Author	EZE, Micheal Ozoemenam PG/ Ph.D/99/26912
Title	Effect of the Use of Scale Models on Academic Achievement and Interest of Students in Map-Work
Faculty	Education
Department	Science Education
Date	June, 2006
Signature	Ojionuka Arinze Digitally signed by Ojionuka Arinze DN: CN = Ojionuka Arinze, C = US, O = University of Nigeria, Nsukka, OU = Innovation Centre Date: 2009.06.01 04:25:13 -07'00'

Title Page

EFFECT OF THE USE OF SCALE MODELS ON ACADEMIC ACHIEVEMENT AND INTEREST OF STUDENTS IN MAP-WORK

BY

EZEH, MICHAEL OZOEMENAM
PG/Ph.D/99/26912

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Approval Page

This thesis has been approved for the Department of Science Education, Faculty of Education, University of Nigeria, Nsukka

by

Prof. J. I. N. Okpala (Mrs.) (Supervisor I)	Prof. S. A. Ezeudu (Supervisor II)
Internal Examiner	External Examiner 09/03/2007
Dr (Mrs.) A. A. Nwosu (Head of Department)	Prof. B. G. Nworgu Dean, Faculty of Education

Certification

Ezeh, Michael Ozoemenam a postgraduate student in the Department of Science Education, and with the Registration Number PG/Ph.D/99/26912, has satisfactorily completed the requirements for the degree of Doctor of Philosophy in Educational Measurement and Evaluation.

The work embodied in this thesis is original and has not been submitted in part or full for any other diploma or degree of this or any other university.

Ezeh, Michael Ozoemenam
PG/Ph.D/99/26912

Prof. J. I. N. Okpala (Mrs.)
(Supervisor I)

Prof. S. A. Ezeudu
(Supervisor II)

Dedication

This thesis is dedicated

to **Almighty God**

and to **my late parents**:

Mr Ezeh Amah (Akurienne), and

Mrs. Mgbafor Maria Ezeh (Okpudioranma)

Acknowledgments

I wish to express my sincere gratitude to the Almighty God whose immense Grace made the completion of this research work possible. I wish to express my appreciation to my Supervisor, Professor (Mrs.) J. I. N. Okpala for her motherly pieces of advice and immense contributions to this work.

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Michael Ozoemenam Ezeh
PG/Ph.D/99/26912

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Abstract

Map is geographers' main tool. However, studies have shown that Map-work poses the greatest difficulty to geography students. This has largely been blamed on the teaching methods. The purpose of this study is to investigate the effect of the use of Scale Models on the academic achievement and interest of students in Map-work. The research also sought to find out the effect of gender and ability level on academic achievement and interest of students in Map-work. Six research questions and ten hypotheses were formulated for the study. The researcher reviewed the related literature. A quasi-experimental design, specifically, the non-equivalent control group design was used. Four mixed schools were randomly selected from Awka Education Zone of Anambra State. The sample consisted of 197 senior secondary two geography students. A stratified random sampling technique was used in drawing the sample. The regular geography teachers of the chosen schools were trained and used for the study. The instruments used for data collection included: the Map-Work Achievement Test (MWAT), the Map-Work Interest Scale (MWIS) and three Topographical Map sheets. The 'MWAT' with a reliability estimate of 0.97 and the 'MWIS' with an internal consistency estimate of 0.82 were developed and validated by the researcher. The Map sheets were adapted and modified by the researcher for the study. The data were analysed using the Analysis of Covariance (ANCOVA), means and Standard Deviation. The major results of the study were as follows: (1) The use of Models had a significant effect on the academic achievement and interest of students in Map-work; (2) Gender was not a significant factor in the academic achievement and interest of students in Map-work when taught using scale models; (3) The students of high academic ability taught using Models performed significantly better and showed greater interest in Map-work than their low-ability counterparts taught using the same method; (4) There were significant interaction effect between method and gender, as well as method and ability levels on academic achievement and interest of students in Map-work. The implications of these findings with respect to teachers, students, educational administrators and planners as well as tertiary institutions were identified. Based on these, it was recommended that the procedures for the application of scale models for teaching concepts in Map-work should be incorporated into the school curriculum. Efforts should be made to equip teachers with the requisite knowledge, skills and competence on the production and use of scale models for teaching through seminars, workshops, conferences, etc. The limitations of the study were identified. Some suggestions for further research were also made.

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CHAPTER ONE

INTRODUCTION

Background of the Study

Geography is a core-subject in the Senior Secondary School (Federal Republic of Nigeria [FRN], 2004:20). The general objectives of geography education in accordance with the National Policy on Education is to help the Nigerian Senior Secondary School students to do the following:

i) understand the concepts of differential character of the spatial relationship of the surface features of the earth;
ii) understand the concepts of man-environment relations (to examine the life of man within his physical and cultural environments and to explain their interactions);
iii) appreciate and develop a sense of responsibility towards one's own society and an intelligent interest in the formulation of national goals and policies; especially, as they influence the different resources and regions of the area;
iv) develop sympathetic understanding of the people of other lands, based upon the recognition that they may have different assemblies of resources, different goals and different problems from the people of their home area;
v) organize and formulate principles according to acquired geographic concepts, which they can use to analyse and interpret special problems in their immediate and wider environment;
vi) develop skills and techniques for accurate, orderly and objective geographical investigations to be carried out both in the classroom and in the immediate environment. (National Educational Research and Development Council, 1985:V)

Map-work (Map reading and interpretation) is fundamental in the study of geography. The ability of one to read a map intelligently is the basis of all geographical studies (Tanser, 1986; Schee, Dijk and Westrhennen, 1992). According to Underwood (1981) the geographers' main tool is the map. Monkhouse and Wilkinson (1986) in support of this view stated that the map is the traditional medium of the geographer.

Strong emphasis has thus been placed on Map-work in geography education at the senior secondary school level. For instance, the map-work section is compulsory for many examination bodies such as the West African Examinations Council (WAEC); National Examinations Council (NECO); University of London General Certificate of Education (WAEC, 2003). This suggests the degree of importance attached to map-work in achieving the objectives of geography education.

Findings in the literature reviewed reinforce and justify the emphasis placed on map-work in geography education. According to Ajaegbu (1977) and Ayeni (1988), map-work provides a strong and effective base to enable students develop special geographical skills and techniques. Modern geography demands the acquisition of greater skills and techniques by geographers (Ajaegbu, 1977). Such include the following: field techniques; skills of map-interpretation; air-photo-interpretation; use and construction of graphs; matrices; statistical and mathematical analysis techniques; observational techniques; literacy expression techniques; remote sensing; basic communication skills, etc.

The basis for mapping is problem-solving (Okafor, 1988). The new secondary school geography curriculum places strong emphasis on problem-solving. According to Gagne (1977), problem-solving is a process by which the learner discovers a combination of previously learned rules that can be applied to achieve a solution to a novel situation. Eya (1988) and Adejuyigbe (1990) believe that the Nigerian child needs an educational experience that is functional and has a relation to real-life situations in and out of school.

It is in order to acquire the skill of problem-solving that new secondary school geography curriculum stresses on map-work (Okafor, 1988; NERDC, 1985). According to Okafor (1988) the emphasis on map-work is in order because maps provide the essential spatial language in which many geographical problems are discussed, conclusions reached and recommendations made. Ayeni (1988) confirmed that geography does not just focus on abstract development of knowledge, but rather on identification of societal problems and articulations of viable solutions to them.

Map-reading skills are highly useful in the study of specific environmental problems of given areas (Abumere, 1995). The state of man's environment and the implications on man's sustained existence have been major concern of nations (Moemeke, 2003; UNESCO, 1992). The following environmental problems have been sources of worry to man: soil-erosion; deforestation; climatic change; environmental pollution; specie depletion; over-population; desert-encroachment; etc. Map-work skills prepare the minds of children for solving environmental problems and also shape their attitude towards the environment (Okafor, 1988; UNESCO, 1988).

Maps show lots of information (Monkhouse and Wilkinson, 1986). They offer the possibility of both finding locations, spatial distributions and aerial differentiations. All these are important in achieving insight into reality and are areas of focus in geography education. Map-work is, therefore, indispensable in geography education.

Despite the significance of map-work in geography education, some studies show that map-work is the most difficult section of geography for students (Burke, 1983; Adetumberu, 1983; Yau-wong and Simma, 1992; Obi, Nweke, Oguamanam and Okonkwo, 1995; Akuma, 2005). It has also been found that many students fear geography because of map-work. Oyeleke (1988) in his case study of Oranmiyan Local Government Area of Oyo State reported that 62% of senior secondary school students he studied, feared Geography because of map-work.

The "WAEC" Chief Examiners' annual reports on "Paper One B" – the Map-work section - confirmed that the students generally find map-work difficult (WAEC, 1998-2001). The reports consistently indicated poor performance of students in the map-work section in the years reviewed. Such ultimately negatively affect achievement and interest in geography.

The "WAEC" Chief Examiners' and Moderators' reports (WAEC, 2000) revealed that the candidates would have performed better had it not been for the poor performance in the map-work section of the subject. The report stated that in spite of good performance of some candidates, they scored low marks because they were poor in map interpretation.

It has also been observed that the students generally tend to lack interest in map-work (Arowosegbe, Egeronu, Iheanacho, Okoye and Uche, 1981; Yalokwu, 1988; Adinna, 1991). WAEC (2001) and Onah (2000) blamed the students' low-interest in geography mainly to the map-work. Obi, et al. (1995) reported a tendency in which students registered initially for geography in WAEC examination and eventually withdrew their registration opting for other subjects. The academic achievement and interest of senior secondary students in map-work have thus been a source of concern in geography education. There is therefore, a need to research on methods of teaching map-work; with a view to testing their efficacy on achievement and interest of students.

Some studies have identified poor instructional methodology as a major reason why students find map-work difficult (Okpala, 1987; Ezeudu, 1992; Obi, et al, 1995; Akuma, 2005). The poor instructional methodology appears to be associated with the conventional lecture method of learning. In a survey of teachers' methods of teaching Map-work in Nigerian secondary schools, Arowosegbe, et al (1981) reported that the method of teaching predominantly used for teaching map-work in the lessons they observed was lecture and note or textbook dictation.

The conventional lecture method of teaching has its advantages and disadvantages. However, it appears that the persistent poor academic achievement and interest in map-work can be associated with the use of lecture method of teaching. Many studies have criticized the monotonous use of the conventional method of teaching. On the other hand, some studies recommend the use of conventional lecture method for teaching topics in map-work because of the nature of most of the topics (Adebola, Elefue, Shodipo, Elefue & Danbaba, 1991:125). There is thus a need to investigate and confirm the effectiveness of other methods of teaching on academic achievement and interest of students in map-work.

There is also a need to determine the effectiveness of other teaching strategies on the other variables of interest to this study. For instance, research reports on the effects of gender and ability levels of students on academic achievement and interest of students have been inconsistent. The available research efforts failed to investigate the area of map-work. To what extent can gender and ability levels of students affect academic achievement and the interest of students in map-work when specific methods are used for teaching?

The following strategies have been recommended for teaching geography: games and simulations; field work; activity; projects; problem-solving approaches; computer-assisted instruction; discussion, role-play; Models, etc. (NERDC, 1985; FMEST, 1985; Okafor, 1995). This study is interested in the use of Models for teaching and learning map-work.

A model may be described as a simplified version of reality, built in order to demonstrate certain of the properties of the reality (Haggett, Cliff and Frey, 1977:17). Nachmias and Nachmias (1992) described a Model as likeness of something, a representation of reality. Models (Ola, 1976) are abstractions or ideals to which the actual life situations may fit-in. According to Abler, Adams and Gould (1977), the most important use of the term 'model' is as a norm against which we measure our experiences of the world. Husen and Postlethwaite (1991) stated that often the result of structuring a problematic situation is called a model.

From the above definitions, the researcher can infer that the term 'model' has been, largely, associated with complexities of systems. As the information field becomes more complex and complicated, the need is created for their simplification and idealization as a means of understanding reality and ultimately solving a given problem.

There are many types of models. This research has been based on the 'Scale Model'. According to Ola (1976), scale models are objects moulded of clay, or plasticine, etc. for purpose of learning. He indicated that the students could be made to mould models of geographical features such as plateau, hills, valley, spur, ox-bow lake, etc. to be kept in Geography Room and used for teaching. Morgan (1971) stated that the scale models can be created and used at all levels of enquiry as many spatial variables lend themselves to modeling. According to Morgan, geographical processes can be reproduced for students to see their results by observation. For instance, the processes of erosion, stages of valley formations, etc.

Scale models in their simplest conventional forms can provide a three dimensional reproduction of the landscape or any object using materials such as superimposed layers of paper, card, pulp, hardboard or wood, moulded plaster or porters'-clay, plastics (Monkhouse, 1980). Chorley and Hagget (1971) described the scale model as hardware models, also known as models of physical construction or experimental constructions. They described the scale models as the types of models where-in the relevant properties of the real world are represented by the same properties with only a change in 'scale'. The scale models are, therefore, models that can provide a three dimensional creation of specific features.

The use of models for teaching and learning geography has been recommended (NERDC, 1985; FMEST, 1985). However, research attempts in the area of investigating the effectiveness of three dimensional models on learning outcomes in map-work, in the senior secondary schools in Nigeria, are not known to have been carried out. The effects of use of such models on academic achievement and interest in map-work are, therefore, not yet clear. There is, therefore, a need to carry out a research on the effects of models on academic achievement and interest of students in map-work.

Statement of the Problem

The acquisition of map-work skills is fundamental in the undertaking of all geographical studies. However, research has shown that map-work has been found to pose the greatest difficulty to students in the Senior Secondary School Certificate Examinations.

Research findings identified poor teaching methods as a major reason why students find map-work difficult. Many studies have criticized the monotonous use of the conventional lecture method and recommended the use of models for teaching and learning map-work.

However, the extent to which the use of models can affect the academic achievement and interest of students as well as their ability levels and gender is not known to have been ascertained empirically for the senior secondary schools in Nigeria. There is, therefore, a need for a research in the area of investigating empirically, the effect of the use of scale models on learning out comes in mapwork

Purpose of the Study

The purpose of this study is to ascertain empirically, the relative effect of the use of scale models on academic achievement and interest of senior secondary school students in map-work.

Specifically, the study aims at achieving the following objectives:

1. Ascertain whether significant differences exist in the mean achievement scores of the students in map-work; when taught using scale models and the conventional lecture method.
2. Compare the influences of the use of models on the mean achievement scores of male and female students in map-work.
3. Find out whether any significant differences exist in the mean achievement scores of high-ability and low-ability students when taught using models.
4. Compare the mean interest scores of the students taught using models with that of their counterparts taught using the conventional lecture method.
5. Compare the mean interest scores of the high-ability with that of low-ability students in map-work, when taught using models.
6. Compare the mean interest scores of the male and female students in map-work when taught using models.

Significance of the Study

The significance of this study shall be discussed on the basis of its theoretical and practical perspectives. On the theoretical perspective, this study is anchored on some psychological theories that account for how learning takes place. The study also has a philosophical relevance. All these, as well as the practical usefulness of this study are examined in this write-up.

The cognitive field theorists (gestalt psychologists) regard learning as re-arrangement of thought patterns. They thus stress the importance of 'structure' and "providing opportunities for intuitive thinking" in the classrooms. They see learning as an interaction between the cognitive structure and the incoming information, which results in meaningful learning. They believe that in meaningful learning, new knowledge is assimilated into the specific relevant existing concepts, where as in "rote learning" new knowledge is arbitrarily in cooperated into the cognitive structured. The cognitive field theory emphasizes insight, perception, discovery and understanding in learning situations. The essence was seen as gaining of insight into the relationship between learning experiences and problems to be solved. The contemporary exponents of this theory include the following: Wolfgang Kohler, Bruner, Kurt Koffka, Ausubel, Max Wertheimer, Kurt Lewin.

The use of scale models is anchored on the cognitive field theory of learning. In this study, opportunities are created for students to be exposed to making and using scale models for the purpose of determining 'contours' with the shapes of the models. The models of geographical features thus provide the basic structures and the opportunities for intuitive thinking. The use of models thus act as a bridge between the cognitive structure and the incoming information. This, facilitates meaningful learning.

The use of scale models by the pupils in the teaching – learning processes, thus creates room for alternative pupils behaviour in decision making processes. Such a situation provides opportunities for creativity, initiative, insight, perception in problem solving situations; in the process of determining contours and other required features using the scale models. The skills learnt, shall ultimately be transferred for solving future day to day problems in similar situations. The cognitive field theorists hold the view that when students are exposed to experiences that can enable them to find out by themselves the solutions to specific problem, they tend to develop problem solving skills as well as gain confidence in their abilities to learn.

The Stimulus-Response (S-R) psychological theory is also relevant to this research. The S-R theorist (the Behaviourists or Associationists) view learning as the formation of association between the stimulus and the responses. They believe that the presence of "stimulus" is very important in any learning event. To the Behaviourists, the quality of what is learnt and retained depends on the strength and the nature of the links (bonds or associations) between the stimulus and the response. The Behaviourists are therefore, interested in observing and explaining overt behavioural changes of an organism. They are also interested in how such behaviours could be controlled.

The stimulus situation could be in the form of words such as "action verbs"; or objects; geographical picture, aerial photographs; printed texts; maps, etc. Based on this, scale models therefore constitute Stimulus Situations. Models of geographical feature such as spurs, valley, concave and convex slopes, conical hills, plateaux, etc. can be created and effectively used as objects form of stimuli situation which facilitate necessary responses and ultimately result in meaningful learning of the specific topics in map-work. The stimuli such as scale models are expected to facilitate responses, especially with their manipulations in the teaching – learning situations, and ultimately result in meaningful learning of map work.

The study has a philosophical relevance. The recommendation for use of models is based on the new secondary school geography curriculum. This curriculum has been recognized to be problem solving oriented, in order to enable it achieve the set objectives of the national educational goals which derives from the country's philosophy of education.

The Nigeria's philosophy of education is based on:

a) the development of individual into a sound and effective citizen;
b) the full integration of the individual into the community; and

c) the provision of equal access to educational opportunities for all citizens of the country at the primary, secondary and tertiary levels both inside and outside the formal school system.

The national educational goals which derive from the above philosophy are as follows:

a) the inculcation of national consciousness and national unity;
b) the inculcation of right type of values and attitudes for the survival of the individual and the Nigerian society;
c) the training of the mind in understanding of the world around; and
d) the acquisition of appropriate skills and the development of mental, physical and social abilities and competencies as equipment for the individual to live in and contribute to the development of his society.

(Federal Republic of Nigeria, 2004:7).

To achieve these goals the new secondary school geography curriculum is problem-solving oriented. Before the advent of the new national policy on education, Nigerians of various fields of endeavour, researchers, parents, students etc, had continued to call for teaching learning processes that should be geared towards problem solving and consequently teach the students the ability to apply learned concepts and principles in solving everyday problems.

In order to achieve these national educational goals, the methodology, content, objectives and evaluation of the new secondary school geography curriculum were all designed and focused on training the child to be able to tackle the present day problems of socio-economic development. This shall enhance the achievement of the national objectives in line with the country's philosophy.

The set national educational goals affected the methodological orientations of the curriculum . Methodological guide was inbuilt into the curriculum with a view to achieving the above national educational goals. For instance, in the methodological guide, it was recommended that the methods of instruction should be activity based and child-centred .

The methodological guide, specifically, recommended the use of Models; games and simulation; fieldwork or local studies; field observation; data collection; projects and increased use of teaching aids. The guide also stressed that such strategies recommended are those that will facilitate the achievement of the set national educational goals linked to the national philosophy. This study focused on models is, therefore, relevant for the achievement of the national goal based on the country's philosophy of education.

