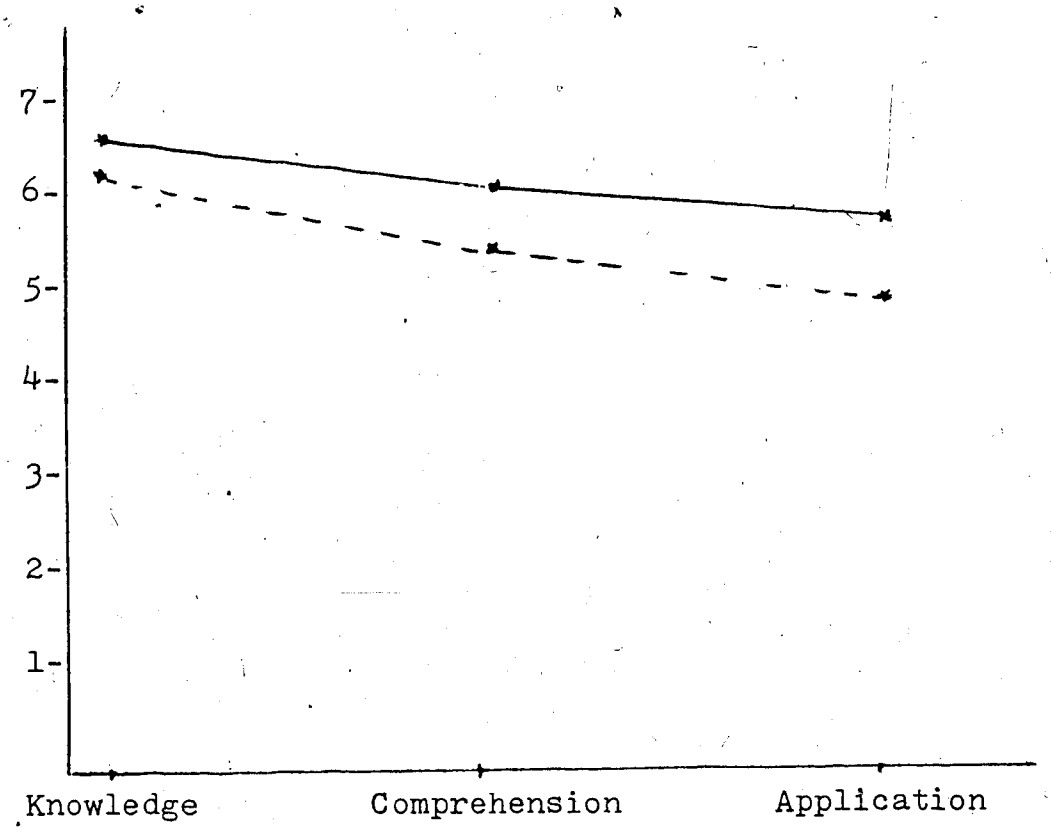

FIGURE 4.3

Graphic Representation of Differences in Means Classified by Environment and Levels of Cognition (English)

TABLE 4.6

Achievement Means Classified by Environment and Items (N = 146)

Item	Mean A_1	Mean A_2	t	Item	Mean A_1	Mean A_2	t
1	.665	.575	-3.12**	14	.502	.418	-2.8**
2	.767	.785	.6	15	.555	.643	2.94**
3	.534	.814	9.40**	16	.884	.885	0.02
4	.856	.857	0.02	17	.890	.908	0.6
5	.390	.510	4.00**	18	.288	.502	7.14**
6	.356	.365	0.29	19	.658	.778	4.00**
7	.403	.363	-1.33	20	.222	.151	-2.35*
8	.686	.623	-2.10*	21	.623	.863	8.06**
9	.458	.356	-3.4**	22	.740	.757	0.58
10	.693	.582	3.70**	23	.870	.871	0.02
11	.205	.516	10.37**	24	.767	.853	2.85**
12	.781	.867	2.85**	25	.527	.578	1.71
13	.651	.665	0.47				

t (1,292) = 2.58 at .01 level

*Significant at .05 level

**Significant at .01 level

Inspection of this table reveals that urban subjects did significantly better than their rural counterparts on items 2, 3, 5, 11, 12, 15, 18, 19, 21 and 24. Three of these (2, 3 and 5) were at the knowledge level; four (11, 12, 15, 18) were at the comprehension, and three (19, 21 and 24) at the application level. Most of these items involved reading a passage and answering some questions based on it. This might suggest lack of understanding or of attention on the part of rural children.

Rural children did better than urbanites on six items. These were items 1, 7, 8, 9, 14 and 20. These items involved the recognition or remembrance of some grammatical rules, which were at the knowledge level. The presence of items 14 and 20 (comprehension and application levels respectively) in this group must have been by chance.