There are some 'practical' usefulness derivable from this study. The classroom teachers, shall benefit immensely from the results of this study. The findings of this study would likely create interest and consciousness in the adoption of models for teaching and learning map-work, and other areas of geography. The literature reviewed reveals that models of any geographical features can be made and used for teaching and learning. The findings of this research will also form the basis for introducing innovations in teaching and learning map-work and other areas of geography.

The study would contribute immensely in simplifying the teaching and learning of complex relationships associated with geographical studies. The use of models simplifies the teaching of geographical processes and features. Models enable some groups of phenomena to be visualized and comprehended, which could otherwise not be either because of their complexities or because of their magnitude . For instance, the study of the processes of erosion can be simplified by moulding a model landscape in a garden, exposing it to weather elements and asking the students to observe and report on the processes of weathering and erosion on the model landscape.

The findings of this study shall be useful to the curriculum planners. In the course of curriculum planning, revision or modification, the curriculum experts shall utilize the relevant data based on the findings of this study. For instance, pieces of information on the skills in the teaching and learning of map-work and the concepts associated with the use of models, shall be utilized in the appropriate stages of curriculum planning, modification or revision. The curriculum experts shall also utilize the findings of this research and appropriately incorporate them while fashioning out the programmes that will help in attaining the objectives of curriculum plans.

The findings of this research would likely increase the students' interest in map-work. The students' participation is likely to stimulate interest and positively affect the students' academic achievement and attitude towards map-work as well as geography as a subject.

The findings of this study would be useful in continuous assessment of pupils' learning outcomes in the cognitive and particularly in the non-cognitive domains of behaviour. The scale models can be used for evaluation of specific skills of map-work exhibited by the students, especially by applying any associated observational techniques with respect to the psychomotor (e.g. manipulative skills) and affective domains of behaviour, for instance, checklist, rating scale etc. Scale models can also be used for 'process' evaluation of students based on specific skills of map-work and other areas of geography especially in the psychomotor and affective domain of behaviour; for instance, manipulative skills, measurement skills, etc. The study is therefore, likely to promote the use of models in assessment especially in areas where written work may not be the best approach for the assessment. Paper and pencil tests evaluate only the learning outcomes in the cognitive domain of behaviour.

The results of this study will be useful in identifying the learning benefits of students of various ability levels, when different methods are used. Such data will help in taking decisions on the suitable methods for teaching the students of various ability levels.

The result of this study shall be useful to teachers and other educational agencies with respect to improvisation of instructional materials for teaching and learning. Scale models can easily be improvised from locally available and cheap materials and used for teaching and learning. In recent times, emphasis is being placed on use of cheap and locally available materials, especially where it is not possible to purchase instructional materials as a result of high cost of such materials and scarce resources.

The findings of this study shall be useful in establishing the influence of gender on learning outcomes in map-work. The claim of male dominance in science education has not been consistent with some research findings. The results of this study will help to establish any gender influence with respect to map-work when exposed to a method of teaching especially in the area of map-work.

The results of this research shall be useful to the Ministry of Education. The Ministry regularly supervises workshops, seminars, conferences, refresher courses, etc., for teachers and others. The data on the results of this study shall be useful to the Ministry on such workshops, seminars, etc. The findings of the research can be utilized and communicated to the participants.

The new secondary school geography curriculum places emphasis on educating the child to be able to solve the present day problems of socio-economic development. Model-making by the students and the teacher, as well as teaching and learning using models, create opportunities for the students' use of: initiatives, critical thinking, creativity, intuition, etc. in decision making processes. These, ultimately induce productive thinking. All these are essential for useful living of the students within the society.

The Scope of the Study

The study focuses on the relative effects of the use of models on the academic achievement and interest of senior secondary school students in map-work, as well as the effects on the learning outcomes with regards to the students' ability groups and gender.

Models are of various types. Two broad classifications can be identified as follows: The Conceptual Models or Theoretical Models and Hardware Models or Experimental Constructions (Scale Model). The research shall be restricted to the use of the 'Scale Models'. The study shall specifically, be based on the under-listed topics on map-work in the senior secondary school geography curriculum. Studies have shown that these topics pose difficulty to the students (Adebisi, 1988; Gerber, 1992; WAEC, 2001).

i) Contour and Vertical interval
ii) Contour representation of highland forms
iii) Contour representation of lowland forms
iv) Relating relief to settlement
v) Relating relief to transportation

Research Questions

The research was guided by the following research questions:

1. Which group performed better in the academic achievement test in map-work; the students taught with models or those taught with the conventional lecture method, as indicated by their mean achievement scores?
2. Which gender group of students performed better in the achievement test in map-work when taught with models?
3. Which group by ability levels gained more in their academic achievement when taught map-work using scale models?
4. Which group of students, those taught with models or those taught with the conventional lecture method showed greater interest in map-work as indicated by their mean interest scores in map-work?
5. Which group of students by ability level showed greater interest in map-work when taught map-work using scale models as shown by their mean interest scores?
6. Which group of students by gender showed greater interest in map-work, when taught with models, as indicated by their mean interest scores?

Hypotheses

The following hypotheses were formulated and tested at 0.05 level of significance ($p<0.05$):

1. There is no significant difference in the mean achievement scores of students taught map-work with models and those taught with the conventional lecture method.
2. There is no significant difference in the mean academic achievement scores of male and female students in map-work when taught using models.
3. There is no significant difference in the academic achievement of high-ability and low-ability students taught with models, as measured by their mean achievement scores in map-work.
4. There is no significant difference in the mean interest scores of students in map-work of those taught using models and those taught using the conventional lecture method.
5. There is no significant difference in the mean interest scores of high-ability and low-ability students taught with models as indicated by their mean interest scores in map-work.
6. There is no significant difference in the mean interest scores of male and female students in map-work, when taught using models.

7. There is no significant interaction between method and gender on the students' academic achievement in map-work.
8. There is no significant interaction effect of method and gender on students' interest in map-work.
9. There is no significant interaction effect of method and ability levels on the mean academic achievement scores of the students in map-work.
10. There is no significant interaction effect of method and ability levels on the students' interest in map-work.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter reviewed the literature related to the study. The review was done under the following sub-headings:

Section A: Review of Theoretical Works

i. Theoretical Framework

ii. The Concept of Models

iii. The Classifications of Models

a) Types Common in geography

b) Other classifications of Models

iv. Functions and disadvantages of Models

v. The place of Map-work in geography education

vi. The Teaching and learning of Map-work in Nigerian senior secondary schools

vii. Achievements in Map-work at the senior secondary school levels.

Section B: Review of Empirical Studies

i. Studies on Map-work in Geography

ii. Studies on Gender and Academic Achievements

iii. Studies on Interest

iv. Studies on Ability levels

v. Studies on Models

vi. Summary of the Literature Review

Theoretical Framework

This discussion shall focus on psychological theories that have attempted to establish facts about knowledge, cognitive abilities, intellectual inquiry, etc., which may guide classroom behaviour and thinking in the teaching-learning process. The writer shall also discuss the philosophical foundation of the study.

This research is anchored on the cognitive field theory of learning (Gestalt psychology). According to Sills (1986) this theory is sufficiently developed to demand consideration from one seriously interested in problem-solving. The cognitive field theory was originated by some German psychologists: Max Wertheimer, Kurt-Koffka and Wolfgang-Kohler who were interested in developing a new approach to behaviour, which came to be known as 'Gestalt psychology' (Noel and Smith, 2002). Gestalt is a German word which means pattern, shape, form or configuration. Other proponents of Gestalt psychology include: Kurt-Lewin, Bruner, Ausubel, etc.

The studies of Chauhan (1987), McMahon and McMahon (1991), Bredo (2000), all point to the fact that the main factor in Gestalt psychology is the development of insight. The individual and his environment form a psychological field. According to the Gestalt psychology, the perception of the field and the gradual restructuring of the field is known as 'insight'. According to Kurt-Lewin as stated in McMahon and McMahon (1991), insight is a process of structuring or restructuring of a perceived area. The concept of insight is, therefore, accorded a central role and employed in the Gestalt psychology.

Some literature reviewed attempted some descriptions of situations which result to insight or insightful learning. When an individual struggles with a problem the solution may come to him all of a sudden (Chauhan, 1987). This quick change in our perception is called insight. According to Sills (1986), when an individual is confronted with a problem, processes occur in the brain and in the consciousness that by dynamic interactions with each other and with memory traces result – initially in seeing the problem. Seeing the problem sets up traces in the psychological field that determines the subsequent course of thinking.

These traces lead to the reorganization or restructuring of the field, enabling the individual to perceive the interrelationships that form the solutions to the problems. Such reorganizations tend to occur suddenly. However, a problem may require for solution, not one, but a series of progressive reorganizations, thus giving the appearance of a gradual solution. The Gestalt psychologists (Kohler and others) developed a new theory of learning known as Theory of Insight after carrying out series of experiments with animals (chimpanzees).

Chauhan (1987) identified some characteristics of insightful learning as follows: survey of a problematic situation; hesitation, pause, attitude of trial or a mode of response; trial of other responses – in case initial mode of response proves inadequate. The transition from one method to the other is always sharp and often sudden. Frequent, recurrent attention to the objective and motivation is common. At the appearance of the critical point the organism suddenly performs the required act. There is steady repetitions of the adaptive response. There is notably the ability to discover and attend to the essential aspects or relations in the problematic situation and to neglect relatively variations in non-essentials.

From the works of Chauhan (1987), McMahon and McMahon (1991), and Bredo (2000), the conclusions drawn on several experiments conducted on insightful learning are as follows:

1. Small children are usually better able to perceive essential relations when they are given concrete materials. They have limited capacity to manipulate, examine, and draw conclusions about objects or events not directly present before them.
2. At high intellectual levels, the students are partially free from their dependence on concrete materials actually before them. They can think in abstract terms.
3. The structure and organization of the subject matter plays an important role in learning. According to Bruner as cited by McMahon and McMahon (1991), the teacher should study the learners' reactions in

order to determine the method and order of presentation that will prove most helpful.

4. The teacher should encourage the students to search the materials to develop insight. He must help the learners to perceive the goal and the intervening variables.

These conclusions agree with Chorley and Haggett (1971) who stated as follows:

> Models are of greatest value in teaching. One recalls the old saying, hear and forget; see and remember and do and understand. The educational advantages that attend students finding out for themselves are increasingly being recognized among science teachers. The process of making, doing, observing and measuring of models develop the students' intuitive capacity and insight. Relationships and principles are also often easily perceived.

The application of scale models (the focus of this study) in teaching and learning map-work, manifests the main factors in Gestalt psychology. In making models to the expected specifications, and manipulating the scale models in the teaching-learning process, the students tend to apply creativity, trial and error, initiative, insight, etc. to arrive at the correct decisions based on the set objectives.

The theoretical framework of this research is also rooted on its strong philosophical base. This study has a philosophical foundation. The Nigeria's philosophy of education is dynamic in line with the contemporary social needs of the society. The school curricula are reflections of the philosophy of education and thus focused on equipping the child to meet the challenges of the changing society.

The Nigeria's philosophy of education is clearly spelt-out in the new National Policy on Education (Federal Republic of Nigeria, 2004:6). The national educational goals which derive from the national philosophy include the following: (a) the inculcation of national consciousness and national unity; (b) the inculcation of the right type of values and attitudes for the survival of the individual and the Nigerian society; (c) the training of the mind in understanding of the world around; and (d) the acquisition of appropriate skills and the development of mental, physical and social abilities and competencies as equipment for the individual to live in and contribute to the development of his society (Federal Republic of Nigeria, 2004:7).

To achieve these goals, there have been changes in the school curriculum with respect to the Objectives, Content, Methodology and Evaluation of the new curricula. The changes are in line with the philosophy of pragmatism. The present Nigeria's philosophy of education emphasizes pragmatism (Okafor, 1984).

The pragmatists believe that the curriculum should be result-oriented and problem-solving based. They believe that changing what should be changed should be the most important consideration in the implementation of the curriculum. According to Abiogu (2005) this is because knowledge should be vindicated by its applications to specific situations and its relevance to the solutions of particular problems – in human cosmic experience. The pursuit of knowledge should be determined by the usefulness of the knowledge in practical circumstances.

There have been series of calls by educators, researchers, parents, students that teaching-learning processes be geared towards problem-solving (Ali, 1983; Eya, 1988; Adejuyigbe, 1990). According to Ali (1983) there is the need to teach the students the ability to apply the learned concepts and principles to solve the day to day problems of the child's environment. This is with a view to achieving the set national educational objectives in line with the country's philosophy of education.

The changes in the school curricula in line with the new national policy, introduced methodological guides in the curriculum – with a view to inducing the achievement of the national objectives. In the methodological guides, it was recommended that the method of instruction should be activity based and child-centred (Akpata, 1991).

The methodological guide particularly recommended the use of models, games and simulations, field-work, local-studies, field observations, data collection, projects and increased use of teaching aids (NERC, 1985; Akpata, 1991). The guide emphasized that such strategies recommended are those that will facilitate the achievement of the national educational objectives derived from the country's philosophy of education.

The controversies on the issue of gender and gender related differences in school achievement and classroom behaviors have continued to be inconclusive. The discussions on the issue are fundamental to the theoretical bases of this research.

Attempts have been made by researchers to account for and provide the theoretical bases of the so-called Gender-related differences in school achievement. According to Fennema and Sherma (1977), as cited in Nwagu (1991), the spatial and verbal abilities were respectively identified as being related to the developments in the 'right' and 'left' hemispheres of the brain.

The males are said to use the right hemisphere more than the females for spatial reasoning. Hence they dominate in the sciences and science based courses. The females on the other hand make more use of the left hemisphere of their brains than the males. They, therefore, perform better than the males in verbal tasks.

Anastasi (1976), identified with gender differences in academic achievement in languages, in favour of the girls. However, she attributed the superiority of the females over males in languages to the amount and nature of contacts which girls had with their mothers, who are the principal models or sources of early language training for the children.

From the above discussions, it appears that there are basically two schools of thought with respect to the existence of gender related differences in classroom behaviors. One group believes that the differences arise from biological differences between the gender groups. The other school of thought attributed the differences to the socialization processes in child up-bringing.

However, researchers have also reported that there are no genetically gender related differences among males and females. Williams (1989), stated that there are no biological proofs to show that females are inferior to males. According to Okeke (2001), the perceived gender differences in the classrooms are not innate. She associated the hypothesized differences to gender stereotypism in the curriculum and instruction which is a reflection of such in the society in favour of the males.

The above argument has a strong backing of some other researchers. Bajah and Bozimo (1989), reinforced the view on sex-role stereotypism in the society in favour of the boys. They observed that the issue of sex-role stereotyping in the society is perhaps the source of all other gender related differences among boys and girls in all educational undertakings.

They argued that from the earliest stages in life, female children are brought-up to play certain roles among which science studies are hardly included. The situation had painted a masculine image of science subjects, brought about lack of support and encouragements to females in science studies and created fear and negative attitude in females with regards to science education. This situation tends to create the wrong impression that boys perform better than girls in science and science related courses.

According to Ezeliora (2004), from birth, the baby-girl is exposed to avoid the sciences. The societal set-up did not give her the opportunity to experience the environment which is a pre-requisite to science. Rather, she was kept indoors to do the house work and help her mother in the kitchen, while her brother is left to move about exploring the environment. The girls were also not exposed to schooling as early as the boys.

Recent events are breaking the barriers of gender stereotypism. The developments have thus enhanced women liberation and equal educational opportunities for the gender groups. According to Hammrich (1997), and Hammrich et al (2000), as cited in Ezeliora (2004), the United Nations organization's activities, especially , within the "United Nations' decade for women" (1976-1985) exposed the low-representation and marginalization of women in science and educational undertakings in the society.

Despite these developments, recent research findings on the academic achievement and interest of gender groups have continued to be inconsistent. There is, therefore, no consensus yet on which gender group achieves higher than the other. There is therefore a need to investigate the effect of use of scale models on academic achievement and interest of gender groups in map work. The expositions in the above psychological theories, research reports and philosophical background thus provide a solid theoretical framework to this study.

The Concept of Models

The term model has been used in a wide variety of contexts. The use cuts across various disciplines. This discussion shall focus on the explanations of the concept as well as various definitions of the term 'Model'.

The term model has been, largely associated with complexity of the systems, which has created a need for simplifications and idealizations as a means of understanding reality. According to Chorafas (1965), the traditional reaction of man to the apparent complexity of the world around him, has been to make for himself a simplified and intelligible picture of the world. He then tries to substitute this cosmos of his own for the world of experience and thus overcomes it. The mind (Apostle, 1969) decomposes the real world, into a series of simplified systems and thus achieves in one act an overview of the essential characteristics of a domain.

There are diverse definitions of the term Model as it can be conceived from various perspectives. From a geographical viewpoint (Skilling, 1964, in Chorley and Haggett, 1971) models include reasoning about the real world by means of translations in space (to give spatial models) or in time (to give historical models). Reality (Chorley and Haggett, 1971) as it exists in actuality, has been explored by the use of simplified patterns of symbols, rules and processes. The simplified statements of this structural interdependence have been termed Models. A model is thus a simplified structuring of reality which presents – supposedly significant figures or relationships in a generalized form.

Abler, Adams and Gould (1977) stated that generally speaking, a 'Model' may refer to any simplifications and abstractions of some relationships we believe to exist between experiences. They, therefore, stated that the term model could be used to designate a theory, a law, a classification, a hypothesis or even science itself, which certainly fits the characterization or a description and the abstraction of reality.

Haggett, Cliff and Frey (1977) stated that a model may be described as a simplified version of reality, built in order to demonstrate certain of the properties of reality. They believe that the role of models in geography is to codify what has gone before and to excite fresh inquiry.

Small and Witherick (1986) see model as a representation of the real-world, necessarily simplified in detail. Macdonald (1981) defined a model as a plan, a design, a preliminary solid representation to be followed in construction, something to be copied. Ola (1976) conceives a model as abstractions or ideals to which the actual life situations may fit in. Husen and Postlethwaite (1991), in another usage stated that often the result of structuring a problematic situation is called a model. They stated that structure is the essential feature of a model. All these definitions appear to relate more to the conceptual forms of models.

Models were also defined in concrete terms. A model in its simple conventional form, can provide a three dimensional reproduction of the landscape (Monkhouse, 1980). The materials may be of super-imposed layer of paper, card, pulp, hardboard or wood, moulded plaster or potter's clay or various plastics. Ola (1976) described this type of model as the 'scale-model' and recommended it for the study of relief features and geomorphological processes. Anikweze (1988) sees a model as a miniature representation of features or a symbolic representation of a geographical phenomena.

Some literature reviewed indicated that the techniques and materials available for the construction of the three dimensional models have been enhanced, with the development of thermoplastics and resins; as well as the use of computer and cutting machines for fitting-in of specific features in the models (Chorley and Haggett, 1971; Offorma, 2004).

Literature evidence revealed and explained a close relationship between conceptual or theoretical models and hardware (concrete) models or physical constructs. According to Morgan (1971), three dimensional models (physical constructs) cannot be isolated from conceptual models. To design a physical model we often without realizing it depend on some conceptual models.

Conversely, observations made from physical constructs (three dimensional models) may lead to some mathematical or verbal formalizations to conceptual models. Therefore the two are closely related.

From the definitions it can be inferred that models can be conceived in conceptual or theoretical terms or in physical constructs or concrete terms. This depends on levels of abstractions of reality. Models may be conceived theoretically as simplifications and abstractions of some relationships, by the use of symbols, rules, formulae, processes, etc. Models may also be conceived in concrete terms using a three dimensional creation which are representations of the real features.

The concrete types of models can provide a general framework with which the various features associated with different types of geography can be conceived and studied. Such, therefore, provide the opportunity for the children to see what they are being taught as they are in reality (Ola, 1976; Chorley and Haggett, 1971).

This fact creates a need to investigate the effectiveness of use of models of this type for teaching map-work. Map-work is considered a difficult section of Geography for students. For the purpose of this study, the researcher shall use the 'Scale Model' type. In this context, therefore, the researcher hereby gives his working definition of a model.

A model is a concrete device, that can provide a three dimensional representation of the desired feature(s), for the purpose of depicting the actual, real-life forms of such feature(s), in order to reduce abstractions and for various other desired purposes of learning. This type of model may be moulded, carved or reproduced into any other forms of concrete shapes to suit the desired purpose(s).

The Classifications of Models

There are various classifications of models. The approach to the classifications vary in literature. It appears, there has been no consensus on the basis for classifications. Models are developed in virtually every field of human activity (Husen and Postlethwaite, 1991). In this write-up, the types of models common in geography shall be discussed. Other classifications of models shall be x-rayed. However, this discussion shall be within the limits of the scope of this study.

Types of Models Common in Geography

The geographical literature identified some types of models that are commonly used in various branches of geography and social sciences (Chorley and Haggett, 1971; Ola, 1976; Ajaegbu, 1976; Abler, Adams and Gould, 1977; Haggett, Cliff and Frey, 1977; Adegoke, 1988). The following types shall be discussed: Industrial Location Models; the Normative Model; Von Thunen's Model of land use pattern; Weaver's Crop Combination Model; Model of Spatial Equilibrium; the Hierarchy Model; Model of Population Growth and Development; Simulation Model; Fieldwork Model and the Scale Model as well as other forms of classifications.

Models of Industrial Location

The ideal locations of industries are determined by certain factors based on empirical evidences. This discussion focuses on factors for the ideal location of industries which, ultimately, exert influence on the development of models for industrial locations. According to Hamilton (1971), geographers have published works giving descriptions and analysis of empirical evidences concerning: the reasons for - the effects of, and the changes in the locations of industries.

Different types of industries have different locational requirements. That is because the operational processes of different types of industries differ. Other factors that can affect the reality of locations of industries include the following: variations in the size of a region; resources available to the region; population of the area, and markets (Hamilton, 1971). All these tend to influence the development of models for industrial locations.

Developments in Industrial Locations Model

The literature reviewed revealed some progressive changes in the ways in which models have attempted to reach solutions to the industrial location problems (Chorley and Haggett, 1971; Hamilton, 1971; Bhatia, 1980). This indicates that early attempts of model building were simple constructions with few variables. Through time, there has been shifts of emphasis to suit the needs of time. Rigid mathematical proofs and multiple variables were then introduced as a means of determining optimum locations. The models are influenced by the ideological positions of the developers.

Adams Smith represents early attempts at Model building. Many ideas at the core of industrial location theory had their roots in the nineteenth century. Writing between 1775 and 1810, Adams Smith developed threads of a model for industries at a time when technical innovations and canal transport were changing the face of Britain. To the early British economists such as Adams Smith, J. S. Mills and David Ricardo, the location of industries was partly a function of spatial distribution of agricultural surpluses for feeding the industrial labourers and processing.

Perhaps, the most influential models of the nineteenth century were those developed by Launhardt (Chorley and Haggett, 1971). Launhardt (1882) developed the "Location Triangle" for a given factory; in which two points represented the source of the materials it used and the third point was the market where it sold its products. He determined the optimum location as the point within the Triangle at which the shortest lines – representing distance – met from the three points. Launhardt later extended the idea, in 1885 he represented a more complex solution "The Pole Principle".

According to Hamilton (1971) the last quarter of the nineteenth century saw a growing interest especially among the theorists in Germany in the industrial location patterns within the region. For instance, Schaffle (1878) suggested the outline of a "gravity model". According to this model of industrial location: Industries are developed chiefly in or near the larger towns, which as markets, attract industries in direct proportion to the square of the distances between them:

$$Mij = Pi\ Pj\ (dij)^{-2}$$

For two centers, "i" and "j" where Mij is the market attraction of the two towns. "Pi" and "Pj" represent their populations and "dij" is the distance separating them.

Any significant deviations from this pattern, Schaffle attributes to the location of industries near raw materials or fuel resources. The model seems to explain broadly, the patterns of "ubiquitous" and market-oriented sporadic industries. In a wider context, the model implies that the greater "localization of industries" the larger is the urban population, the shorter is the distance to the market and the closer are the large cities to one another. The model provides theoretical support for the more recent empirical findings.

Achielle Loria, an Italian economist, was among the first to recognize that labour was an important factor in the location of industries. Achille Loria (1888 and 1889), asserted that industries are located with reference to the market areas they serve, with the exception of those industries which use bulky materials, losing most of their weight in processing. The less these raw-material-oriented industries needed to transport bulky materials, he argued, the larger the market area their products could command at a given price.

Although Loria makes little reference to pricing policies, his model works on the premise that entrepreneurs seek the location that will give them maximum profits. He recognized the fact that labour was an important location factor. He assigned industries with high labour inputs in production process to predominantly agricultural areas.

In twentieth century, Alfred Weber introduced his "Least-cost Model of Industrial location". Alfred Weber (Chorley and Haggett, 1971) made the first important break with Geometry when he introduced "the Isodapane" or a line joining points of equal costs. The technique permitted greater diagrammatic flexibility and greater approximations to reality. This break through marked the retreat to Geometric determinism. Though the "Least cost Location Model" originated in the work of Launhardt in nineteenth century, Weber propagated, extended and modified the model in the twentieth century. Weber's model was framed in an isolated state, where natural resources for processing conform to the "Thunen-Ring System" around a number of given market centres.

Weber stressed that within this heterogeneous environment, entrepreneurs will locate industries at the point of least cost in response to the three general locations factors. These are transport and labour (as inter-regional factors) and agglomeration or deglomeration (as intra-regional factors). The criticism of Weber's model laid the foundations for improving the model by modifications and extensions.

Palander (1935) and Hoover (1937) used Isodapanes and other isolines extensively to show the locational irregularities in procurement and distribution cost that resulted from the varied patterns of different transport media. These are often translated into graphs. The use of these techniques – isolines and graphs just like geometry suffered severe limitations.

Karl Marx represents the Socialist approach to model building. The Socialists' approach differs from Capitalists' approach in several important ways. Industrial location under capitalism is criticized by the Socialists on the ground that it leads to disproportions in economic opportunities between regions. However, though Western theorists are criticized by the Socialist groups, location planners in the Socialist countries take inspiration from the work of Alfred Weber and Losch (Mrzyglod, 1969 as cited in Hamilton, 1971).

Karl Marx is the exponent of scientific socialism. This is an approach in which the emergence of socialism is considered a matter of historical evolution (Bhatia, 1980). Marxist economists and geographers stressed (following Karl Marx, 1850) that the distribution of capitalist industries bears little relationship either to material resources or to markets. Karl Marx revealed what might be termed a "capital localization location model". This is a model which was framed in a world of international political inequalities. Karl Marx emphasized that localized capital backed by imperial power was the most powerful single factor in localizing industry in a small part of the world in the nineteenth century.

Hitchcock (1941) responded to the need for more modern models and methods to cope with several location variables (Hamilton, 1971). He devised an algebraic formula for minimizing transport in distribution of a product from several manufacturing plants (located at different points) to a large number of market areas. That was the origin of the formula:

$$y = \sum aij\ xij$$

Summed: for $i = 1, 2 \ldots m$

and $j = 1, 2 \ldots n$

where y = Total Cost

aij = Cost of transporting one 'tonne' product from the i^{th} factory to the j^{th} market and xij = No of "tons" to be moved.

The linear programme technique is eminently applicable to "Industrial location problems" if the optimum (Maximum or minimum) solution can be expressed algebraically as a linear equation.

Koopman and Bechman (1957) developed a Model of industrial location, to assign "n" factories to 'n' locations. This is in such a way as to maximize the combined profit. They found that as the number of variables considered increase, the programming method becomes too cumbersome for satisfactory solutions of the assignments or allocation problems.

The models of industrial locations were intended to account for reasons, effects of, changes concerning industrial locations, etc. for various types of industries. The varieties of approaches adopted reveal progressive changes and shifts of emphasis through time due to the need for new methods to cope with several location variables. The changes have been facilitated by the evolution of and the application of more refined mathematical techniques – with a view to reaching at solutions to industrial location problems.

The Normative Model

Abler, Adams and Gould (1977) described a Normative model as one which is used as a standard or idealization of a particular relationship. They believed that normative models are scale-point on rulers which enables us to compare experiences to one another in a precise way. Abler *et al*, stated that one can always make a rank order comparison of performances so long as we have some basis for the measurement.

The most important use of models (Abler, *et al*, 1977) at the present time is as a "norm" against which we measure our experiences of the world. They believe that when geographers and other social scientists talk about models, they often talk about the normative models. They gave example of a normative model developed by geographers as a normative model of settlement process which produces an hexagonal network of evenly spaced villages, towns and cities. Normative models often involve the use of a more familiar situation as a model for a less familiar one, either in a time (Historical) or a spatial sense, and have a strong predictive connotation (Haggett, 1971).

Ola (1976) considered some normative models that are used to represent optimized conditions in human geography. He stated that the fundamental principle at the core of many models in human geography is the idea of a spatial order. He cited examples as the concentric zone model of Ajaegbu (1976), the central place model, or the hierarchical models. This model is based on the distribution of some features, functions and processes from the centre outwards.

Von Thünen's Model (The Model of Land Use Pattern)

The Von Thünen's model of agricultural location can be used to illustrate the model of land use patterns. The location of space for various needs is the basic preoccupation of man. These needs compete for spaces, whether in the city or in the rural areas. The Von Thünen's model of agricultural location has been introduced as a model that can be wisely used to study these competing needs of man (Henshall, 1971; Ola, 1976).

The basic feature of this model is that it describes the pattern of land use in an imaginary, isolated state. Underlying the assumptions in Von Thünen's model in his hypothetical state are: the existence of an isolated state; a single city (an imaginary city) with a uniformly fertile land, where the only means of transportation is the horse-drawn cart; a uniform plain surrounding the city and the plain is inhabited by farmers supplying the city. By calculating the economic rent due to each type of land-use, at various distances from the city, Von Thünen was able to construct a number of concentric rings indicating the land-use patterns around the central city.

The original model was very simple. Von Thünen later introduced some modifications by involving other variables such as: improved transportation – for instance, a navigable river. Others include differences in soil fertility and another city with its own zones of land use. All these have the effects of distorting the shape of the original rings.

Within the isolated state, Von Thünen considered the relationship of three factors: Distance of farmers from the market; the prices received by farmers for their goods and finally the land rent. The relationship between the distance of farms and prices received by farmers for their goods was fairly simple. The prices received by farmers was the market price minus the cost of transportation which increased directly with distance from the market. Land rent was defined as the return from the investment in the land.

The basic principles of the model are: the adverse effects of increasing distance away from the city-centre and the decreasing density in the distribution of population from the city-centre. There can also be a decrease in the intensity of the operation as well. This model associated with Von Thünen has been radically modified by changes in transportation, new technological achievements, for instance, refrigeration and replacements on markets of certain goods such as firewood, by new items (Henshall, 1971).

In less developed countries, the conditions are still similar to those in the Von Thünen model. There are several cases cited in geographical literature where land use around the settlement is directly related to the distance from the settlement (Prothero, 1957 as cited in Henshall, 1971). The Von Thünen model (Henshall, 1971) has probably been the most fruitful in the field of agricultural geography.

Weaver's Model

J. C. Weaver (Henshall, 1971) is one of the first people to set-up a quantitative model for classification of agricultural regions. This model is an important contribution to agricultural geography, as it has been made use of by several geographers (Henshall, 1971).

According to Henshall (1971) the model is focused on crop and livestock combinations. Weaver became interested in quantifying these combinations with a view to studying the change over time in the pattern of agricultural activities. Henshal (1971) cited Weaver (1954) as identifying his objectives as follows: The central concern is that of a precise and objective measurement and pattern definitions among the individual features and combination features of agricultural production as physical entities and economically active phenomena.

Weaver developed a mathematical model to enable him attain the set objectives. He, thus, developed the mathematical model for his crop combinations regions. In the model, he developed a standard deviation analysis for determining the number and identity of crops combined in a farming region. He was interested in relative rank deviations from the expected, not the actual, magnitude of deviations. He used the standard deviation formula without extracting the square-root. This was expressed as follows:

$$б = \frac{\sum d^2}{n}$$

where d = the difference between the actual and the expected values of crop percentage.

n = Number of crops in a given combinations.

The crop combination that showed the least deviations from the expected curve was recorded for every region. The areas where interrelationships of crops and livestock are important were not recognized by Weaver in the model. Weaver also developed livestock combination regions based on livestock units.

The model has been criticized because it assumed that all crops are equal in any given crop-combination. It also fails to recognize those combinations in which one or more crops may be dominant although other crops are significant. Despite its limitations, Weaver's model is an important contribution to agricultural geography, since he was one of the first people to set up a quantitative model for the classification of agricultural regions.

Spatial Equilibrium Model

This is an inter-regional equilibrium model. In this type of model, areas are conceptualized as points. Producers, factors of production and consumers are treated as located at a series of discrete points with zero transport cost between them. An analysis of comparative advantage then explains the differences in production at various points (Chorley and Haggett, 1971).

The most operational technique and probably the most popular for examining the spatial equilibrium of agricultural production patterns is linear programming (Chorley and Haggett, 1971). According to Chorley and Haggett (1971), Egbert and Heady (1964) made a study of inter-regional competitions and optimal spatial allocation of crops production in USA. The study typified the application of spatial equilibrium model. They stated their research problem as: the need to bring agricultural production into greater balance with food requirements and to cause the inter-regional allocation of crops to be more consistent with differential changes in technology and factor prices by regions.

For that purpose, USA was divided into one hundred and twenty two producing regions. Three linear programming models were used to specify which of the regions might provide the nation's requirements for wheat, grains, cotton and soyabeans most efficiently in 1965. The first model required that soyabeans be grown in rotation. The second model allowed the least cost mix to be used and the third model allowed a continuous cropping of soyabeans in each region.

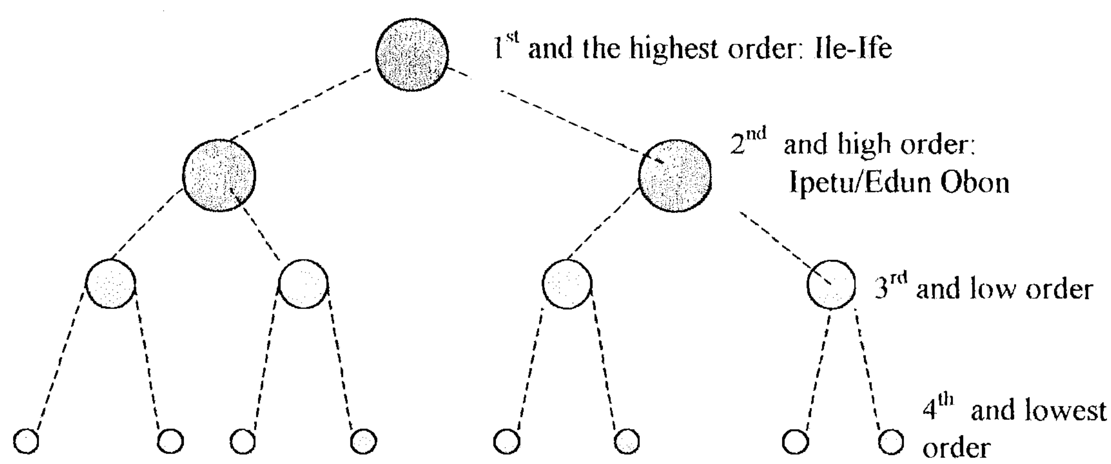
The models had built into them as many as five hundred restraints, an upper limit on the acreage of each crop category in each region, being especially important. According to the report, the result is only as good as the data, a fact which the authors emphasize. Non-discrete and non-linear data could not be handled. The use of linear programming to optimize a solution places the model as a normative one, but the use of empirical data gives it a strong descriptive base. The spatial equilibrium model is regarded as a problem-solving technique.

The Hierarchy Model

An hierarchy is an order in which the scope and area of authority and/or influence widens with a higher status in the order and conversely shrinks with a lower status in the order (Ola, 1976). The hierarchical model is thus particularly useful in the study of the distribution of settlements and the services they perform.

A central place (Ola, 1976) describes a location providing varied centralized services for the surrounding areas in a hierarchy of settlements, therefore, there can be central places of various orders ranging from the first order to the lowest order. A central place's order (Abler, *et al*, 1977) depends on the number of goods and services it offers.

Abiodun (1970) in his study of Ife-region identified four tiers in settlement hierarchy. For instance, the first order to the fourth orders which were based on the type and level of functions performed by the settlements. These are shown in the diagram below:



A model of hierarchy of settlements (Abiodun, 1970).

Model of Population Growth and Development

This model identifies the criteria for determining the actual population growth and economic development. In population geography, the distribution of population can be either dense, moderate or sparse. Similarly, one talks about the well being of people in terms of the 'living standard'. Ola (1976) stated that determining the actual population growth cannot be divorced from the developed resources of the particular environment or geographic area.

The model of population growth and economic development, therefore, suggests the need to relate population growth to the developmental resources of a country. The criteria should therefore include determining the standard of living of the people, the rate of increase in the natural resources; rate of natural increase in population and other indices of development.

Simulation Model

Simulation is an attempt to present some facts of reality in a convincing manner for the purpose of explanation, manipulation and analysis (Kibel, 1972). Jones (1981) cited in Okpala (1987) argued that in a simulation exercise, participants do not pretend to be those characters, but really are. This fact thus helps to create a clear picture of reality of the situation being simulated. Simulation therefore, is a model of situation with reality simplified.

A simulation model is governed by some predetermined and consistent rules for handling information as they may be introduced into the simulation. Ola (1976) identified two important features of simulation. The first is the systematic selection of a few number of items of reality for explanation, manipulation and analysis. The second feature of simulation is the collapsing and/or expanding of the time scale.

There are two main types of simulation (Ola, 1976). They are, the computer and gaming simulations. The computer simulations treat that part of the society being studied, as a system of interacting variables, responding to some facts introduced from without. The computer simulation is so called because the volume of data often involved is so large that the electronic computers are best used for handling it.

The gaming simulations mirror a set organisation in which strategies and tactics are given prominence. Hence, the players act-out their parts to provide effects similar to real-life situations. In designing game simulations, a clear conceptual framework for the players must be provided; that is the role, objectives, and resources of each player. The emphasis on games is deliberate since these are likely to interest the secondary school students more, while many of them if properly handled by competent teachers will lead to formulation of appropriate models. These are simple simulations which can be performed without machines.

The Field Work Model

This model provides information and offer practical guidance for carrying out a successful fieldwork in geography. An example is the Ajaegbu (1976) model for fieldwork in geography. This model satisfies the conditions for a scientific approach to fieldwork in geography. In this model, Ajaegbu (1976) classified fieldwork into three major components that must be followed in planning any fieldwork. These include the following:

a) The pre-field activities

b) In the field activities

c) Post-field activities

Pre-field Work Activities

The following are the essential steps to take:

1. Delimitation of the scope and the definition of the problems; having in mind such factors as the time available; intellectual maturity of the learners; available resources, etc.
2. The teacher should prepare tentatively the major aspects to be covered in the field.
3. Prepare relevant questionnaires relevant to the theme.
4. A preparatory reconnaissance visit(s) may be carried out.
5. Hold discussions with the students to intimate them on the proposed fieldwork.