There were no significant differences on the remaining nine items. Most of these items involved definitions and knowledge of specifics and grammar. It seems that on less complex materials, rural pupils tend to be at par with their urban counterparts. Figure 4.4 illustrates the interaction of the items with environment graphically.

Summary of Results for English Data

Fifteen hypotheses related to the English data were tested. Factors A, B, C and D were significant. Because of the presence of interactions, these overall effects were considered to be meaningless. Tests of simple main effects

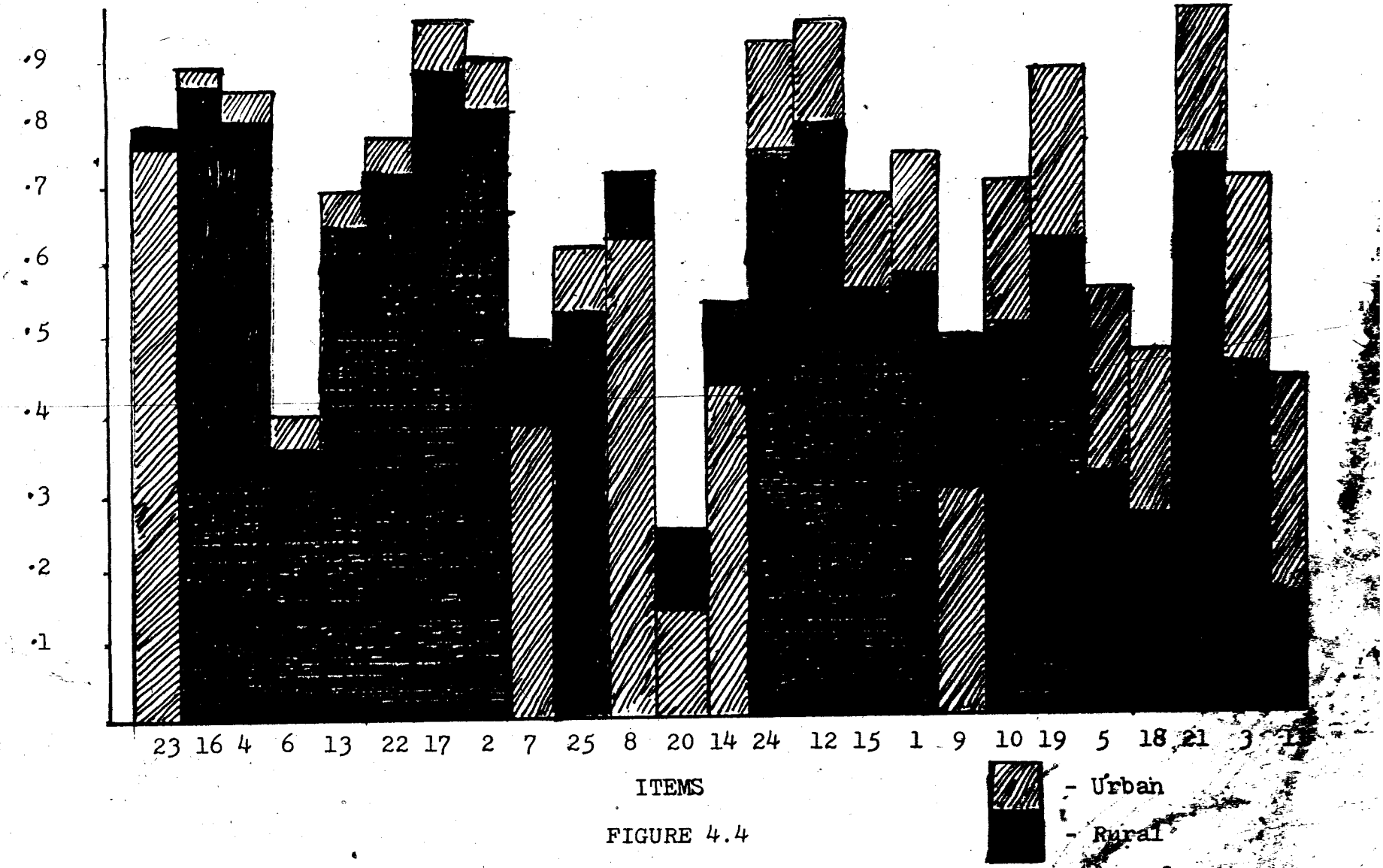

FIGURE 4.4

Graphic Representation of Differences Between Means in Order of Magnitude (English)

were done where necessary. Differences related to rural-urban environments became more noticeable as the cognitive level in Bloom's Taxonomy became higher. At the knowledge level, the difference between the two groups was non-significant. It was significant at .01 level at each of the other two levels. This was as predicted. This was also consistent with the findings from mathematics data reported earlier.

Simple main effects for A on factor D were also examined. Most of the significant differences were in favour of urban pupils; and more of the differences were on items at the comprehension and application levels. Rural children were found to be superior on certain items. The items were those which involved definitions and spelling which do not require higher level mental abilities.

Out of the 11 interactions in the analysis, 4 were statistically significant. These were: AC, AD, ABC and ABD. Simple main effects for the last two interactions were not examined for practical reasons.

The results from the English data confirmed the assumption that English is not as functional for rural students as it is for urbanites. Urban students scored higher than rural ones on items that involved reading a passage and answering questions based on it, and also on items that required reasoning or the application of a grammatical rule. These results corresponded with expectations.

There were no significant differences between the two

groups on items that required the recall of grammatical rules, definitions and knowledge of specifics. In fact, on some items of this nature rural children scored higher than urban ones. The reason for this could be that teachers in the rural areas put more emphasis on feeding the children with information, and achievement depends on how much of it the children can recall.

The results of the analysis of the questionnaire are presented next.

Results from the Questionnaire

As will be recalled, there were no definite or formal hypotheses relating to the questionnaire. The items were originally intended to be used descriptively only. Hence, the results are presented briefly. Frequency of responses on the bases of rural-urban environments were examined by the help of χ^2 tests. The results are given in Table 4.7.

As was expected, parents' educational levels differed considerably. It depended upon where they lived. More educated parents lived in the urban areas. Similarly, children in the urban areas indicated that they use English more frequently at home in contrast to rural children who rarely do so. Item 11 confirmed the assumption that English language is more functional in the urban than in the rural areas.

Items related to motivation showed that urban pupils are also more highly motivated than their rural counterparts.

TABLE 4.7

Frequency of Responses to the Questionnaire Items Classified by Rural and Urban also Resulting χ^2

Item	Rural Frequency of Responses				Urban Frequency of Responses				χ^2
	1	2	3	4	1	2	3	4	
1	20	14	67	36	77	33	34	6	66.84**
2	15	19	72	30	31	69	47	4	58.64**
3	56	23	35	35	62	21	59	9	21.52**
4	3	29	44	67	5	14	43	87	8.35*
5	49	53	37	8	45	66	37	1	6.86
6	118	22	3	4	129	19	1	4	1.50
7	42	5	19	79	28	19	23	82	11.29**
8	70	47	10	10	107	40	1	1	18.47**
9	63	28	51	1	30	26	65	26	37.35**
10	62	51	10	20	27	85	8	25	18.40**
11	3	6	123	6	18	29	102	2	29.20**
12	48	33	15	38	65	44	14	24	6.81
13	2	2	140	2	64	4	76	3	72.67**
14	30	70	40	8	45	65	29	6	4.98
15	6	66	17	15	21	81	13	35	9.84**
16	12	113	13	4	9	132	1	8	13.65**
17	61	67	5	6	81	56	6	4	3.93
18	20	7	108	7	24	28	92	1	18.40**
19	56	35	25	31	58	40	18	28	1.49
20	85	61			82	58			.82

χ^2 (3 d.f.) at .01 = 9.84 *Sig. at .05
at .05 = 7.82 **Sig. at .01

This can be seen from items 7, 8, 9 and 10. These items were designed to find why they go to school (items 6, 7); how much time they devote to private study at home (item 5) and also the type of persons they would like to become (item 10). The responses from urban children showed that they were more highly motivated, (items 7 through 10). Most of them planned going for secondary education (item 8) and they did better academically.

Since differences in academic achievement were in favour of urban children, it would appear from the results of the items of the questionnaire that motivation, parents' educational status, school environment and facilities worked together as influences on achievement. There was no attempt here, however, to relate the items of the questionnaire to achievement measures. This could probably form the focus of another study.

CHAPTER V

SUMMARY, RESULTS AND DISCUSSION, IMPLICATIONS AND SUGGESTIONS

Summary

The present study examined main effects and interactions of environment (factor A) and sex (factor B) with achievement, using sixth graders in Nigeria as subjects. Tests in Mathematics and English provided the criterion measures. The tests were based upon the first three levels of Bloom's Taxonomy. These levels constituted the third factor, (C) in the design. The items at each level of C constituted the fourth factor, (D). All the factors were assumed fixed.

Thus the study used a fixed factor design: factors A and B providing classification, and factors C and D providing repeated measures.

It was stipulated that not only would urban children perform better on the overall scores, but also that the differences would be more pronounced as the level of cognition became higher. It was also expected that there would be similar sex differences in favour of boys in Mathematics and girls in English.

A random sample of five elementary schools (2 urban and 3 rural) was drawn from a population of 452 urban and rural schools in three provinces of Nigeria. Two hundred

ninety-two sixth graders who were studying in these five schools were administered two tests, one in Mathematics and the other in English. In addition, the children completed a questionnaire of twenty items. The three instruments were constructed by the researcher for this study.