6. Divide the students into groups and appoint group leaders.
7. Hold talks with the school authority for necessary approvals.
8. Arrange for collection of money and students to take charge.
9. Reach agreement with the authorities to be visited in terms of date and time of arrival, etc.

In the Field Activities

The teacher should carry out necessary checks before the team sets-off. The teacher has more to do while in the field. The teacher should particularly ensure inter-group discipline in the course of the fieldwork. Help the groups focus attention on their respective sub-topics. The teacher should create rooms for questions and answers.

Post-field Activities

The teacher should write letters of appreciation to the authorities visited. The groups should be made to prepare and present papers on the fieldwork. Every member of the group should participate in the write-up. The paper presentation should be done in a class room discussion forum. The teacher should give necessary commendations and observations at the end of the exercise.

The Scale Models

Ola (1977) described the Scale Models as objects moulded of clay or plasticine etc. for the purpose of learning. He indicated that pupils can be made to mould models of geographical features to be kept in the Geography Rooms and used for teaching and learning. Such features may include mountains, plateaux, hills, valleys, spurs, ox-bow-lakes, plains, etc.

A model, in this respect in its simplest conventional form can provide a three dimensional reproduction of the landscape or objects, using materials such as superimposed layers of paper, card, pulp, hardboard or wood, moulded plaster or porter's clay, plastics, etc. (Monkhouse, 1980). This form of model implies the Scale Model.

According to Chorley (1971) the Scale Models are closely imitative of a segment of the real world which they resemble, in some very obvious respect – being composed mostly of the same type of materials – and the semblance may sometimes be so close that the scale model becomes merely a suitable controlled portion of the real-world.

Chorley and Haggett (1971) identified scale models as Hardware Models. Hardware models, also known as physical constructions or experimental constructions can be the types of models where-in the relevant properties of the real world are represented by the same properties with only a change in "scale" (scale models) or Analogue (simulations) models, having the real world properties represented by different properties. Literature evidence (Chorley, 1971) indicated that often the use of hardware models end with the presentation of simple visual impressions of the geomorphic phenomena.

'Scaling' has been identified as a general problem associated with scale models. Chorley (1971) observed that the changes in scale affect the relationship between certain properties of the model and the real world. The most obvious geomorphic advantages of the use of scale model are high degree of control which can be achieved over the simplified experimental conditions and the manner in which time can be compressed.

The Scale models can be created in any aspect of Geography either by the teacher or the students and used for teaching and learning. According to Morgan (1971), models can be used at all levels of enquiry, as many spatial variables lend themselves to modeling. For instance, geographical processes can be reproduced for students to see their results by observations. For example, the processes of erosion, valley formations, weathering, studying different stages of the cycles of specific geographical features using a scale model.

The techniques and materials available for scale models construction have been enhanced with developments of "Thermoplastics and resins". The use of computers, which can be programmed to feed-in taped instructions from three dimensional coordinates, as well as the development of cutting machines which can carve the final scale models. All these are recent developments which have improved production of models.

The Scale models (models of empirical consideration) have been associated with low level of abstraction, compared with the conceptual (theoretical) models with high level of abstraction (Haggett, Cliff and Frey, 1977). Geographical literature (Ola, 1976; Haggett, *et al*, 1977; NERC, 1985) particularly recommend the use of 'Scale Models' for teaching in secondary schools and teacher training colleges. This is in line with the recommendation that the types of models introduced at secondary schools and teacher training colleges levels should be simple, less abstract and less difficult to handle with regards to the learners in order to yield the desired results.

According to Chorley and Haggett (1971), no map can perfectly depict reality as a result of the following: loss of the third dimension; reduction in scale; human artifice in the various map representations, inability to read the depictions perfectly. It appears that these factors may have contributed to the difficulties experienced by the geography students in map-work section of Geography.

The students may have found it difficult to conceive the three dimensional features represented by contours on a two dimensional paper. There is, therefore, a need to investigate the effectiveness of the use of scale models, a three dimensional object for teaching map-work.

There are other forms of classifications of models in geographical literature. Small and Witherick (1986) identified four types of models used by geographers as follows:

i. Simple linear Model: This he said involves the fitting of regression lines to the scatter of points on a graph, showing the relationships between variables; for instance, stream discharge and channel width.

ii. Simulation Models: This involves attempts to represent the operations of the real-world using counterfeits; for instance, the simulation in sequent drainage patterns by the random walk method.

iii. The Working Scale Models: This can be constructed, for instance, stream channels of various shapes and sizes can be fed with different discharges and sediment loads and the resultant changes monitored.

iv. The Conceptual Models: These are derived from observations of the real-situations or from deductive reasoning; for instance, the Von Thünen's theory of land use zonation around the city. This type of model provides hypothesis which can be tested by comparison with the real world.

Haggett, Cliff and Frey (1977:17) recognized two broad classifications of models. They are: the conceptual models and models of empirical considerations. They stated that the conceptual models, generally, have high degree of abstraction and are often said to be "theoretical". Similarly, they believed that models of empirical considerations are said to have low-level of abstraction and are often called "operational".

All these types represent models commonly used in geography and social sciences. From the classifications presented, it can be inferred that there can be two broad classifications of models as follows: the conceptual models and hardware models (scale-models). From the literature reviewed, the conceptual models, are also known as theoretical, symbolic or mental models. Such models are generally associated with high degree of abstractions. They are also concerned with symbolic or formal assertions of verbal or mathematical kinds. Conceptual (theoretical, symbolic) models are usually derived from deductive reasoning or observations of real situations.

On the other hand, hardware models (scale models), also known as physical constructions or experimental constructions, are known as models of empirical considerations. They are generally, associated with low-level of abstractions and are referred to as 'operational'. This research is based on the scale model (hardware model).

Other Classifications of Models

Hussen and Postlethwaite (1991) presented a general classification of Models. They stated that the types identified have been modified to accommodate recent developments in various disciplines that have occurred since the models were first developed. Their classifications include the following: The Analogue models; the Mathematical models; the Semantic models and the Causal models.

The Analogue Model

The analogue models (Husen and Postlethwaite, 1991) are widely used in the physical sciences, relatively uncommon in the social sciences and behavioural sciences and rare in the field of education. According to Husen and Postlethwaite (1991), the analogue models comprise those models that are related to the physical system. This type of model is characterized by the use of correspondences. For instance, in advancing such models, correspondences are necessary between the elements and the elements occurring in the problems under investigation.

A typical example of an analogue model used in education - though claimed to have been taken from the field of demography - is "a model of school population". This model is that of "a water tank" with inlet and outlet pipes to represent the students' population of a school system. The inlet pipes correspond to the intake controlled by birth rate, as influenced by rate of immigration and reception rates into the school at the ages below the lower age of compulsory schooling.

The outlet pipes correspond to the rate of emigration and the school departure rate at ages above the upper age of compulsory schooling and departure rates taken as complementary at the age of specific retention rates. The estimation of the parameters of the model, at a particular point in time using the data collected over previous years would enable predictions to be made for the size of the school populations of the system at a future time. The operations on the analogue which preserves its structure shows what will happen in any other system having the same structure.

Semantic Model

The essential feature of the semantic models is that they are expressed in verbal forms (Husen and Postlethwaite, 1991). Semantic models, therefore, suggest verbal statements of the type of relationship expressed in the analogue models. Semantic models (Husen and Postlethwaite, 1991) provide a conceptual analogue rather than physical analogue to the subject matter under consideration.

Frequently, the semantic models are involved in the use of figures of speech or metaphors. Semantic models that are expressed in verbal forms can be referred to as "Figurative or metaphoric models." Semantic models are common in the field of educational research.

Examples of semantic models include: the model of school learning, proposed by Caroll (1973). The model contains five elements, three of which are associated with the individual student; two arise from the external conditions. The factors in the individual include: (i) Aptitude - the amount of time needed to learn the task under optimal instructional conditions, (ii) Ability to understand instruction, and (iii) Perseverance (iv) Opportunity (v) Quality of instruction.

From the model the learning of instruction for any individual on a task was tentatively expressed, as on functional form, as a ratio of the amount of time the learner actually spends on the learning task to the total amount he needs. Research workers in education have used the model as a starting point for development of theories of school learning.

For instance, Bloom (1976) has advanced a theory in relation to mastery learning. Cooley and Lohness (1976) have proposed steps towards a theory in relation to the evaluation of schooling. Similarly, Harnischfeger and Wiley (1976) proposed a view of the teaching learning process in elementary schools based upon the concept of time as part of a more general model of schooling.

Mathematical Models

The significance of mathematical models and its important contributions in the advancement of theories is attracting increasing recognition. The mathematical models permit the derivations of explicit quantitative predictions that can be tested with the empirical data. It also lays the foundation for a more formal theory built around the causal relationships that are implicitly or explicitly contained within the model (Husen and Postlethwaite, 1991).

They cited typical examples of a successful application of a mathematical model to an educational problem. For instance, the confluence model which Zajonc and Markus (1975) advanced, were built around the concept of mutual intellectual influences among children as they develop within the family environment. The primary emphasis was on the intellectual environment of the child during the course of development and in particular on the intellectual level of the individual's siblings and parents.

Zajonc and Markus (1975) assumed that the effects of family configuration could be represented by a sigmoid function of age:

$$Mt = 1 - e^{-k^2 t^2}$$

Where t = Age; and K an arbitrary constant associated with the type of intellectual ability involved.

Causal Model

There has been an increasing use of the 'Causal Models' in the field of educational research since early 1970s (Abler, et al, 1977). The use of causal models has been associated with the work in the field of Genetics and linked with the analytical technique of path analysis (Husen and Postlethwaite, 1991). The approach adopted in the development of this type of model applied the principles of path analysis. The procedure adopted enables the investigator to move from verbal statement or 'semantic model' of a complex set of interrelationships between variables, to a more precise one in which the principles of path analysis are employed.

The uses of diagrams here apply to help portray the interrelationships, though not essential to the procedure. In the procedure, a set of linear equations is constructed to specify the relationships between the variables in the causal model. The causal model is, therefore, also known as the "Structural equation model". An important feature of a causal model is the building of a simplified structural equation of the causal process operating between the variables under consideration.

The causal model is thus written as a set of linear equations, each representing a casual relationship hypothesized to act between the variables. The parameters of the model may be estimated from such equations. The model and its component parts may also be evaluated from the structural equations.

From the classifications, it can be inferred that models cut across various disciplines. All models have basic identities in terms of characters and functions. Models are dynamic. They are modified with time, in line with researches and developments in various fields. From the classifications, it could be argued that all models belong to two broad types: Conceptual models (symbolic or theoretical models) and hardware models (physical constructions or experimental constructions) examples, the scale models, Analogue models. Literature evidence (Haggett and Chorley, 1971) indicated that the two broad types are closely related. This study used the scale model.

Functions of Models

Literatures reviewed (Haggett and Chorley, 1971; Abler, Adams and Gould, 1977; Husen and Postlethwaite, 1991) indicate that models perform the following functions.

1. They constitute a bridge between observational and theoretical levels and are concerned with simplifications, reduction, concretization, experimentation, action, extention, globalization, theory formation and explanation.
2. Models perform psychological functions. For instance, they enable some groups of phenomena to be visualized and comprehended, which could otherwise not be because of their magnitude or complexity.
3. Models provide a framework where information may be defined, collected and ordered. In this case, models perform acquisitive function.
4. Models have organizational function with respect to data, and also fertility in allowing the maximum amount of information to be squeezed out of the data.

5. Models help to explain how a particular phenomena comes about. By so doing models are said to perform logical function.
6. Models perform systematic function, for instance reality is viewed in terms of inter-locking systems. Haggett and Chorley, (1971) quoting Meadow (1957) stated that one view of the history of science is that it represents the construction of a succession of models by which systems have been explored and tested.
7. By comparing some phenomena with a more familiar one, models also perform normative functions.
8. Models also perform constructional functions. For instance, models form stepping-stones to the building of theories and laws. Haggett and Chorley quoted Theobald (1964) as stating that models and theories are very closely linked, perhaps differing only in the degree of probability with which they can predict reality.

Researchers in the field of education (Husen and Postlethwaite, 1991) have used models as a starting point for the development of hypothesis, theories and laws. Abler, Adams and Gould (1977) stated that the term 'model' could be used to designate a theory, a law, a classification or an hypothesis. Model building have helped geographers to make classification, formulate theories, laws and make generalization and thus increase the possibilities of accurate predictions of causal relationships (Abler, et al, 1977).

Disadvantages of Use of Models

The use of models has been associated with some disadvantages. The literature reviewed (Haggett and Chorley, 1971; Husen and Posttethwaite, 1991) identified some disadvantages of models and model building.

Simplification of reality might lead to over generalization and exaggeration. According to Chorley and Haggett (1971); approximations may lead to unreality. Suggestiveness may lead to improper predication. Structuring may lead to spurious correlations. Analogy may lead to unjustifiable leaps into different domains.

A bad model would be heavily symbolic and may present the wrong impressions. Such may present an overly formalized view of reality; be much over-simplified; represent an attempt to erect a more exact structure and be used for inappropriate predictions.

Many model builders do not have the skill for construction of good models (Okunrotifa, 1987; Offorma, 2004). This may lead to presenting the wrong impressions of the reality of the features being represented and consequently inaccurate interpretations.

The Place of Map-Work In Geographic Education

Map-work is given a special emphasis in geography education. The West African Examinations Council, for instance, consistently makes the map-work section compulsory in all its examinations in geography. The new geography curriculum with emphasis on problem solving places special stress on map-work. These suggest that the map is an indispensable tool in geography. In this discussion the researcher focuses on literature justifications for the consistent stresses on map-work in geography education.

Geography as a study of spatial relationship requires not only the linguistic skill but also a high degree of spatial imagery. The discipline's main tool is the map. The map is used both to clarify thoughts and problems for geographers and communicate their findings to the outside world (Underwood, 1981). The acquisition of map-work skill is, therefore, fundamental in the undertaking of all geographical studies.

It is in order to acquire the skill of problem solving (Okafor, 1988) that the syllabus stresses the use of maps. This, he stated, is because the maps provide the essential spatial language in which many geographical problems are discussed, conclusions reached and recommendations made. Abegunde (1988) argued that the acquisition of map-reading skill is highly useful in the study of specific environmental problems of a given area as well as the utilization of the skills when the student goes into the world of employment.

The above fact may explain why geographers play pivotal roles on issues relating to the environment. Geographers (Abumere, 1995:19) have been at the forefront of research on the, now, very topical issue of the 'environment'. Man now realizes the tremendous damage inflicted on the environment by the pressing environmental problems of deforestation, soil-erosion, climatic-change, over-population; specie-depletion; environmental pollution; desert-encroachment. Abumere stated that geographers have, probably, done more than any other discipline in finding solutions to these pressing problems of the environment. Maps (Abegunde, 1988) as important tools, are indispensable to the work of many professions which are concerned with the study of these environmental problems.

Geography is the study of the interrelationship of man and his physical environment (Dompreh, 1977). He stated that for such a study, the map is a useful tool, as it provides a survey of the distribution of the various geographical features over a large area. According to Dompreh (1977) a student who knows how to interpret a map will be able to grasp the complex interrelationships between the different items depicted on the map. This argument corroborates the view (Tancer, 1986, Schee, et al 1992) that the ability to read the map intelligently is the basis of all geographical studies.

Geography teaching presents knowledge in various ways such as textbooks, journals, tables, graphs, maps et-ce-tera. For the geographer (Westrhenen, 1992) the map is the most important of these various sources of information. Maps, he stated, show lots of data and in this way offer the possibility of both finding locations, spatial distributions and area differentiations which are important in order to achieve more insight into reality.

Maps are fundamental to the work of many disciplines. According to Abegunde (1988) the acquisition of map-work skills is an area of geographical expertise, which can influence the students to enter into a wide range of professional careers. Many of these careers have the need to deal with the study of processed data on topographical features; land-use, agriculture, settlement patterns etc. Maps are particularly useful in the conduct of reconnaissance and detailed studies of specific projects.

The acquisition of map work skills (Schee et al, 1992) plays an important role in the acquisition of procedural knowledge. Such knowledge applies both deductive and inductive reasoning. Schee et al stated that what the map user sees on a map and can conclude from depends on his ability to use the 'map skills'.

They classified map-skills into three as follows: Map-reading, map analysis and map-interpretation. In all the three stages of action, they stated, there is procedural knowledge. They explained, for instance, that a person who cannot use the map-legend, scale, cannot identify the phenomena on the map (map-reading). Similarly, the person who cannot classify facts into spatial distribution and areal differentiation and cannot discover areal associations on a map is not able to analyze the map. The map-user will, therefore, only be able to interpret the map if he has enough procedural and declarative knowledge.

There are some special abilities that are known to be associated with the acquisition of map reading skill. These special abilities have been found to correlate highly with map-interpretation. The abilities include "embeddedness" and "Visual-spatial abilities" (Underwood, 1981; Okpala, 1991: 101).

The visual spatial abilities, one element of measurable intelligence, can be defined as the ability to visualize and manipulate geometrical figures in space. This according to Underwood is assumed to correlate highly with the level of map-reading skill for any individual. It is, therefore, believed that in teaching pupils to read and interpret maps, one is making available to them an efficient and valuable communication system (Underwood, 1981, Anikweze, 1995).

The acquisition of map-reading skill, has been associated with the development of the right-brain-thinking in the students. According to Underwood (1981), geography has, therefore, been seen as an educational tool to enhance the development of the right hemisphere cerebral functions of the pupils with the acquisition of the map-reading skills.

Blake (1978) suggested that geography is not only a spatial study based upon locational phenomena, but an educational tool to enhance the process of right brain thinking. He concluded that geographers can fill the valuable role of aiding the development of right hemisphere cerebral functions of the pupils through geographical training.

These literature evidences provide a solid base, and sufficient justifications for the emphasis placed on map-work in geography education. However, the difficulties which students experience in map-work, has been widely reported (WAEC, 1995 – 1997; Okafor, 1995). These create a need for a research in the area of teaching and learning of map-work.

Teaching and Learning of Map-work in Nigerian Senior Secondary Schools

The new orientation in teaching and learning geography places emphasis on training the child to be able to tackle the present day problems of socio-economic development (NERC, 1985). To what extent have geography teachers adopted this new orientation in the teaching and learning of map-work? In this write-up, the researcher examines the reality of the situation, in the teaching and learning of map work – in Nigerian Secondary Schools. The write-up also presents the solutions and recommendations, based on literature reports.

The WAEC Chief Examiners' reports for the years 1995 – 2001 consistently reported that the students do not appear to have handled the topographical map-sheets before the examinations. They also reported that the candidates would have performed better in geography, if more attention was given to map work. The report attributed poor performance in map-work to poor preparation for the examination.

Adebisi (1988) identified reasons why students find map-work difficult as follows: paucity of teaching aids, poor and inappropriate teaching methods; over wide syllabus; inadequate periods for map-work, inadequate fund for the purchase of map-sheets and other materials.

Many research findings on the attitude of students to geography have identified the following as reasons why students have poor attitude to geography: difficulty experienced in map-work; poor instructional methodology, vast nature of geography, shortage of qualified teachers; poor academic performance of students in geography; inadequate instructional materials; mathematics aspect of geography (Okoye, 1980; Adetumberu, 1983; Adinna, 1991; Obi, et al; 1995).

From these literature evidences, poor teaching methodology has been particularly, consistently identified as a major problem of teaching and learning map-work. Lack of instructional materials as well as shortage of qualified teachers were also identified. Studies (Burke, 1983: 255; Schee et al, 1992) confirm that the type of learning outcomes the students use and develop are heavily influenced by the teaching methodology the teacher uses.