The Mathematics and English tests were modelled after the First School Leaving Certificate Examination which sixth graders write at the end of the school year. In Mathematics, there were ten items at each level of factor C. In English, there were ten, eight, seven respectively for the various levels.

The tests and questionnaire were administered to the children by the writer with the help of an assistant. The design of the study generated 15 null hypotheses for Mathematics, and as many for English.

Six of the fifteen null hypotheses for Mathematics were rejected. Three of them were for main effects and three for interactions. They all involved factors A, C and D. Factor B (sex) was non-significant so far as Mathematics was concerned; nor did it interact with any other factor. The significant interactions were AC, AD, and CD.

This implied:

1. Environment has an overall differential effect on the performance of sixth graders.
2. This differential influence was not significant at the knowledge level, but became significant at the comprehension and application levels.

Moreover, the differences became larger as one went from knowledge to comprehension to application.

3. Environment also interacted with items. Rural children performed poorly on certain categories of items, such as fractions and decimals.
4. In English, rural children were at par with their urban counterparts on items that required mere recall of grammatical rules and definitions, but differed significantly in favour of urban pupils on items that required higher levels of cognition.

Results and Discussion
(Mathematics)

Most of the results obtained in Mathematics were in the expected direction. For example, it was expected that the difference between the mean performance of urban and rural sixth graders would widen as the level of cognition became higher. This was found to be so. When simple main effects for factor A on the items were examined, more information was obtained about the relationship of environment to some categories of the items, thus confirming the premise of the present study - that micro-analysis of test scores is a more informative technique than macro-analysis for understanding the academic performance of school children.

One interesting finding was the non-significant difference related to sex as a factor, in the childrens' performance in the Mathematics test. This was contrary to

expectation. However, the lack of significant difference due to sex in experimental tasks has been a common phenomenon in several recent researches (Maccoby and Jacklin, 1974). Moreover, there seems to be less emphasis nowadays on traditional roles assigned to the sexes, so that one would not be surprised if the two sexes showed equal academic achievement.

Another reason may be that sex differences in academic achievement probably begin to be noticeable after sixth grade. This could be a matter for further investigation.

AD Interaction and Related Simple Main Effects (Mathematics)

The results of simple main effects for environment exposed the weakness of rural sixth graders in problems involving fractions and decimals. Their mean scores on these problems were significantly lower when compared with those on other types of mathematics items. This may be due to the way fractions and related problems are taught in the schools. Surprisingly, there was wide difference in favour of urban children in the practical implications of things such as 'circle,' 'triangle,' 'square,' 'gallon.' Some of these may not have any meaning outside the classroom in rural areas. However, further research is needed to examine simple main effects for environment on different subject-matter areas of grade six mathematics.

Results and Discussion (English)

All the four overall main effects A, B, C and D were found to be significant when English test data furnished the criterion. Simple main effects for environment (factor A) on levels of cognition (factor C) were found to be similar to those in Mathematics. The differences between urban and rural children widened as the items required higher mental abilities for successfully answering them.

As was expected, there were significant differences related to sex as a factor in favour of girls. This confirms earlier published findings that girls do better than boys in linguistic and literary tasks (Witkin et al., 1962). Neither AB nor BC interaction was significant.

AD Interaction and Related Simple Main Effects

Simple main effects for environment on the items produced interesting results. Urban children had higher mean scores on items which required higher mental abilities, but were at par on problems that required mere knowledge of grammar to solve. The reason could be that since English is not functional in the rural areas, as was seen in item 11 of the questionnaire, the children simply learn the rules of grammar by rote and can reproduce them. When it comes to comprehension and application, which are more complex than recalling, they are not as good. The failure of rural children to achieve equally well as their urban counterparts on more complex problems may be related to lack of school

facilities. This is a matter for further investigation.

In summary, one could conclude that the present study has shed more light on the performance of sixth graders in Mathematics and English tasks. As was predicted, rural environment is not conducive to abstract thinking or to solving problems requiring more than remembering, recognizing or recalling. Plans to improve on their performance must include ways and means for developing abstract thinking and symbolic representation.

The results of the questionnaire may lead one to say, though not categorically, that urban children have much better chances for greater achievement. They are freer with their teachers, have better educated parents and are more likely to develop 'affect' for certain subjects from parental influence and supervision, and from better school and environmental facilities. It would be difficult, however, to relate these directly to achievement in the present study.

Implications and Suggestions

The lower performance of rural children on the tests raises some question about how they are taught at school. Some teachers in the rural schools think of education as merely the imparting of information, "mental filling," whereby children only take in and reproduce their lessons. Children in the rural areas should be encouraged to discover, to think, to undertake abstraction, and be able to apply what they have learned in different situations.

This calls for reorientation in teaching methods and

teacher education, the use of learning experiences such as educational trips to large cities, to enable the children to integrate what they learned in the classroom with the outside world. They could be taught to manipulate physical environment in the home or at school to enhance thinking and abstraction.