In a survey of teachers' methods of teaching map-work in Nigerian schools, Arowosegbe, et al (1981) observed that the method of teaching predominantly used for teaching map-work, in the lessons they observed has been lecture and note or text-book dictation. The researchers observed that even the available teaching materials were not utilized. They also observed that teachers do not make good use of the chalkboard, as they preferred to dictate from the note or textbooks. They pointed out that even the available topographical map sheets were not brought out for the map-work lessons.

Okunrotifa (1977) had earlier pointed out that the teaching strategies of map-work in Nigerian schools have been mainly theoretical oriented and tend to neglect the non-cognitive domain of behaviour. Okunrotifa emphasized that map-work belongs to the psychomotor domain of behaviour. He therefore, stressed that the teaching and learning of map-work should emphasize manipulation of materials, objects or other mechanical skills in the adoption of teaching strategies. He therefore, suggested that the teaching strategies of map-work should be activity oriented.

Studies (Mobogunje, 1972; Oyeleke, 1988; Ezeudu, 1992; Anikweze, 1995; Obi et al 1995) indicated acute shortage of instructional materials for teaching and learning map-work in Nigerian schools. Okunrotifa (1977) indicated virtual absence of instructional materials such as topographical map sheets; text-books, charts, film strips, etc. He reported that where such were available, majority of teachers do not use them for teaching. Adebisi (1988) reported that students in most cases handled topographical map sheet for the first time in the examination hall. Awaritefe (1988) reported that the situation of the inadequacy of instructional materials for teaching map-work has not changed significantly today. He indicated that where laboratories and geography rooms are found, they are stocked with outdated equipments that are not often made use of.

Many studies (Burke, 1983; Ayeni, 1988; Jibunoh, 1988; Schee et al, 1992; Okafor, 1995) believe that many geography teachers still employ the traditional geography methodology, from which recent emphasis is being shifted, for teaching and learning map-work in geography. The new orientation in teaching and learning geography stresses problem solving approaches.

Ayeni (1988) observes that despite workshops, seminars organized and books published by academic geographers, the way the subject has been taught in Nigerian schools has not reflected significant changes. He believes that the degree of integration of the basic skills into the teaching of geography has been slow and inadequate.

Okpala (1991) stated that the way map-work has been taught in Nigerian schools does not prepare students for effective living in the society. She stated that the teaching and learning strategies of map-work have been examination oriented. The teaching has been theoretical and places emphasis on memory in questions asked in map-work.

All these suggest that teaching and learning of map-work in Nigerian schools are still battling with the consolidation of the adoption of innovative methods of teaching map-work, following the introduction of the new geography curriculum. It may be appropriate to highlight the anomalies associated with the old traditional geographic principle, of which criticism necessitated the radical change in the education policy, which gave birth to the New Secondary School Geography Curriculum.

Ola (1976) and Okunrotifa (1977) identified the inadequacies of the so-called traditional geography which has dominated the Nigerian scene for many decades as follows: Much of the learning was in the cognitive domain which stresses intellectualism. The learning was teacher centred. Memorization of facts was considered important. Learning activities centred on note-taking to be memorized. Learning was of facts and mainly in isolation. The result is that pupils could make an encyclopedic recitation of "facts" but cannot apply their knowledge to understand features and processes, outside the areas they studied.

The measure of the learners' knowledge was his ability to recall what he has learnt. Less attention was paid to either his ability to apply such knowledge to solve problems or to the affective and psychomotor domains of learning. The studies were divorced from the learners' immediate environment. All these resulted in low interest, poor attitude to geography, difficulty in understanding and ultimately low enrolment in geography. The traditional geography though served the needs of a particular period, is now ill equipped to cope with today's problems.

Literature reviewed indicated that such poor methodological approaches contributed significantly to the students' poor attitude, low-enrolment, decreasing interest and poor academic achievement in geography in general and map work in particular (Okunrotifa, 1977; Ayeni, 1988; Jibunoh, 1988; Okpala, 1991).

The new orientation in teaching and learning stresses on problem solving approaches. It places emphasis on training the child to be able to tackle the present day problems of socio-economic development. The methodology, the objective, the content and the evaluation of the new secondary school geography curriculum are all designed and focused on achieving this goal.

The following methods of teaching have been recommended for effective teaching and learning of geography in Nigerian Secondary Schools: Use of models; Games and Simulations, field work; problem solving; discussion; lecture; assignments; inquiry; traditional directive approach etc (NERDC, 1985, FMEST, 1985).

Saylor and Alexander (1976) identified the following groups of instructional modes: lecture and verbal presentation; discussion and questioning; practice and drill; listening and answering, problem solving; heuristic and discovery; laboratory and inquiry; role-playing and simulation and games.

Studies show that the conventional lecture method is seen as the most commonly used method of teaching (Okunrotifa, 1977; Adetumberu,1983; Ezeudu, 1992; Okwo, 2004). Poor teaching method which has been persistently mentioned as a major problem of teaching and learning map-work, appears to be associated with the lecture method of teaching. Arowosegbe, et al (1981), in a survey of method of teaching map-work, observed that the method predominantly used for teaching map-work has been lecture and note or textbook dictation.

According to Okwo (2004) it does appear that the innovations and recommendations by various professional associations for effective teaching are not being implemented at the classroom levels. Teachers he said have continued to dominate the instructional process through the use of authoritarian teaching methods.

The literature reviewed identified the advantages and the disadvantages of the conventional lecture method (Saylor and Alexander, 1976; Mills, 1973). The advantages are as follows: A teacher can take a large class of students at a time. A lot of grounds can be covered by the teacher. The method makes it possible to disseminate large quantity of information to the students in a short period of time. The lecture method is economical in terms of time and staff needs. Lectures well prepared can be repeated, thus saving the lecturer's time and energy.

The disadvantages of the conventional lecture method of teaching include the following: The lecture method is teacher centred and teacher oriented. The method shows no regard for individual differences among learners. It does not provide opportunity for adequate class participation. The students learn comparatively little of what has been taught as they only hear and see the teacher. The class is, in most cases, passive. Boredom is easily associated with the method.

In most cases the use of lecture method has been to the detriment of the children in terms of appropriateness of the use in relation to the children's learning outcomes. It is possible that the predominance of lecture method may be because the effectiveness of other alternative methods of teaching have not been empirically determined.

Some suggestions and proposals have been made for effective teaching and learning of Map-work in Nigerian Secondary Schools. Okpala (1987) in a research report recommended the use of problem solving type of questioning in the teaching and learning of map-work. This, she argued would induce teachers into using more pupil oriented strategies for teaching. This she believes would make learning of map-work meaningful and interesting to learners; facilitate better understanding of concepts and improve the attitude of students towards map-work.

Okpala (1987) recommended the "Reality oriented problem solving " ('Rops'). She explained that the fundamental principle behind the 'Rops' pattern of questioning is not to provide the candidates with the concepts to work with; but rather to create a problematic situation which will necessitate the calling up and utilization of the concepts of which the learners have real understanding.

The 'Rops' type of question in its characteristic nature incorporates various strategies that could expose learners to experiencing some societal values and attitudes in the process of learning. It can, therefore, be a deterrent to 'rote-learning'. Okpala clarifies that the problem solving approach is based on the assumption that teaching is not telling, but providing learners with opportunities for probing; thinking, discovery, analyzing, inquiring and searching. Okpala argues that map-work contain concepts which relate to realistic issues that could form the stimulus for learning. For instance, she believes that problem areas exist in issues concerning distances, scales, location, interaction, movement, spatial change and distribution. Okpala believes that the approach to teaching map-work would induce the students into practising the expected attitudes, knowledge and skills long after the teaching experiences.

WAEC Chief Examiners' reports suggested that adequate attention be given to the teaching and learning of map-work in Nigerian schools. They observed that students generally lack skills in map reading and interpretation

(WAEC, 1995-2000). In line with this view, Adebisi (1988) reported inadequate allocation of periods for teaching map-work on the school time table as part of the reasons why students find some topics in map-work difficult. Though the curriculum recommended four periods a week for geography, the researcher discovered in the course of collecting preliminary data for the research, that a sample of schools covered, within the area of study allocate a minimum of two and a maximum of three periods a week to geography. The number of periods is considered inadequate.

Many studies, advocate for the adoption of 'fieldwork' approach in teaching map-work in Nigerian schools as an effective means of teaching map-work (Ajaegbu, 1977; Hawkins, 1983; NERC, 1985; Yalokwu, 1988; Ezeudu, 1992; Okafor, 1995; Anikweze, 1995). According to Ezeudu (1992), in the strategy commonly used in teaching map-work, the local environment conditions are not reflected in the teaching learning process. He recommended the use of fieldwork approach for teaching and learning map-work. However, some studies (Ezeudu, 1989; Eya, 1991; Anikweze, 1995) show that many geography teachers hardly show interest in embarking on fieldwork.

Literature (Haggett, Cliff and Frey, 1977; Anikweze, 1988; Husen and Postlethwaite, 1991) reveals that models of specific and desired features can be created and brought into the classroom for necessary observations and consequent teaching learning interactions. This situation can serve as a substitute for field observations, especially where it is not possible to organize fieldworks.

According to Anikweze (1988) a model can provide a three dimensional reproduction of the landscape or any other features. They are therefore, representations of the real, desired features on the earth's surface usually seen in the course of field observations. This suggests that any features physical or cultural of the earth surface, desired to be taught or observed by the students can be represented in the form of a scale model and presented to the students for observations and necessary teaching and learning.

Ola (1976) believes that much of the poor performances of students in Nigerian schools and public examinations are due, in part to the candidates' inability to visualize most of the features they come across in textbooks as they are in reality. Ola, therefore, recommended for the adoption of models especially the "scale or concrete models" for teaching and learning. He believes that it will help to solve the problems of not understanding what was taught and ultimately improve the image of geography.

Map-work (Underwood, 1981) requires the recognition of geometrical configurations variously oriented in space, and of differences and similarities between patterns such as those formed by the contour lines. Anikweze (1988) speculated that students often find learning map-work difficult because teachers do not use concrete models in teaching map-work. As a result, the students are unable to appreciate the three dimensional forms represented by the contour patterns on a two dimensional paper. He recommended that this type of difficulty can be removed by making the teaching and learning of map-work more practical especially by the use of models of various types representing specific desired features.

The situation of teaching and learning of map-work in Nigerian schools suggests that the use of old approaches has persisted among many teachers, despite the emphasis on the new orientation. It appears there are not enough empirical research prototypes of innovative strategies which teachers can adopt and use to supplement workshops and seminars. This creates a need for more empirical research efforts. Despite the recommendations on the use of models, there has not been research efforts in the area in Nigeria with respect to map-work. The difficulty that students encounter with map-work creates a need to empirically investigate the effects of the use of models on learning outcomes in map-work.

Achievements in Map-work at the Senior Secondary School Level

Research reports, and other studies suggest that map-work has been a problem in geography education. In this discussion, the researcher focuses in the academic achievement of students in the map-work section of geography. The literature reports on this shall be x-rayed.

A solid body of evidence indicates that map-work is the most difficult area of geography for students (Abegunde, 1990; Okafor, 1995; WAEC, 1998-2003). Some geographers (Okpala, 1987; Yalokwu, 1988; Adinna, 1991) believe that map-work is a major problem in geography education with regards to the poor performance of students in that section of geography.

Findings from many studies indicate that poor academic achievement, low interest, generally poor attitude, and low-enrolment in geography as a discipline are, mainly, as a result of poor academic achievement of students, in the map-work section of geography (Abegunde, 1990; Anikweze, 1995; WAEC, 1999; Okafor, 2000). Data collected by this researcher, from a sample of five selected schools from the area of study, on the performance of students in the SSSCE for three years (1999-2001) indicate that out of a total of 1,809 students that sat for the examination, 417 (23.1%) offered geography and out of this number; 118 (28.3%) passed geography with at least a credit level. This fact appears to confirm the poor achievement in geography.

The poor achievement in the map-work section has been widely reported by researchers and other studies. Oyeleke (1988) in his research on the attitude of students towards the study of geography reported that 62% of students fear geography because of map-work. Adebisi (1988) also reported that map interpretation had the highest percentage index of difficulty (79.3%) among the geography students he studied.

Table 1

Aspects of geography, which the students hate most.

Physical Geography	2%
Regional Geography	12%
Human Geography	24%
Map-work	62%

Adapted from Oyeleke (1988)

These suggest that majority of students offering geography, may perform poorly in the compulsory, map-work section.

The WAEC Chief Examiners' and Moderators' reports on (Geography paper IB) map-work (WAEC, 1995-2000) for the years covered provide the comprehensive reports on the actual performance of students in the map-work section of geography. The major features in their reports are as follow:

SSCE May/June, 1997 **:** They indicated that the overall performance in the map-work section has been poor, most candidates were unable to draw the correct section drawing or even label it correctly; inability to calculate the gradient correctly affected most students. It was reported that candidates overwhelmingly failed this question. Specifically more than 90% scored less than 25% of marks obtainable in the number (WAEC, SSSCE, 1997).

SSCE May/June, 1996 **:** The reports indicate, generally, that many candidates performed badly in the map-work section and that such can be attributed generally, to inadequate preparation for the examination by the candidates. They also pointed out that part of the major weaknesses of the candidates is poor-skills in map-work.

The chief examiners observed that many candidates lost valuable marks in map-work because of their inability to:

> Draw the map-outline correctly using the given scale, correctly identify and shade areas required; use scale to calculate the actual distances between given towns; describe the characteristics of drainage pattern of the area shown on the map, use contour lines to identify the direction of flow of Rivers (WAEC, SSSCE, 1996).

SSCE, May/June, 1995 **:** The Chief Examiners' reports observed that the main weaknesses of the candidates were noticeable in (Map-reading and interpretation) map-work. They reported that the questions were poorly answered by the candidates. The candidates failed to insert correctly, for instance the Plantation, River Obibia, and the direction of flow, the main roads and the water tower. Where they did, they failed to label the features on their outlines, leaving this to be interpreted by the examiners.

In part (b) where the candidates were required to describe three land use types in the map, many candidates were able to identify the land use types, but far too many failed to give evidences for such land use types from the map. Some even went on to mention Rivers and vegetation as land use types.

SSCE,May/June,2000 : The Chief Examiners' reports indicated cases of poor performance in the map-work section. They attributed such to some factors among which are: The inability of the candidates to read and interpret survey maps and their inability to reduce maps and insert features accurately on the maps.

The Chief Examiners recommended that the candidates could perform better if they pay attention to map-reading and interpretation; acquire topographical maps for use and form the habit of reading textbooks and notebooks.

From the report of the WAEC Chief Examiners for the years reviewed, poor performance of candidates in the map-work section appears to be consistent. The reports agree with research reports that students generally find map-work difficult. This creates a need for research interests in the area of determining a more effective method of teaching map-work to enhance interest and academic achievement of students in that section of geography (WAEC, 2000).

The phenomena of poor performance in the map-work section of Geography is not limited to Nigerian senior secondary schools. Betty, Kam-fai and Lai-sim (1992) in their research entitled "Group Learning in Map-work" reported that students in Hong-Kong find it difficult to master the area of map-work in geography and they repeat the same mistake over and over in spite of revision. They observed as follows:

> Reports from the last ten years certificate of secondary education examination (Grade two) in geography indicate that map-work result were poor in seven years out of ten, fairly good in only two years and quite good in only one year. Comments like: Students make mistakes in calculations (vertical exaggeration; gradients; and areas etc) appeared in eight years out of ten; poor correlation of photographs with maps appeared in four years out of ten. Poor analytical thinking, poor identification of contour features from topographical maps and poor knowledge of conventional signs and failure to orient the map correctly. (Betty, et al 1992).

The reports above are therefore, similar to what obtains in Nigeria senior secondary school geography. It can therefore, be argued that "map-work problems" appear to be global. Underwood (1981) even stated that the fundamental skills and positive attitude towards maps are not acquired universally among students.

However, many studies have indicated that there are methods of teaching and learning map-work that are activity oriented, pupil centred, interesting, intellectually stimulating, and innovative, that are capable of creating interest and ultimately affecting learning behaviours of students (Hawkins, 1982; Anikweze, 1988; Okoye, 1995; Okafor, 1995). Such methods include the use of models, games and simulations. There is, therefore, particularly, a need to investigate the effectiveness of the use of such innovative methods as "use of models" on the learning behaviour of students in map-work.

Section B

Review of Related Empirical Studies

Some research studies have been carried out on the areas related to this research. In this section, the researcher reviews the related empirical studies on the area such as: map-work; interest, gender, academic achievement; ability levels and models.

Studies on Map-work

Okpala (1987) carried out a research, to ascertain whether adopting reality oriented problem solving questions in the West African School Certificate Examinations in map-work would lead to an improvement in the attitude of students towards map-work in Nigerian Secondary Schools. It was a quasi-experimental study. The research involved sixty-two teachers of map-work; ninety-one examiners and cohorts of two hundred and eleven as well as a sample of one hundred and forty five school certificate geography students. A total of eight secondary schools were used for the study.

The instrument used for data collections included: two sets of map-work tests on the proposed "Rops" question type and the existing WAEC type questions; aptitude tests of numerical and verbal abilities and the "EFT" embedded figures tests. The data were analysed using the quantitative 't-score';

Analysis of variance; Z-test and the chi-square as well as the Aschner-Gallagher system.

The results obtained showed that: the clients generally, had significantly more positive attitude towards the 'Rops' - Reality oriented problem solving types than the WAEC type questions. The findings also revealed that the attitude of the students towards the WAEC questions type correlate positively and significantly with the numerical Aptitute and 'EFT', while for the 'Rops', it was the contrary.

The teachers without basic qualifications expressed more significant positive attitude towards the 'Rops' than the higher degree holders. The findings of the research also revealed that the teaching approach changed. Again, the students' participation and productive thinking involved in verbal interactions were significantly higher in 'Rops' lessons. The above research motivates research attempts in area that involve the students' use of their real life experiences in the teaching learning process. The use of models is one of such methods.

In a research entitled: "Skilled map-interpretation and visual spatial ability", Underwood (1981:55) carried out an investigation to ascertain the impact of geography training (controlled experience) on the students ability to interpret the topographical maps successfully. It was hypothesized that while the visual-spatial ability and the map reading would be highly correlated, in untrained subjects, the relationship would become progressively weaker for subjects with higher degree of controlled experience with maps.

The subjects of the study included fifty-five, (fifteen year old) and eleven (seventeen year old) English school girls. The instruments used for the data collection included: A standard test of visual spatial ability; map reading test; basic maps for test. The data were analysed using the Pearson's product moment correlation coefficient; t-test and the Analysis of variance.

The results obtained indicated that of the fifteen year old in the less experienced 'group A', all were average or above average in the visual spatial ability for their age. The more experienced group B included subject for below average, average and above average abilities. The highly experienced 'group C', had no subjects in the least or most able categories or visual spatial abilities, although they had a lower visual spatial score (x=15.73). Subject in the more experienced group B, scored slightly higher on the map reading test $\left(\bar{x} = 10.21\right)$ than the subjects in the less experienced group "A" (visual-spatial ability) $\left(\bar{x} = 18.36\right)$ map reading ability $\left(\bar{x} = 9.55\right)$.

The analysis revealed that the visual spatial ability and the map reading skill were reliably related for group "A", the least experienced subjects. However, there was no reliable relationship for the more experienced group "B", nor for the highly experienced group "C". The data indicated that as the subjects level of controlled experience with the topographical maps increased, there was a change in the relationship between the visual spatial ability as indicated by the ":AH5" test, and the map reading skills.

Adebisi (1988) carried out a research study entitled "Difficult aspects of map reading: A case study of Ten secondary schools in Ibadan Municipality Local Government Area". Part of the purpose of the research was to investigate the areas of difficulty in map reading and interpretation as perceived by the students and teachers. The data collected were analysed using: descriptive statistics, correlational techniques, for instance the Pearsons Product moment correlation and percentages.

The findings revealed that the following topics were perceived and identified as difficult to both the teachers and students in map-work: Vertical exaggeration and Horizontal equivalent (Gradient); identification of settlement patterns and economic activities, map interpretation, for instance - relating relief to historical, socio-economic activities etc. The result of data analysis shows that the topic that has the highest percentage index of difficulty (79.3%) is map interpretation. Findings from the research show that the specific reasons stated for the difficulty, among others, is that the students are not exposed to models and fieldwork.

Oyeleke (1988) in his research "A Case Study of Oranmiyan Local Government Area of Oyo State", reported some aspects of geography which the students hate most. The result of the study on "the attitude of students towards learning of Geography", indicates that 62% of the sample used for the study feared geography because of map-work. Such students believe that failure in map-work means failure in geography. The researcher recommended that the teaching of map-work should be made as practical as possible to reduce the abstract nature of the area. The use of concrete models for teaching and learning of map-work, may make a difference in terms of the learning outcomes of students.

Miller (1982:51) carried out a research entitled: "Improving the design of classroom maps: the experimental comparison of alternative formats." The objective of the research is to identify the source of difficulties in the American map reading, particularly, the design of the maps and work to improve those over which we have some control.

Ninety-six (96) students randomly selected for the study, were stratified by socio-economic status as well as grade-level. The instrument used for data collection was interviews. The analysis of variance was applied for the data analysis.

The results showed that some types of map reading tasks seem inherently more difficult than others. The most difficult task appears to be associated with the use of latitude and longitude; as well as grid-systems, estimating and measuring distance, the interpretation of features, systems and symbol.

From the findings of some of these researches, this researcher can infer that there are specific topics that make map-work difficult for students. For instance, the general interpretation of maps has been considered particularly difficult for students. It is also observed that the methods of teaching the subject contribute to the difficulty. This creates a need to try some innovative methods for teaching this section of geography. Models, for instance are not known to have been adopted for teaching map-work. There is thus a need for a research in the area of investigating empirically, the effects of models on learning behaviours in map-work in geography.

Studies on Gender and Academic Achievement

A lot of researches have been carried out in the area of academic achievement of students. The variables which have been predominant in most of the studies include the following: the influence of gender, method of teaching, school location etc.

Findings from many research works confirm a significant difference in academic achievements of students along the lines of sex. However, the research reports differ on the influence of gender on academic achievement. Okafor (2000) in his research on the effects of note takings on the academic achievements of students in Geography reported that gender on achievement in geography was significant in favour of male students. Other researchers such as Bajah (1979), Abadom (1986) Obioma and Ohuche (1988) reported that male students are superior to female students in achievement in science.

However, there are contradictory research findings on this. The findings from some studies indicated that female students are better than male students in academic achievements, for instance studies such as Nworgu (1990) and Obodo (1990). Ezeudu (1992) developed and validated some project and instruments for evaluating students learning outcomes in Geography. In the projects he reported that the mean scores of female students on the entire projects were higher than that of the male students in all the dimensions of the four projects.

Some research reports indicate that there is no significant difference in academic achievement of male and female students. Agbaegbu (1999) for instance, carried out a research to determine the effect of peer and self-assessment techniques on students' academic achievement in geography. He used a quasi-experimental design and a sample of 222 senior secondary two students. The data was analysed using 3 x 2 analysis of covariance as well as Post-hoc tests using Turkey's method. The results he obtained indicated that the influence of gender on academic achievement in geography was not significant. Other studies which reported that there is no significant difference in academic achievement of male and female students include that of Orji (1984), Ezeudu (1995), Njoku (1996).

Some studies produced results, which indicate that academic achievements are influenced by school location. Balogun (1985) for instance reported in his research that urban based students achieved significantly better in science than rural based students. However, Njoku (1996) on his investigation in the "effects of school location on the acquisition of skills in chemistry practical activities" reported that school location had no significant influence on the achievement of students on chemistry practical activities.

Some studies attribute differences on academic achievement to teaching methods. Okoye (1995) in her research, investigated the effects of teaching methods (Simulation and lecture) on academic achievement of students in Geography. It was a quasi-experimental design. The data collected were analysed using one-way analysis of variance and two way analysis of covariance. The hypotheses were tested at 0.05 significant level. The results showed that the students taught using simulation method had significantly higher academic achievement in memory questions, problem solving and retention tests than those taught using the lecture method.

Moemeke (2003) in her research aimed at determining the effects of fieldwork on academic achievement of students in ecology. The study specifically investigated the potency of studying ecology concepts through fieldwork instead of the traditional expository method of teaching. Quasi-experimental design was used. A sample of 161 students participated in the study. Mean and T-tests were used to analyse the data collected. The results revealed a significant difference in academic achievement with the experimental group (exposed to fieldwork) showing superiority over the control group taught using the conventional method.

The results of these studies create a need for further researches into other methods of teaching. There is also a need to introduce other variables in the research efforts. Extending research investigation to the area of map-work in geography, adopting an innovative method of teaching such as use of models can be considered a worthwhile venture.

Studies on Interest

Many studies (Rusell, 1970; Burke, 1983; Chauhan, 1987) show that interest plays a major role in any undertaking, as it influences devotion to duty, fairness, hard work, endurance, discipline, etc. This fact agrees with Obioma and Ohuche (1988). Their research finding indicates that interest factors correlate positively and significantly with competency factors. Obioma and Ohuche (1988) reported that subjects performed significantly better in those areas they had interest in, and performed poorly in the areas they lacked interest.

Ekeke (1987) developed and validated interest inventory in geography. The result of his studies revealed that gender had no significant effect on students' interest in geography. He reported that while gender can be a factor in academic achievement, it was not in the determination of interest in geography. This fact is in agreement with Ezeudu (1995). In her studies on the effects of concept maps on interest in organic chemistry, the influence of gender in interest in organic chemistry was not significant. Both males and female students demonstrated the same level of interest in the subject. However, Oyeleke (1988) in his research finding reported that male students responded more favorably than their female counterparts in terms of interest in geography. This fact is in agreement with Agbaegbu (1999) who in his research results reported that assessment techniques had a significant gender influence on interest in geography. He indicated that male students expressed higher level of interest than female students.

Akpudo (1977) researched on major factors leading to the decline of interest in choice of geography as a WASC subject: a case study of Idemili Local Government Area of Anambra State. His findings revealed that teaching method was a major factor contributing to the students' decline of interest in choice of geography. He revealed that 52.29% of the sample chosen showed that they were discouraged by the geography teachers' method of teaching. This fact agrees with the research findings of Obi, Nweke, Oguamanam and

Okonkwo (1995). On the results of their research findings, they reported that the students tend to loose interest in geography to the extent of dropping the subject, after the initial registration for WAEC examination as a result of poor teaching method.

Many other studies have blamed the students' lack interest in geography to poor teaching methods, which have dominated the teaching-learning process in Nigerian secondary schools (Arowosegbe, et al 1981; Yalokwu, 1988; Ayeni, 1988; Adinna, 1991). In a research carried out on "the attitude of students towards learning of geography in Nigerian secondary schools," Oyeleke (1988) reported that most students loose interest in geography because of the map-work section. The findings indicated that 62% of the sample used lost interest in geography because of map-work. The findings indicated that bad teaching method was a major cause of the lack of interest in geography.

Research attempts have been made at evaluating the effectiveness of specific methods of teaching on the interest of students. Anikweze (1988) investigated the effectiveness of the use of conceptual models, games and simulations. The findings of his research revealed that the use of models, games and simulations sustained pupils' interest especially the below average groups more than the traditional lecture method. He indicated that the use of models, sustained the interest of higher ability groups compared to their low ability counterparts. This result is consistent with that of Obioma and Adibe (1987); Nworgu (1990); Ezeudu (1995); Agbaegbu (1999); Aburime (2004).

Researchers have made suggestions on the best ways to improve the interest of students in geography; the suggestions include the following: improving the teaching methodology; making the teaching of map-work more meaningful by making it truly practical; reducing the abstractions of the subject; increasing the motivations of pupils during teaching (Oyeleke, 1988, Adebisi, 1988; Adinna, 1991). All these suggest the use of pupil-oriented methods of teaching aimed at attracting pupils' interest in the lesson. This creates a need for the adoption of innovative methods of teaching, such as use of models. The extent to which the use of models can affect interest in map-work in geography creates the need for this research.

Studies on Ability Levels

The diversity in learning abilities among the students is a common phenomenon. Learning abilities vary among the individual students (McMahon and McMahon, 1990; Chauhan, 1987). Some studies categorize learning abilities into three levels. They are high ability, medium (average) ability and low ability levels (Stones, 1976; Chauhan, 1987). However some studies recognize an overlap in the medium ability level and thus categorize the ability groups into two distinct levels. These are: the High ability and the Low ability levels (Beckerman and Good, 1981).

Researches have recognized ability groups as a potent factor influencing learning. Studies have revealed that the learning behaviour of students of various ability .groups is affected by the method of teaching (Ali, 1985; Ehindero, 1984). This suggests that it does not necessarily follow that the high ability learner must always perform better than the low ability learner after instruction. There is, therefore, a need for the teacher to select teaching strategies that will be effective for the students of different ability levels.

Some research studies have been carried out to investigate the effectiveness of methods of teaching on specific variables with respect to the students' ability levels. Anikweze (1988), for instance, researched on the effectiveness of the use of conceptual models, games and simulations on the academic achievement and interest of high and low ability groups on topics in geography. The findings of the research indicated that there was no significant difference in the interest of high and low ability groups. The result revealed that the high and low ability groups benefited equally from the instruction presented using games, simulation and lecture methods. The result also indicated that the high ability group taught using conceptual models indicated significantly higher gain in interest than the low ability group taught using the same method.

The research studies of Obioma and Adibe (1987) found that small group instructional strategy was effective for slow learners in mathematics. A slow-learner (Kephart, 1971) is one who has reached his potential and yet achieves quite poorly in school subjects. He stated that a slow-learner's pattern of poor achievement is basic and consistent over time and across school subjects. A slow learner, therefore, is associated with consistent poor achievement across school subjects. It can, therefore, be argued that a slow-learner belongs to the students of low-ability level. The implication is that teachers of low-ability level or slow-learners require certain competencies to cope with the attendant problems associated with slow learning. Ali (1985) revealed that Nigerian secondary school mathematics teachers lack necessary skills in diagnosing and teaching slow learners.

Nwosu (1990) in her studies entitled "The acquisition of science process skills among senior secondary year one Biology students in Anambra state," used three classifications of ability groups. High, medium (average) and low ability levels. The result of the studies indicated that the high ability level students performed significantly better, than the medium, while the medium scored significantly higher than the low ability level students on the acquisition of science process skills.

Okoye (1995) investigated the effects of teaching methods (Simulation and Lecture) on academic achievement based on ability levels. The study was a quasi-experimental non-equivalent control group design. The results of her studies indicated that the high ability groups, taught using simulation, performed significantly better than the low ability group in academic achievement in memory questions, problem solving questions and retention tests. The result also revealed that the low ability students taught geography using simulation method, showed the greatest positive attitude to geography, followed by high ability students taught with the simulation method.

Literature evidence reveal that there is dearth of studies that investigate the effects of teaching strategies on performance of students of various ability levels (Okoye, 1995; Ali, 1985). This creates a need for such a research, especially in the area of map-work in geography.

Studies on Models

Anikweze (1988) researched on the use of conceptual models, game and simulations for teaching geography. The purpose of the study was to ascertain through experimentation, the effectiveness of the use of models, games and simulations as innovative strategies for teaching geography in Nigerian secondary schools. The researcher formulated three research questions and eight hypotheses for the study.

A six week experimental teaching was conducted. The researcher used a sample of 300 students. He developed four conceptual models, two instructional games and two simulations for the experimental teaching. Data were collected using a 60 item objective test on achievement and a students' interest scale were designed and used for the study. The instruments were administered in a pre-test, post-test model.

The data were analysed using the multiple analysis of variance (ANOVA), analysis of covariance (ANCOVA) and t-test. The findings from the study indicated that the teacher-made conceptual models, games and simulations could be effectively utilized to achieve instructional objective in geography teaching. The study revealed that the students' interest and attendance to geography classes could be sustained by the use of the models and games much more than the use of the lecture method. The study shows that the "high-ability" students gained significantly more than the low-ability students when models were used for instruction.

The group taught using models indicated the highest mean interest score (55.36), though there is no significant difference in the post-treatment interest scores of the three groups taught using the three different methods of teaching. Though the researcher observed no significant difference between the interest scores of high-ability groups and low-ability groups, taught using the three method, yet the high-ability groups taught using models indicated a significantly higher mean gain in interest than the low-ability group taught using the lecture method. The study has demonstrated that geography teachers can profitably create and utilize models in different forms for teaching any aspect of secondary school geography.

Anikweze (1988) applied conceptual models in the area of human and physical geography. There is yet to be any such work in area of map-work in geography. The researcher used conceptual models for his study. There is a need for a research in the area of investigating the effects of scale models on learning behaviours in map-work.

Rice (1982) developed a model in service programme for preparing secondary school administrators to be effective instructional supervisors. The purpose of the study was to ascertain the necessary experiences, skills and proficiencies that an instructional supervisor should have. The findings of the study indicate as follows: that the in-service experience which the administrator should have must include the opportunity to examine his commitment to the interest of those with whom he works; it must also include the opportunities for evaluation of, and improvement upon, his personal and inter-personal skills in human relations. It must also include the provision of in-service opportunities.

The instructional supervisor should also be able to assist the teacher; analyse and improve his skills in the teaching and evaluation processes. He should realize the importance of in-service experience and in the course of that, must provide the necessary opportunities for the administrators and teachers to use the available supervisory models.

Umeakuka (1997) developed a "recreation model" for the industrial workers in Anambra State of Nigeria. He used six (6) research questions and five research hypotheses for the study. The instrument for data collection was a fifty-six-item questionnaire. The researcher used a sample of 2,006 workers drawn from among the three categories of workers in industries namely: the management, senior and junior-staff. The data were analysed using percentages, ANOVA statistics and the t-test statistics.

The findings from the research show that the proposed recreation model for workers in industries in Anambra state should have five component parts namely: philosophies, objectives, funding, management, arrangement and recreation activities. There should be eleven alternative philosophies to direct industrial recreation-practice in Anambra State.

There should be fifteen objectives to guide industrial recreation practice in Anambra State. Nine visible sources of fund were identified and, therefore, should be explored to raise money to administer recreation programmes in industries in Anambra state.

In this study, the researcher adopted scale models for teaching and learning map-work in geography. This area of geography is known to be difficult for students. The researcher investigated the effect of the use of scale models on learning behaviours of the students in the map-work section of geography.

The Summary of the Literature Review

The review of literature related to this study was done under two major sections. These are, the review of theoretical literature (Section A) and the review of empirical studies (Section B). Attempts were made to link the units discussed to the problem of this study.

In Section A, the theoretical framework featured some psychological theories underlying the study. The philosophical relevance of the study as well as the theoretical framework of the controversial gender-related differences in class-room behaviors were also discussed. The relevance of the above discussions to the problem of the study were highlighted.

The concept and classifications of models were also discussed. Some types of models identified as common in geography and social sciences were outlined and discussed. A general classification of models was also featured. The review also discussed the functions of models as well as the disadvantages of the use of models. The places of map work in geography education was discussed.

An appraisal of the teaching and learning of Map-work in Nigeria's senior secondary schools was reviewed. The discussion mirrors the literature evidences of the reality of the situation in the classrooms based on the research reports. It was revealed that the actual situation in the field is that most teachers still adhere to the old traditional geography approaches for teaching and learning of Map-work (Okunrotifa, 1977; Arowosegbe, et al, 1981; Ayeni, 1988).

The old traditional approaches have been criticized as they were associated with anomalies and inadequacies, the criticism of which culminated to the birth of the new national policy on education and consequently, the new school curriculum. The anomalies and inadequacies of the old traditional methods were outlined as discussed. Poor teaching method was, therefore, blamed for the difficulty which the students experience in Map-work. There have, therefore, been calls for alternative methods of teaching.

The suggestions, proposals and recommendations of methods of teaching for effective teaching and learning of map-work were featured. They include the use of models; games and simulations, fieldwork, projects, etc. These methods were recommended as problem-solving based and innovative. The researcher reviewed the academic achievements in Map-work at the senior secondary school levels. The research results reviewed indicated that map-work has been a very difficult area of geography for students.

In the review of empirical literature, attempts were made to outline and discuss some research findings on different variables of interest to the study. Some studies carried out in the areas of Map-work, Gender, Academic Achievements, Ability Levels, Models, Interest, were outlined and discussed. In reviewing the studies on academic achievement, the variables which have been dominant in most studies include the influence of gender, location and methods of teaching. The effects of gender and other variables on achievement were discussed.

The studies on ability levels were reviewed. Research has shown that learning behaviour of students of various ability groups is affected by method of teaching. However, the effect of use of scale-models on the learning outcomes of students of different ability levels in map work is not yet clear.

It is evident from the literature reviewed that, generally, there is scarcity of research attempts in the area of use of Scale-Models especially for teaching and learning of Map-work. The findings from the literature reviewed create a need for a research in establishing the effect of the use of scale-models on learning outcomes in Map-work.

CHAPTER THREE

THE RESEARCH METHOD

This chapter is concerned with the general procedure for executing the study. Specifically, this chapter is presented under the following titles: The research design; the area of study; the population; sample and sampling techniques; the instruments used for data collection and the procedures for establishing their validity and reliability; the treatment procedures; measures taken to control the extraneous variables; the validation of lesson plans and the methods of data analysis.

The Research Design

Quasi-experimental design was used in the study. The type is the non-equivalent control group design. Symbolically this design can be represented thus:

E	01	X	02
C	03		04

Where: E = Experimental group

C = Control group

01 and 03 = pre-tests administered to the "E" and "C" units respectively.

X = Treatment

02 and 04 = Indicate post-tests given to 'E' and 'C' units respectively.

------------- = The broken line in the diagram separating the two groups indicate that no formal means such as randomization has been employed to assure the equivalence of the two groups. In other words, a potential selection bias could exist.

The rational for adopting the Quasi-experimental design is as follows: The researcher used intact classes. Quasi-experimental design does not involve randomization of participating units as applied in true experimental designs. Such random selection in true experimental designs is hardly permitted by the school authorities, as it would likely disrupt normal school programmes. The design thus suits the use of intact classes which can easily fit into the normal school timetable and programmes. This will ultimately smoothen the conduct of the experiment.

Area of Study

The study was carried out in Awka Education Zone of Anambra State. The zone comprises five local government areas: Awka-South, Awka-North, Njikoka, Anaocha and Dunukofia local government areas. Awka Education Zone is made up of sixty four (64) secondary schools. This comprises thirteen (13) Male; twenty three (23) Female and twenty eight (28) mixed (co-educational) schools.

Population for the Study

The accessible population for the study comprised all the senior secondary two Geography students in Awka Education Zone of Anambra State (about 1,800 students). The target population comprised all the senior secondary two Geography students in Nigeria. The senior secondary two (SS 2) students were chosen for the study because they are most likely to devote attention to the study compared to the senior secondary three (SS 3) students who are preparing for or may even have sat for their senior secondary certificate examination. The senior secondary one (SS1) students are beginners in geography.