It was evident that rural children exhibited weakness in some areas of Mathematics. Fractions in Mathematics, for example, could be illustrated practically, and the children encouraged to conceptualize what they are learning. There may be other areas in Mathematics, in English, or for that matter, in other subjects where children experience special difficulties. Such special difficulties cannot come to light by merely looking at the global scores of the children in a given test, but by micro analysis of the test scores, as has been illustrated in this study.

Finally, the idea that girls are not as smart as boys in Mathematics seems disproved by the present study; as has been done by other recent studies (Maccoby and Jacklin, 1974). Given equal opportunity and the absence of traditional restrictions, they should be able to compete well with their male counterparts. Similarly, rural children may develop to abstract, to think and compete equally well with their urban counterparts in problems requiring higher levels of cognition, given the right direction and teaching.

Suggestions for Further Research

On the basis of the findings reported in this study,

further research may be suggested in the following areas:

1. There was no significant difference due to sex in the mean score of boys and girls in Mathematics. Some earlier studies assert that differences related to sex appear much later than the primary school age. This is a matter for further research using higher secondary Mathematics.
2. The relationship between achievement at different levels of cognition and environment could also be investigated at other age levels and other school subjects in the elementary school, rather than just at the grade six level.
3. Replication of the present study, this time using non-cognitive factors as independent variables. For example, grouping together those with similar family background, and comparing their achievement at different levels of Bloom's Taxonomy, or similar tasks; using motivational factors, teacher-class relationship, levels of aspiration and self concept, and other related variables.
4. There could be a follow-up study of rural children who get into urban secondary schools and vice versa, to see what changes, if any, took place because of changed environment. Such a study could help confirm findings about environment and cognitive development.
5. Simple main effects for environment on other areas

of grade six Mathematics could be examined, to see where teaching methods should be improved.

These studies should prove very useful to administrators and school authorities in the country.

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APPENDICES

APPENDIX A

Instruments (Mathematics and English tests):
(The Questionnaire)

Department of Educational Psychology
Faculty of Education, University of Alberta
Achievement Test Grade 6
Mathematics

Name of Candidate.....Sex.....

School.....Date.....

Instructions

1. You are going to take part in an important research experiment, which will be very useful to our schools. Work by yourself only. Do not ask the pupil sitting near you to help you. If you have any questions, ask the supervisor.

2. Attempt all questions. You will have 60 minutes to do so.

3. At the top of these instructions, print your name on the space provided for "Name of Candidate," write your sex, name of your school and today's date on the spaces provided.

4. Read each question carefully and decide which of the four answers numbered A-D is the correct answer to the question. Then circle your choice as shown in the following example:

   Example - How many kobo are there in 1 naira?

   A - 120
   (B) - 100
   C - 80
   D - 50

   Yes, 100 is the correct answer, therefore, circle B.

5. Use pencils only to mark your answers. If you want to change your answer, be sure that you erase the first answer completely before you make the change.

6. Distribute your time wisely. You should be able to complete the examination in the 60 minutes allowed. There is no penalty for guessing.

Are there any questions?

Turn to next page.

1. Which of the following is equal to 5/9?

   A - 3/27
   B - 10/27
   C - 15/27
   D - None of these

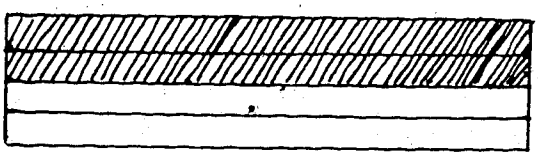
2. If $630 \div 6 = 105$, what is 105 called?

   A - sum
   B - product
   C - quotient
   D - remainder

3. What is fifty thousand and forty-three in figures?

   A - 50,043
   B - 50,0043
   C - 5,043
   D - 54,300

4. What fraction best represents the shaded portion of the diagram?



   A - 2/16
   B - 4/16
   C - 6/16
   D - 8/16

5. The meaning of 5^2 is?

   A - 5 x 2
   B - 5 - 2
   C - 5/2
   D - 5 x 5

6. What is the sum of the angles of a triangle?

   A - 90 degrees
   B - 180 degrees
   C - 270 degrees
   D - 360 degrees

7. Which of the following is the largest number?

   A - .064
   B - .06
   C - .046
   D - .46

Turn to next page.

8. Which of the following is an improper fraction?

A - 1/8
B - 8/8
C - 9/8
D - 7/8

9. What is the distance round an object called?

A - area
B - length
C - perimeter
D - width

10. What fraction is expressed in lowest terms?

A - 2/6
B - 13/27
C - 10/14
D - 7/21

11. A boy bought a book that cost one naira 63 kobo. He gave the store clerk ₦2. How much change does he get from the clerk?