Sample and Sampling Technique

The sample consisted of one hundred and ninety seven (197) geography students. A multistage sampling technique was used to draw the sample. A simple random sampling technique was used to select one zone (Awka education zone) out of six (6) education zones in Anambra state. Two Local Government Areas were chosen from the five Local Government Areas of the Zone using simple random sampling technique.

A stratified random sampling technique was used to select the two mixed (co-educational) schools from each of the two chosen Local Government Areas of the Zone. The four mixed (co-educational) schools in the Zone chosen for the study were those that offer Geography up to the Senior Secondary School "Two" (SS2) level.

Two intact classes were used for the research in each of the selected schools. A simple random sampling technique was adopted to select the classes used for the study. The samples of the students in each of the intact classes constituted the samples used for the study. The intact classes selected in each of the schools chosen served as either the experimental or the control group. The intact classes were randomly assigned to the treatment conditions.

Table 2: The sampling plan of the study

	Schools	TREATMENT GROUPS						
		1			2			
		Experimental Group			Control Group			
		Models			Conventional Lecture			
		M	F	Total	M	F	Total	Grand Total
	A	17	26	43	15	17	32	75
	B	6	8	14	6	8	14	28
	C	12	16	28	15	15	30	58
	D	8	10	18	10	8	18	36
Grand Totals	4	43	60	103	46	48	94	197

Instruments for Data Collection

The following instruments were developed and used for data collection:

(a) Map-work achievement test (MWAT)

(b) Map-work interest scale (MWIS)

(c) Three topographical map sheets:

(i) Umuko District

(ii) Ekpuana Basin
(iii) Agbana Basin

These three topographical map sheets for use in the study were adapted from WAEC (1985) and (1986) and Federal Survey Department (1978) and modified by the researcher to suit the needs of the study.

The Map-work Achievement Test (MWAT)

This instrument was constructed and validated by the researcher. The Map-work Achievement Test (MWAT) is a forty item, Multiple Choice Objective Test instrument, made up of four options (Appendix 6). The MWAT uses the topographical Map-sheet: "Umuko District". The instrument is based on the five content areas of map-work chosen for the study. Measures were taken to ensure that the necessary psychometric properties were built into the instrument.

Table 3 : Table of Specifications (The Test Blue Print) For the Map-work Achievement Test (MWAT)

Content	%	Objective Levels		Total items
	100%	Low Order	High Order	50
Contours/ Vertical Interval	10%	3	2	5
Contour Representation: Highland relief features.	30%	9	6	15
Contour Representation: Low-Land relief feature	26%	8	5	13
Relating relief to Settlement	20%	4	6	10
Relating relief to Transportation	14%	3	4	7
Total		27	23	50

The five content areas identified for this study are analysed on the table of specifications, in line with the objectives of teaching map-work. The proportion of low-order and high order objective levels was adopted on the weighting of the objective levels.

The objectives of teaching each of the chosen topics in map-work, as indicated in the Senior Secondary School Geography Curriculum, are more of low-level than high-level cognitive objectives. The researcher has, therefore, generally assigned weight that reflect the predominance of low-order objectives compared to high order objectives.

The Validation of the Map-work Achievement Test

The researcher ensured that the instrument "MWAT" satisfies the necessary psychometric properties. The instrument was initially face validated by five experts selected from the Sub-department of Science Education and the Department of Geography, University of Nigeria, Nsukka.

The researcher initially generated a total of one hundred test items, based on the content of map-work and within each of the topics selected for the study. After the initial eliminations, the items were later re-organized into a total of sixty items. In the course of face validation, the experts in measurement and evaluation and geography subjected the remaining items to criticism and vetting as requested by the researcher. The criteria for this may be with respect to relevance, suitability, content areas identified, repetitions, set-objectives, use of language, ambiguity and any other considerations. At the end of the face validation, the remaining items were further reduced and ultimately re-organized into a total of fifty test items.

The content validity of the instrument was ensured by applying a table of specification on the instrument, based on the Blooms Taxonomy of educational objectives. This ensures an appropriate distribution of the test items with respect to the relevant content areas chosen as well as the cognitive objective levels desired (see table of specification). Based on the Test Blue Print, the MWAT test items were written out. The test items are now re-organized in line with the distribution of the items in terms of content area, objective level and proportions in the table of specifications.

The Test Blue Print as well as the final test items were face validated and scrutinized by seven experts in measurement and evaluation and geography drawn from the Sub-department of Science Education and Department of Geography, University of Nigeria, Nsukka. They were requested to among other things address specific issues such as: suitability of the alternative answers provided, repetitions, time allocation, suitability of each of the items, ensuring that clues to answers were not given, modifying and/or replacement of unsuitable items among others. The imputs from the experts - such as corrections, modifications, restructuring of items etc. helped in improving the quality of the instrument.

MWAT Trial Testing and Item Analysis

The researcher trial-tested the instrument using a school sampled out from the schools within the area of study but not selected for the study. The researcher trial-tested the instrument (MWAT) on a sample of thirty-six Geography students of Ezike High School, Nibo (a mixed school) Awka South Local Government Area of Anambra State. A mixed school was used in order to avoid sex variability, which may affect the external validity of the study.

From the results of the trial testing, the items analysis was carried out based on the scores of the students on each of the items of the test instrument. With this, the effectiveness of each of the test items was determined.

The researcher employed the following criteria in the item analysis: difficulty analysis, distractor analysis and discrimination analysis of each of the test items to determine their suitability for inclusion in the instrument. The items selected were those that met the set criteria.

The item analysis was done using two contrasted criterion groups: the top $33^1/_3$% (upper group) and the $33^1/_3$% (lower group) of the sample tested (Nwana, 1979). The item selection was, therefore, based on the following criteria: effective use of the table of specification indicating only items which satisfied the requirements of the table; having a difficulty index $\left(P = \frac{\text{Nu} + \text{NL}}{2\text{N}}\right)$

of the range between 0.30 and 0.70; having a discrimination index $\left(d = \frac{\text{NU - NL}}{\text{N}}\right)$ of between 0.3 and 1.2; where:

"NU" = Number in the upper (bright) group.

"NL" = Number in the lower (dull) group.

"N" = Total number in each of the groups.

Another criteria is also having a distractor indices where each alternative answer should attract a significant number of responses; and where more persons from the upper group get correct answers right than those in the lower group; while more of those in the lower group get the "wrong answers" wrong compared to those in the upper group.

Based on these considerations, the items that satisfied the set criteria were selected. These made up the final number of items of the map-work achievement test instrument (MWAT). The final number of items selected for the instrument is thus, forty (Appendix 6).

Table 4: The Table of Specification For the Forty (40) Items of the MWAT

Content	%	Objective Levels		Total items
	100%	Low Order	High Order	40
Contours/ Vertical Interval	12½%	3	2	5
Contour Representation: Highland relief features	30%	8	4	12
Contour Representation: Low-Land relief feature	25%	7	3	10
Relating relief to Settlement	20%	3	5	8
Relating relief to Transportation	12½%	2	3	5
Total		23	17	40

Map-work Interest Scale (MWIS)

The map-work interest scale, made up of thirty (30) items was developed and validated by the researcher. The instrument is a four (4) point scale. The scale points are as follows: Strongly Agree = 4; Agree = 3; Disagree =2 and Strongly Disagree = 1. The range of scoring mode for positive interest statements is four to one (4-1) (from strongly agree to strongly disagree). The reverse is the case for negative statements.

The statements are in accordance with the activities related to map-work in geography. The instrument is made up of eighteen (18) positive interest statements and twelve (12) negative interest statements. The students are required to express the degree of their agreement or disagreement with each of the statements with a tick (√) as instructed.

<u>The Stages of Validation of the MWIS</u>

A number of stages were undergone in the process of validation of the instrument. The researcher initially assembled one hundred (100) statements on map-work. This was done through reviews of relevant literature. The researcher also requested geography teachers and students to write out for him some attributes of interest to them in map-work; as well as some attributes or statements they do not like about map-work. Collating these statements and others collected from relevant literature, the researcher was able to assemble a pool of one hundred positive and negative interest statements on map-work.

The researcher later subjected these statements to a closer scrutiny. This resulted in necessary sorting out, re-organization and necessary re-assembling of the items. Seventy items survived this scrutiny.

The remaining items of the instrument were subjected to face validation by a team of five experts in measurement and evaluation and geography. The researcher requested the experts to critically examine each of the items and determine their suitability for inclusion with a view to improving the validity of the instrument. They were also requested to make necessary inputs. At this stage of face validation some items of the instrument were eliminated, particularly those that have inter-judge disagreement. The remaining items were re-assembled and re-organized. Forty items of the instrument survived this stage.

The forty (40) items were prepared in the form of a questionnaire using a five (5) point Likert scale. The questionnaires were given to thirteen (13) experts in geography and measurement and evaluation for further validation of the instrument. The experts were requested to rate the suitability of each of the items of the instrument on the five point rating scale provided (Appendix 11).

The experts were provided the following criteria as a guide: relevance of the statements to the content for study; simplicity of the expression; ambiguity; vagueness; double barreled statements; and any other relevant observations, repetitions; etc. The researcher also requested the experts to make necessary input in terms of modifications, corrections, suggestions, reconstructions etc. and any other necessary inputs and suggestions.

The experts' ratings were analysed using semi-interquartile range (S.I.R); median, standard deviation and the mean (Appendix 12). The semi-interquartile range and the median were mainly the measures used to determine the items to be retained or eliminated. However the standard deviation and the mean were also used in borderline cases.

The semi-interquartile range was used instead of the standard deviation as a measure of variability in this situation because the standard deviation is sensitive to extreme scores. The semi-interquartile range is not susceptible to extreme scores (Nwana, 1979). The median was also used instead of the mean because the mean is more affected by skewness than the median (Borg and Gal, 1979; Kerlinger, 1973).

Based on the analysis, the criterion for rejection or acceptance of each of the items of the instrument (MWIS) was determined. The statements with semi-interquartile range less than or equal to 0.75 (SIR ≤ 0.75) or the median greater than or equal to 3.9 (median ≥ 3.9) or above were selected for inclusion in the instrument. The figures outside the range were removed.

As part of the reasons for using a relatively high cut off (S.I.R. ≤ 0.75 and median ≥ 3.9) for acceptance or rejection of the items of the instrument, the researcher considered the usability of the instrument. An instrument may have very high reliability (Mehrens and Lehman, 1978: 101) but may be too lengthy to be useable. Again, from the inputs of the experts, although lengthy instruments can ensure content validity, it may, more importantly, result in poor returns, faking of responses, leaving of uncompleted spaces and other problems on the part of the respondents, which may adversely affect the validity of the instrument.

Based on the analysis of the experts' ratings, ten (10) items were eliminated. The remaining thirty (30) items of the instrument were reassembled and re-organized. The items resulted as the final items of the instrument (MWIS). The thirty items were prepared on a four (4) point scale and used for pilot studies.

The pilot study was carried out to trial-test the instrument. A sample of (36) thirty-six students of Ezike High School Nibo, a mixed school, was used for the pilot study. The sampled school was selected from the area of study but not specifically selected for the study. The purpose of the pilot study was to try out the instrument and receive feedback on the reactions and effects based on the application. The corrections on such feedbacks ultimately helped improve the quality of the instrument.

Field observations, in the course of pilot study were useful in the validation of the instrument. The following observations were particularly noted and necessary measures taken: Time taken to complete the responses to the instrument; reactions of the respondents on specific items; general impressions of the respondents; for instance many students prefer to interact with others so as to react the same way to the items. The problems encountered with the school administration as regards clashes with the school programmes; student contributions, for instance footnotes written by some students on the questionnaire.

All these field observations contributed to the final re-organization, necessary adjustments and structuring of the instrument. Necessary modifications, re-assembly and re-organizations were effected on the instrument. The thirty (30) items of the instrument (MWIS) were re-written and re-copied using a four (4) point rating scale (strongly agree = 4; agree = 3;

disagree =2; strongly disagree =1). The thirty (30) items therefore became the final items of the instrument "Map-work interest scale" (MWIS) (Appendix 13).

Reliability of the instruments

In order to establish the reliability of the Map-work Achievement Test (MWAT) instrument, an estimate of internal consistency was applied using the Kuder Richardson formula 21. The "K-R 21" gives an estimate of the degree of internal consistency of the test instrument. The internal consistency estimates give a measure of the homogeneity of the items of the test instrument. This form of reliability is considered appropriate for the instruments that have items that are dichotomously scored such as MWAT.

To compute the reliability coefficient, the test instrument was administered to a sample of thirty-six students of Ezike High school Nibo. The scores obtained were subjected to "K-R 21" formula. The reliability coefficient obtained was "0.97" (Appendix 7). This gives an estimate of the internal consistency of the instrument (MWAT). The reliability coefficient obtained indicates that the instrument has high reliability.

For the Map-work Interest Scale (MWIS) the Cronbach's Alpha reliability coefficient was used to establish the reliability of this instrument. The Cronbach's Alpha gives an estimate of the internal consistency of the test instrument (MWIS). The Cronbach's Alpha was considered suitable because the items of the instrument were not dichotomously scored. Using the Cronbach's Alpha, the reliability, coefficient computed for the "MWIS" was "0.82" (Appendix 14). This indicates that the instrument (MWIS) is reliable.

Experimental Procedure

The treatment was carried out as follows: The experiment involved the experimental group (taught using models) and the control group (taught using the conventional lecture method). The groups were randomly assigned to treatment conditions. For instance, balloting was used to determine the experimental and the control groups.

Prior to the treatment, a pre-test was administered to the two groups. The pre-test was the achievement test on map-work. An interest scale on map-work was also administered to the experimental and the control groups before the commencement of the treatment.

The control groups were taught map-work using the conventional lecture method. The experimental group was taught map-work using the scale models of landscape features. Specific steps were taken to control all the possible extraneous variables to the study.

After six weeks of treatment, a post-test was administered to the two groups. The map-work interest scale was administered. The post-test administered was the same as the test used as the pre test for the two groups except for a different map sheet attached to the pre-test. The pre-test and the post-test scores of the students were then compared to determine the effects of the treatment conditions on the dependent variables of interest.

Measures taken to Control the Extraneous Variables

The following measures were taken to control specified extraneous variables, which would have affected the treatment variable and ultimately would have influenced the internal and external validity of the study.

Experimental Bias:

The researcher was not directly involved in the administration of the treatment. The actual instructions on the lessons was carried out by the regular teachers of the respective schools used for the study. This is necessary in order to eliminate experimental bias.

Teacher Variable:

In order to ensure homogeneity of instruction across the groups, the classroom teachers involved, were properly trained by the researcher for both the experimental and control groups. There were lesson plans for both groups as well as other instructional materials. The lesson notes and modes of instruction and presentation were discussed by the teachers with the researcher prior to the treatment.

The lesson notes were prepared by the researcher. Each teacher expected to participate, was made to teach an equivalent group using the lesson notes prior to the experiment. This was supervised by the researcher. All these were aimed at arriving at a standardized mode of presentation among the participating teachers, and thus eliminate the teacher variable factor extraneous to the study.

The researcher had a pilot study. The objective of this was to observe teachers to be involved in the experiment teach as well as rate them. If there should be a need for re-training, this exercise enables such re-training to be carried out before using the teachers for the actual experiment. The teacher variable was therefore, expected to have been kept constant as a result of these measures taken.

Pre-test Sensitization:

The duration between the pre-test and the post-test was six weeks. The period, six weeks, is adequate, neither too short nor too long with respect to carry over effect from the pre-test to post-test. The period is long enough to eliminate a possibility of any response set being carried over from the pre-test to post-test capable of confounding the effects of the treatment variable.

Experimental Mortality:

The participation of subjects in the lessons was enhanced through the introduction of roll call before and after the lessons. That was also aimed at controlling irregular attendance. The teachers were also instructed to remind the students that the exercise was part of their continuous assessment.

Effects of School Environment:

The schools sampled for the study shared almost the same environmental conditions. The experimental and control groups were chosen from the same school. Again, the training and orientations given to the participating teachers were intended to enhance homogeneity of instruction and ultimately contribute in controlling this variable.

Non-equivalence of the Intact Classes:

To counter the effect of the non-equivalence of the intact classes used for the study, the intact classes were randomly assigned to treatment conditions. The initial group differences were controlled statistically by using the pre-test scores as covariate of the post-test scores as the analysis of covariance (ANCOVA) was applied in the data analysis. There was no evidence of ability streaming in the schools selected for the study.

Training Programme for the Teachers

A training workshop was put in place for the teachers that participated in the study. Four geography teachers selected from the sampled schools for the study were involved in the workshop. All the teachers had minimum of ten years teaching experience and first degree in geography. The researcher trained them on the specific procedures for conducting the study.

The Training Programme were as Follows:

i. The scope, the objective, and nature of geography curriculum in Nigeria.

ii. The purpose of the study

iii. The map-work concepts and topics to be covered by the study.

iv. The concept of 'Models', with emphasis on scale models.

v. The use of models for teaching map-work with illustrations. The use of conventional lecture methods.

vi. The use of lesson plans for both conventional method and models method, for teaching map-work.

vii. During the coordination, the researcher emphasized the teaching methods and the strategies to be used in the study.

There were two training sessions: one for use of model and the other for the use of conventional lecture method. The teachers were evaluated at the end of the training by asking them to teach the topics. The researcher did the evaluation. There were questions and answers session.

At the end of the training, the requirements for the study, which should be given to each of the teachers participating in the study, were shown to the teachers. These include the following: Lesson plans; scale models; instructional materials and other materials for the exercise.

Validation of Lesson Plans

The initial draft of the lesson plans for experimental and control groups were face validated by five experts in geography and measurement and evaluation from the Faculty of Education, University of Nigeria, Nsukka. Five secondary school geography teachers (Vice Principals) also validated the lesson plans. The inputs of these experts were incorporated in the final draft of the lesson plans.

The recopied lesson plans were used during the training programme. In the training, the teachers used the lesson plans for trial teaching. This provided the opportunity to standardize the lesson plan among the participating teachers and ensure that the lesson plans can be used to achieve the specific objectives. For instance, the instructional materials to be used for both the experimental and control groups; units to be taught; the levels of treatment for students; the timing; students' activities; the strategies to be used for the experimental and control groups were coordinated, etc. The inputs from the teachers and the observations from trial testing were incorporated in writing out the final lesson plans used for the actual study.

Methods of Data Analysis

The mean and the standard deviation were used to answer the research questions. The analysis of covariance (ANCOVA) was used for testing the hypotheses. This statistical technique (ANCOVA) enables the researcher to adjust the initial group differences (Non-equivalence) since intact classes were used and hence establish the equivalence statistically. The hypotheses were tested at 0.05 significance level.

CHAPTER FOUR

RESULTS

In this chapter the data collected were analysed and the results of the study presented. The results were presented according to the research questions and the hypotheses. A preliminary analysis to test the assumptions of the analysis of covariance was presented. The two major assumptions of the analysis of covariance are, linearity between the covariates and the corresponding dependent variables and the homogenelty of variance.

(a) Testing the significance of the relationship between the covariates and the corresponding dependent variables.

Ho: There is no significant ($p<0.05$) relationship between the covariates and the dependent variables

Table 5: Pearson correlation coefficients between the covariates and the corresponding dependent variables

COVARIATES	Dependent Variables	Experimental Group	Control Group	Pooled	Significance
Pre-Achievement Scores	Post-Achievement Scores	0.860	0.916	0.785	0.000
Pre-Interest Scores	Post-Interest Scores	0.647	0.832	0.651	0.000
N		103	94	197	
Critical ratio		0.195	0.195	0.195	

Table 5 shows that the pooled correlation coefficient between the covariates and the corresponding dependent variables is 0.785 for the pre-achievement versus post-achievement scores and 0.651 for the pre-interest versus post-interest scores. They are, therefore, significant at 0.05 significance level. The null hypothesis is therefore rejected. This indicates that the covariates exhibited significant relationship with the corresponding dependent variables. The assumption of linear relationship between the covariates and the corresponding dependent variables is therefore satisfied.