A - 37 kobo
B - 43 kobo
C - 39 kobo
D - 47 kobo

12. Which of the numbers given below is the largest whole number you can write with the following four digits, 5, 8, 6, 4?

A - 6,584
B - 8,654
C - 8,465
D - 8,645

13. How many hours are there from 11 a.m. Tuesday to 11 p.m. the following day?

A - 20
B - 24
C - 30
D - 36

14. Ada wrote $6.79 = 6 + 7/10 + 9/100$. Uche wrote $6.79 = 6 + \frac{79}{100}$. Who is right?

A - Ada
B - Uche
C - Both
D - Neither

Turn to next page.

15. What is the sum of 205, 9, and 84?

A - 278
B - 318
C - 298
D - 308

16. In a class of 65 children 40% failed. How many passed?

A - 39
B - 40
C - 60
D - 13

17. The average marks of two boys is 60%. One of them scored 48%. What did the other score?

A - 12%
B - 72%
C - 60%
D - 24%

18. What is the least common denominator for 1/8 and 5/6?

A - 24
B - 12
C - 48
D - 40

19. Reduce $\frac{14}{6}$ to a proper fraction.

A - 1 4/6
B - 2 1/6
C - 2 1/3
D - 2 2/3

20. Find the ratio of 25 to 15.

A - 3:8
B - 3:5
C - 5:3
D - 3:2

21. Which is the smallest of these fractions?

A - 1/2
B - 3/8
C - 7/16
D - 5/12

Turn to next page.

22. Chike, Ngozi and Chidi share 108 oranges in the ratio 2:3:4 respectively. What is Chike's share?

A - 24
B - 12
C - 30
D - 15

23. The average of three numbers is 7. Two of the numbers are each 6. Find the third number.

A - 6
B - 5
C - 10
D - 9

24. A boy walks the first 2 kilometers in 40 minutes, and another kilometer in 32 minutes. Find the average time in minutes he takes to walk one kilometer.

A - 20
B - 22
C - 24
D - 30

25. If 15% of a certain number is 90, what is the number?

A - 500
B - 600
C - 720
D - 840

26. One factor of 96 is 8. What is the other factor?

A - 6
B - 12
C - 16
D - 24

27. A number, x is as less than 10 as it is greater than 4. What is the number?

A - 10
B - 8
C - 9
D - 7

Turn to next page.

28. Divide ₦3.51 between Okeke and Okafor so that Okeke may have twice as much as Okafor. What is Okafor's share?

A - ₦1.17
B - ₦1.24
C - ₦2.34
D - ₦2.32

29. A tank 4/5 full contains 40 gallons of water. How many gallons would it hold when full?

A - 45 gallons
B - 50 gallons
C - 55 gallons
D - 60 gallons

30. In which list are all the fractions equal?

A - 2/6, 3/9, 4/12
B - 2/3, 4/6. 6/12
C - 4/5, 5/6, 7/8
D - None of these.

The End.

Key to Mathematics Test

1	C	16	A
2	C	17	B
3	A	18	A
4	D	19	C
5	D	20	C
6	B	21	B
7	D	22	A
8	C	23	D
9	C	24	C
10	B	25	B
11	A	26	B
12	B	27	D
13	D	28	A
14	C	29	B
15	C	30	A

Department of Educational Psychology
Faculty of Education, University of Alberta
Achievement Test Grade 6
English

Name of Candidate.....Sex.....

School.....Date.....

Instructions

1. You are going to take part in an important research experiment, which will be very useful to our schools. Work by yourself only. Do not ask the pupil sitting near you to help you. If you have any questions, ask the supervisor.

2. Attempt all questions. You will have 60 minutes to do so.

3. At the top of these instructions, print your name on the space provided for "Name of Candidate", write your sex, name of your school and today's date on the spaces provided.

4. Read each question carefully and decide which of the four answers numbered A - D is the correct answer to the question. Then circle your choice as shown in the following example.

   Example - He wants to sleep, but he.....
   do his home work.

   A - have to
   (B) - has to
   C - having
   D - having to

   Yes, has to is the correct answer.
   Therefore, circle B.

5. Use pencils only to mark your answers. If you want to change your answer, be sure that you erase the first answer completely before you make the change.

6. Distribute your time wisely. You should be able to complete the examination in the 60 minutes allowed. There is no penalty for guessing.

Are there any questions?

Turn to next page.

1. In the following sentence, if cobra is a noun, what is dirty?

   A - Verb
   B - Preposition
   C - Adverb
   D - Adjective

2. Choose the best word to fill the blank.

   ".....is she?" "She's 21."
   A - How
   B - How big
   C - How much
   D - How old

3. I'm tired and I want to.....

   A - Go bed
   B - Go to bed
   C - Go to the bed
   D - Go into the bed

4. "This is Ibe's sweater." "Do you want me to give it .....him?"

   A - By
   B - For
   C - To
   D - With

5. Choose the correct one from the following four different spellings of the same word.

   A - Immediate
   B - Imidiate
   C - Immidiate
   D - Immedate

6. What is the underlined word in the following sentence?

   "Ibe cut his finger with a knife."

   A - Subject
   B - Object
   C - Verb
   D - Adjective

Turn to next page.

7. What do we call a word that qualifies another word?

A - Preposition
B - Adjective
C - Adverb
D - Pronoun

8. Which of the following sentences has a proper noun in it?

A - Buy some new clothes so that you will look decent.
B - David gave him a book for a present.
C - She usually did things the right way.
D - He did not know what to say.

9. Which is the verb in the following sentence?

"From out of the window came the sound of music."

A - Came
B - From
C - Out
D - Sound

10. Which word in the list has nearly the opposite meaning to the word underlined?

Do not <u>hide</u> your face.

A - Uncover
B - Conceal
C - Disguise
D - Seek

Read the following passages carefully and then answer the questions which follow.

As Mrs. Eke entered her shop in the market, it began to rain so heavily that people started running here and there in confusion. Since Mrs. Eke did not want to lose any of the things she was selling, she refused to offer shelter to anybody.

Turn to next page.

11. Mrs. Eke did not allow anybody to take shelter in her shop because.....

A - She might be robbed
B - The store was not big enough
C - People were running about in confusion
D - It was raining heavily

12. People started running here and there in confusion because.....

A - Mrs. Eke had opened her shop
B - It was raining heavily
C - They wanted to buy something from Mrs. Eke
D - They wanted to rob Mrs. Eke.

13. Although Ngozi does not like running, she took part in the race in order to please her father.

A - Ngozi did not run
B - Ngozi pleased her father
C - Ngozi likes running
D - Ngozi was absent from school

The cobra is the most poisonous snake in Jupe. Its colour is sometimes yellow, sometimes brown with a dirty white underside. It is about five feet long.

14. The cobra is the ..... snake in Jupe.

A - Most harmless
B - Longest
C - Most deadly
D - Most friendly

15. The cobra is .....

A - Sometimes yellow
B - Always brown
C - Sometimes white
D - Always both yellow and brown

As the man entered the lorry, the driver demanded the fare and it was then that he knew that his money had been stolen.

16. Who demanded the fare?

A - The taxi driver
B - The guard
C - The passenger
D - The lorry driver

Turn to next page.

17. The man couldn't pay because .....

A - He did not want to travel anymore
B - The driver was rude to him
C - His money had been stolen
D - The fare was too high

A group of boys in Enugu held a party during the last Christmas season in honour of Ibe, one of their members who was leaving Enugu finally to settle in Aba.

18. A party was held because the boys were .....

A - Celebrating Christmas with Ibe
B - Entertaining their members from Aba
C - Sending off one of their members
D - Finally leaving Enugu for Aba

19. Choose the right word that best fits in the blank space.

Have you ..... of my brother's success?

A - Herd
B - Heard
C - Heed
D - Hard

20. Choose the right word that best fits in the blank space.

My teacher praised me by ..... me on the shoulder.

A - Parting
B - Petting
C - Patting
D - Panting

21. If this book belongs to John, ... book is that other one?

A - Whose
B - Whom
C - Which
D - Who

Turn to next page.

22. In the following number, there are three sentences. Read them carefully and decide which one should come first, which second and which third. Then circle the letter which represents the right order of the sentences.

    1. The driver stopped the car.
    2. The driver chased the cow off the road.
    3. The driver got out of the car.

    A - 1,2,3
    B - 2,3,1
    C - 3,2,1
    D - 1,3,2

23. Put the correct tense of the verb in the blank.

    If he comes again that dog ..... him.

    A - Bites
    B - Will bite
    C - Has bitten
    D - Bite

24. Pick the word that does not belong to the group and circle your choice.

    A - Handsome
    B - Ugly
    C - Lazy
    D - Beautiful

25. Complete the following statement using one of the words below.

    Sky is to ground as ceiling is to .....

    A - Roof
    B - Down
    C - Rug
    D - Floor

The End.

Key to English Test

1	D	14	C
2	D	15	A
3	B	16	D
4	C	17	C
5	A	18	C
6	B	19	B
7	B	20	C
8	B	21	A
9	A	22	D
10	A	23	B
11	A	24	C
12	B	25	D
13	B		

Questionnaire

Instructions:

Fill in your name, sex and school. Select your best answer to each question. Answer all questions.

Name.....Sex .....

School.....Date.....

1. Which of these shows your father's level of education?

   A. Took University degree
   B. Passed Secondary School/Teacher Training/Technical
   C. Passed Primary School
   D. Did not finish Primary School

2. Which of these shows your mother's level of education?

   A. Took University degree
   B. Passed Secondary School/Teacher Training/Technical
   C. Passed Primary School
   D. Did not finish Primary School

3. How do you find it talking with your parents?

   A. Very easy
   B. Easy
   C. Not so difficult
   D. Very difficult

4. How many brothers and sisters do you have, not including yourself?

   A. None
   B. 1-2
   C. 3-4
   D. 5 and above

5. How much time do you find for studying at home?

   A. Plenty - more than what I need
   B. Just enough
   C. Very little
   D. None at all

6. What is the best reason for you to go to school?

A. I want to achieve something
B. My parents want me to
C. My close friends go there
D. I have no good reason

7. How happy are you with the marks you get at school?

A. I wish I could do better
B. I am not very happy
C. I am quite happy
D. I am very happy

8. How confident do you feel about your ability to go to a Secondary School?

A. Very much
B. Just enough
C. Very little
D. Not at all

9. How often do you take part in school sports?

A. Always
B. Most times
C. Occasionally
D. Never

10. Do you have some person(s) in mind whom you wish to grow up like?

A. Never thought of that
B. Haven't found one
C. One person
D. Two or more

11. How often do you speak English at home?

A. Always
B. Most of the time
C. Sometimes
D. Rarely

12. How far is your school from your home?

A. Less than 1 kilometer
B. Between 1 and 2 kilometers
C. Between 2 and 3 kilometers
D. More than 3 kilometers

13. How do you get to school?

A. By car or bus
B. On bicycle
C. On foot
D. Other

14. How many of your school friends live near you?

A. Many
B. Quite a few
C. Just one or two
D. None

15. What type of playgrounds do you have near you?

A. Equipped playgrounds
B. Open fields
C. Side streets
D. None of these

16. If a classmate hurts your feelings, to whom would you like to complain?

A. Other classmates
B. The class teacher
C. The principal
D. Your parents

17. How would you describe your classmates?

A. Very friendly
B. Friendly
C. Not friendly
D. Don't care

18. How often do you talk with your teacher?

A. Very often
B. Often
C. Only when necessary
D. Rarely

19. If you were to celebrate your birthday, how many of your classmates would you invite?

A. All of them
B. About half of them
C. Just a few
D. None at all

20. If you had a choice, would you choose a different school?

A. No
B. Yes

APPENDIX B

(Results of second run of item analysis program on data)

Results of Second Run of Item-Analysis Program Mathematics

ITEM	DIFF	CRPB	RBIS	CRBIS	IRI
1	.673	.339	.572	.441	.206
2	.463	.271	.476	.341	.189
3	.883	.260	.539	.426	.106
4	.250	.290	.522	.395	.166
5	.917	.174	.422	.314	.065
6	.480	.166	.343	.208	.137
7	.707	.274	.493	.363	.170
8	.603	.277	.486	.352	.187
9	.560	.351	.577	.442	.227
10	.893	.258	.546	.434	.100
11	.760	.210	.416	.289	.129
12	.180	.236	.467	.345	.122
13	.883	.249	.521	.407	.102
14	.407	.285	.495	.361	.192
15	.213	.357	.627	.502	.182
16	.440	.226	.420	.285	.166
17	.707	.363	.610	.480	.210
18	.783	.275	.510	.385	.150
19	.200	.433	.741	.618	.208
20	.553	.420	.663	.529	.262
21	.500	.346	.569	.433	.227
22	.487	.375	.605	.470	.241
23	.713	.359	.606	.477	.206
24	.503	.149	.322	.186	.128
25	.533	.159	.335	.199	.133
26	.667	.372	.613	.482	.223
27	.543	.269	.473	.338	.187

Results of Second Run of Item-Analysis Program English

ITEM	DIFF	CRPB	RBIS	CRBIS	IRI
1	.873	.354	.737	.566	.153
2	.663	.220	.482	.285	.176
3	.910	.167	.457	.294	.074
4	.490	.166	.410	.209	.164
5	.377	.152	.392	.194	.149
6	.413	.088	.312	.112	.122
7	.687	.108	.337	.142	.119
8	.433	.158	.400	.199	.157
9	.350	.270	.545	.348	.202
10	.857	.324	.677	.502	.153
11	.687	.266	.543	.348	.192
12	.890	.187	.478	.311	.090
13	.927	.143	.426	.268	.059
14	.413	.261	.530	.330	.206
15	.740	.194	.453	.262	.147
16	.227	.080	.299	.112	.090
17	.760	.281	.574	.385	.178
18	.780	.270	.564	.378	.167
19	.890	.352	.752	.585	.141
20	.847	.352	.712	.536	.168
21	.567	.238	.500	.300	.197

(DIFF = Difficulty; CRPB = Corrected point biserial; RBIS = Biserial correlation; CRBIS = Corrected biserial correlation; IRI = Item reliability index