(b) Testing of the Homogeneity of variance.

Ho: The variance of different dependent variables is not significantly ($p<0.05$) homogeneous.

Table 6: Levene Test for Homogeneity of Variance

Dependent Variables	Mean ($\bar{x}$)	Standard Error	dfI	dfII	Calculated Value	Significance
Post-Achievement Scores	67.2	0.634	1	195	1.240	0.267
Post-Interest Scores	78.1	0.827	1	195	3.715	0.055

The data presented on Table 6 revealed that the calculated values of the variance of the post-achievement scores is 1.240. That of the post-interest scores is 3.715. The critical values for significance for the calculated values of the variances of the post-achievement and the post-interest scores were 0.267 and 0.055 respectively.

They are, therefore, significant at 0.05 significant level. The Null hypothesis is therefore rejected. This implies that the variance of the dependent variables are homogeneous. The assumption of homogeneity of variance between the dependent variables is, therefore, established.

Research Question One

- Which group performs better in an academic achievement test in map-work, the students taught with models or those taught with the conventional lecture method, as indicated by their mean achievement scores?

Table 7: Mean ($\bar{x}$) and Standard Deviation (S.D.) of the students' post-achievement scores.

	Mean ($\bar{x}$)	S.D	N
Experimental Group (Use of Models)	67.2	10.3	103
Control Group (Use of Conventional Lecture	51.5	12.2	94

Table 7 indicates that the overall mean-achievement scores for the experimental group (taught using Models) is 67.2, with a standard deviation of 10.3. The mean score for the control group (taught using the conventional lecture method) is 51.5, with a standard deviation of 12.2. The students taught using models, therefore, had higher mean score than those taught using the conventional lecture method.

The range of scores, as indicated from the standard deviations is also lower in the experimental group than that of the control group. From the data on the table, therefore, the students taught using models had higher mean achievement scores than those taught using the conventional lecture method. In order to take a decision on this, hypothesis one was tested.

Hypothesis One

There is no significant ($p<0.05$) difference in the mean achievement scores of the students taught map-work with models and those taught with the conventional lecture method.

Table 8: Analysis of Covariance (ANCOVA) of the students' post-achievement scores in map-work achievement test (by treatment, by gender and by ability levels).

Source	Variation	Sum of Squares	df	Mean Square	F	Signifi-cance
Post-test: Covariates	Pre-test	11446.442	1	1146.442	389.562	.000
Main effects	Method	8152.273	1	8152.273	277.450	.000
	Gender	2.864	1	2.864	.097	.755
	Ability	115.391	1	115.391	3.927	.049
2-Way Interaction	Method * Gender	100.559	1	100.559	3.422	.066
	Method * Ability	544.886	1	544.886	18.544	.000
	Gender * Ability	48.954	1	48.954	1.666	.198
3-Way Interaction	Ability Level * Method *Gender	70.575	1	70.575	2.402	.123
Corrected Model		34307.438	8	4288.430	145.950	.000
Residual		5523.973	188	29.383		
Total		740537.000	197			
Corrected Total		39831.411	196			

The above table (Table 8) has shown that the calculated 'F-ratio' for the main effects of treatment on students' achievement in map-work is 277.450. This value is therefore significant at 0.05 level of significance. The decision, therefore, is to reject the Null hypothesis. This, therefore, implied that there was a significant difference between the mean achievement scores of students taught map-work using models ($\bar{x}$ = 67.2) and that of those taught using the conventional lecture method ($\bar{x}$ = 51.5).

This implied that the experimental group taught using models scored significantly higher than the control group taught using the conventional lecture method. The implication of this result is that the use of models indicated superiority over the use of the conventional lecture method for teaching map-work.

Research Question Two

Which gender group of students performs better in the achievement test in map-work, when taught with models?

Table 9: Mean ($\bar{x}$) and the Standard Deviation (S.D.) of the students' post-treatment achievement scores by gender.

Gender	Experimental Group (Use of Models)			Control Group (Use of Conventional Method)		
	Mean ($\bar{x}$)	S.D.	N	Mean ($\bar{x}$)	S.D.	N
Male	67.5	11.6	43	52.1	12.1	46
Female	66.9	11.3	60	50.8	12.4	48
			103			94

The data on the above Table 9 has revealed that the male students had slightly higher mean score ($\bar{x}$ = 67.5) than their female counterparts ($\bar{x}$ = 66.9) when taught using models. The male students also had a standard deviation of 11.6 compared to that of the female students (11.3). The data suggested that the performances of the two gender groups may have been equal.

Hypothesis Two

> There is no significant ($p<0.05$) difference in the mean academic achievement scores of the male and female students in map-work when taught with models.

The data on Table 8 indicated that the computed F-value for the effect of treatment on gender is 0.097. This value was not significant at 0.05 level of significance. The null hypothesis was, therefore, not rejected. This implied that there was no significant difference in the mean academic achievement scores of male and female students when taught with models. The male and female students, therefore, achieved equally when taught using models.

Research Question Three

> Which group (by ability level) performs better in the achievement test in map-work when taught using models, as shown by their mean scores?

Table 10: Mean ($\bar{x}$) and the Standard Deviation (S.D.) of the students' post-treatment achievement scores by ability levels.

ABILITY LEVELS	Experimental Group			Control Group		
	($\bar{x}$)	S.D.	N	($\bar{x}$)	S.D.	N
High Ability	73.5	9.90	46	63.1	9.3	39
Low Ability	61.2	11.3	57	44.0	9.0	55

From the data on the above table, the mean score of the high ability students in the experimental group taught using models is 73.5, with a standard deviation of 9.9. The low ability students in the same group have a mean score of 61.2 with a standard deviation of 11.3. Evidence from the data tends to suggest that generally, the high ability students had higher mean achievement scores than the low ability students and thus performed better. For a valid decision to be taken on this, the hypothesis three was tested.

Hypothesis Three

> There is no significant ($p<0.05$) difference in the mean academic achievement of high ability and low ability students taught with models, as measured by their mean achievement scores in map-work.

The data on Table 8 has shown that the F-value calculated on the main effect of treatment on ability level of the students is 3.927. This value is significant at 0.05 level of significance. The null hypothesis is, therefore, rejected. This implied that there was a significant main effect due to treatment on the mean achievement scores of high ability and low ability students taught using models. The high ability students taught map-work using models, therefore, performed better than their low ability counterparts taught using the same method.

Research Question Four

> Which group of students, those taught with models or those taught with the conventional lecture method, show greater interest in map-work, as indicated by their mean interest scores in map-work?

Table 11: Mean ($\bar{x}$) and the Standard Deviation (S.D.) of the students' post-interest scores.

	Mean ($\bar{x}$)	S.D.	N
Experimental Group (Use of Models)	78.0	8.5	103
Control Group (Use of Conventional Lecture)	65.7	9.7	94

Table 11 indicated that the mean interest score for the experimental group is 78.0. They have a standard deviation of 8.5. The mean interest score for the control group is 65.7, with a standard deviation of 9.7. This suggests that the experimental group taught using models showed greater interest in map-work than the control group taught using the conventional lecture method.

Hypothesis Four

There is no significant ($p<0.05$) difference in the mean interest scores of students in map-work, of those taught using models and those taught using the conventional lecture method.

Table 12: Analysis of Covariance (ANCOVA) of the students' post-interest scores in map-work interest scale by treatment, by gender and by ability level.

Source of Variation		Variation	Sum of Squares	Df	Mean Square	F	Significance
Map-work Interest Scale Post-test Score	Covariates	Map-work interest scale pre-test scores	5880.713	1	5880.713	68.494	.000
	Main Effects	Ability Level	40.495	1	40.495	1.472	.493
		Gender	97.406	1	97.406	.135	.288
		Treatment	5800.742	1	5800.742	67.563	.000
	2-Way Interactions	Ability * Gender	166.413	1	166.413	1.938	.166
		Ability * Treatment	85.405	1	85.405	.995	.320
		Gender * Treatment	141.034	1	141.034	1.643	.202
	3-Way Interactions	Ability Level * Gender * Treatment	253.136	1	253.136	2.948	.088
	Corrected Model		22987.184	8	2873.398	33.467	.000
	Residual		16141.130	188	85.857		
	Total		1028942.000	197			
	Corrected Total		39128.315	196			

The results on Table 12 revealed that the calculated F-value for the main effects of treatment on interest is 67.563. The value was significant at 0.05 level of significance. Based on this result, the null hypothesis is rejected. This implies that there was a significant ($p<0.05$) difference in the mean interest scores of the students taught using models ($\bar{x}$ = 78.0) and those taught using the conventional lecture method ($\bar{x}$ = 65.7). The students taught with models, therefore, showed greater interest in map-work than their counterparts taught using the conventional lecture method.

Research Question Five

- Which group of students (by ability level) showed greater interest in map-work, as shown by their mean interest scores, when taught using models?

Table 13: The Mean ($\bar{x}$) and Standard Deviation (S.D.) of the students' post-interest scores by ability level

Ability Levels	Experimental Group			Control Group		
	($\bar{x}$)	S.D.	N	($\bar{x}$)	S.D.	N
High Ability	84.8	7.0	46	73.3	6.5	39
Low Ability	72.2	6.9	57	59.4	7.1	55

Table 13 revealed that the high ability students taught with models had a mean interest score of 84.8 with a standard deviation of 7.0. The low ability students in the same group had a mean interest score of 72.2 and a standard deviation of 6.9. The data, therefore, suggests that the high ability students in the experimental group showed greater interest in map-work when taught using models, than their low ability counterparts.

Hypothesis Five

There is no significant ($p<0.05$) difference in the mean interest scores of high ability and low ability students taught with models as indicated by their mean interest scores in map-work.

As shown on Table 12, the calculated F-value for the main effects of treatment on interest based on ability level is 1.472. This value is significant at 0.05 level of significance. The null hypothesis is therefore rejected. This, therefore, implies that there is a significant difference between the mean interest scores of high ability group ($\bar{x}$ = 84.8) and that of low ability group ($\bar{x}$ = 72.2). The high ability students, therefore, showed greater interest in map-work when taught with models than the low ability students taught with the same method.

Research Question Six

Which group of students by gender show greater interest in map-work, as indicated by their mean interest scores, when taught using models?

Table 14: The Mean ($\bar{x}$) and Standard Deviation (S.D.) of the students' post-interest scores in map-work (by gender).

Gender	Experimental Group			Control Group		
	($\bar{x}$)	S.D.	N	($\bar{x}$)	S.D.	N
Male	78.1	9.2	43	66.1	9.7	46
Female	77.8	8.3	60	65.2	9.8	48

The data on Table 14 has shown that the male students in the experimental group have a mean interest score of 78.1 and a standard deviation of 9.2. The female students in the same group have a mean interest score of 77.8 and a standard deviation of 8.3. The data indicated that the mean interest scores of male and female students in the experimental group are nearly the same, with that of male students being slightly higher than that of their female counterparts.

Hypothesis Six

> There is no significant ($p<0.05$) difference in the mean interest scores of male and female students in map-work, when taught using models.

The results on the ANCOVA table (Table 12) has shown that the calculated F-value for the main effect of treatment on gender was 0.135. The value therefore indicated that the difference between the mean interest scores of male ($\bar{x}$ = 78.1) and female students ($\bar{x}$ = 77.8) was not significant. The null hypothesis is therefore not rejected. This implied that there was no significant difference in the mean interest scores of male and female students in map-work when taught with models. This indicated that gender has no effects, on the interest of students in map-work when taught using models.

Hypothesis Seven

> There is no significant ($p<0.05$) interaction between method and gender on the students' academic achievement in map-work.

Table 8 indicated that the F-value of the two-way interaction between method and gender was 3.422. This value was significant at 0.05 level of significance. The null hypothesis was, therefore, rejected. There was, therefore, significant interaction between gender groups and methods on the students' academic achievement in map-work. This implied that the effects of models and gender groups influenced the students' academic achievement in map-work.

Hypothesis Eight

> There is no significant ($p<0.05$) interaction effect of method and gender on the students' interest in map-work.

The data on Table 12 has revealed that the F-value of the two-way interaction between gender and treatment was 1.643. This value was significant at 0.05 significance level. The null hypothesis was, therefore, rejected. That means that there was a significant interaction effect of method and gender on the students' interest in map-work. This implied that the combined effect of method and gender influenced the students' interest in map-work.

Hypothesis Nine

There is no significant ($p<0.05$) interaction effect of method and ability levels on the mean academic achievement scores of the students in map-work.

With respect to the results in Table 8, the F-value of the two-way interaction between method and ability levels was 18.544. This value was significant at 0.05 significance level. The null hypothesis is therefore rejected. There was, therefore, significant interaction effects of method and ability levels on the students' academic achievement in map-work.

Hypothesis Ten

There is no significant ($p<0.05$) interaction effect of method and ability levels on the students' interest in map-work.

Table 12 showed that the F-value of the two-way interaction between ability level and treatment is 0.995. This value was significant at 0.05 significance level. The null hypothesis was therefore rejected. There was, therefore, a significant interaction effect of method and ability levels on the students' interest in map-work. This implied that the effect of treatment was not consistent across the ability levels.

The Summary of the Findings

The major findings of this study include the following:

1. The students taught using models have higher academic achievement in map-work than those taught using the conventional lecture method.
2. The academic achievement of male and female students taught using models did not differ significantly. This implies that gender was not a significant factor in students' academic achievement in map-work when taught using scale models.
3. The high ability students had higher academic achievement in map-work than the low ability students, when taught using models.
4. The students taught with models showed greater interest in map-work than those taught with the conventional lecture method.
5. The interest of male and female students taught map-work using models did not differ significantly. In order words, gender did not exert any significant influence on the students' interest in map-work.
6. The students of high ability showed greater interest in map-work than students of low ability when taught using models.
7. There was a significant interaction between method and gender on the students' academic achievement in map-work.
8. There was a significant interaction effect due to treatment and gender on the student's interest in map-work.

9. There was a significant interaction effect of method and ability levels on the mean academic achievement scores of the students in map-work.
10. There was also a significant interaction effect of method and ability levels on the students' interest in map-work.

CHAPTER FIVE

THE DICUSSIONS OF THE RESULTS, CONCLUSIONS, EDUCATIONAL IMPLICATIONS, RECOMMENDATIONS AND SUMMARY

The chapter deals with the discussions and interpretations of the results of the study. The .chapter is organized under the following sub-headings: the discussion; limitations of the study; recommendations, suggestions for further research and summary.

Discussion of the Results

In discussing the major findings of this study, the following sub-headings have been used:

- The effect of the use of models on academic achievement in map-work.
- The effect of the use of models on interest in map-work.
- The effect of the use of models on academic achievement of gender-groups on map-work.
- The effect of the use of models on the interest of gender-groups in map-work.
- The effect of the use of models on academic achievement of students of different ability levels in map-work.

- The effect of the use of models on the interest of students of different ability levels in map-work.
- The combined effect of method and gender on achievement and interest of students in map-work.
- The combined effect of method and ability levels on academic achievement and interest of students in map-work.

The Effect of the Use of Models on Academic Achievement in Map-work

The results on Table 7 revealed that the students taught using models scored higher in the map-work achievement test ($\bar{x}$ = 67.2) than those taught using the conventional lecture method ($\bar{x}$ = 51.5). The experimental and the control groups had relatively equal mean scores prior to treatment. The results on Table 8 showed that there was a significant effect of treatment on the students' academic achievement in map-work. This implied that the students taught using models performed significantly better than those taught using the conventional lecture method.

The above finding is in agreement with that of Okoye (1995). In the study, the students taught geography using simulation method, scored significantly higher than their counterparts taught using the conventional lecture method. The findings are also in line with those of Atkins (1983); Osho (1990); Moemeke (2003); Ehi (2004).

The result, however, differed from that of Anikweze (1988). In his research report, there was no significant difference in the mean academic achievement scores of three groups of students taught using three different methods - models, games, simulations and conventional lecture.

The positive effect of models on the academic achievement of students may be attributed to the fact that the type of model used is the three dimensional type (the scale model). Ola (1976) attributed the difficulty which the students experience in map-work to the students' inability to appreciate the three dimensional form represented by the contour patterns on a two dimensional paper.

The result of this study lends credence to psychological learning theories. Gestalt psychologists – Max-Wertheimer, Kurt-Kuffka, Wolfgang Kohler, Ausubel, etc placed emphasis on the development of insight in learning situations (Noel and Smith, 2002). Structure such as concrete materials like models as well as organization of the subject matter play an important role in the development of insight (Bruner as cited in Chauhan, 1987).

The use of models, therefore, creates room for insightful learning experiences. According to Haggett and Chorley (1971), the processes of manipulating, making, measuring, observing which are applied in teaching and learning using models, develop the students' intuitive capacity, creativity and insight. The result of this study is in line with the assertion by Jean Piaget, as cited in Bredo (2000), that concepts develop from concrete to abstract as the learner draws from his experiences - when concrete materials are used for teaching.

The Effect of Use of Models on Interest in Map-work

The results of the study as shown on Table 11 has revealed that the mean interest scores of students taught using models ($\bar{x}$ = 78.0) is significantly higher than that of those taught using the conventional lecture method ($\bar{x}$ = 65.7). Prior to treatment their mean scores of the pretest results showed that the subjects in the experimental and control groups operated at relatively the same level.

The results on Table 12 indicated that the difference between the mean interest scores of the experimental and control groups is significant. The use of models, therefore, had a significant effect on the students' interest in map-work. The students taught map-work using models, therefore, showed greater interest in map-work than those taught using the conventional lecture method.

The findings of this study are consistent with that of Busari (1991), which reported that interest correlates positively and significantly with competency factor. It also agrees with that of Ezeudu (1995), which reported that concept mapping has a significant effect on students' interest in organic chemistry concepts. The results also agree with that of Okafor (2000). Many studies have identified poor instructional methods as a major reason why students lack interest in geography (Awaritefe, 1988; Adinna, 1991; Obi, et al, 1995; Madu, 2002).

The Effect of Use of Models on the Academic Achievement of Gender Groups In Map-work

The results on Table 9 revealed that the difference between the mean academic achievement scores of male students ($\bar{x}$ = 67.5) and that of female students ($\bar{x}$ = 66.9) in the experimental group is closely marginal though in favour of the male students. The results shown on the ANCOVA table (Table 8) indicated that the difference was not statistically significant. This showed that gender was not a significant factor in students' academic achievement in map-work, as male and female students achieved equally when taught using models.

This result is in agreement with that of Orji (1984), Williams (1989), Ugwu (1993), Njoku (1996), Agbaegbu (1999). The result obtained also agrees with the findings of Azikiwe (2005). In her studies on the influence of gender on academic achievement in language use in Nigeria, Azikiwe reported that there was no significant difference in the academic achievement of gender groups in languages. The research report indicated that out of the thirty one ()31) empirical studies used, 74% (23) of the studies showed that gender had no significant influence on language use in Nigeria.

interest in geography (Awaritefe, 1988; Adinna, 1991; Obi, et al, 1995; Madu, 2002).

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The finding however differed with the results obtained by Obioma and Ohuche (1988), Abadom (1986), Ezeife (1990), Kimura (1996), Okafor (2000). In the studies identified, gender was found to be a relevant factor in academic achievement. In the results mentioned, the male students performed significantly better than their female counterparts.

The finding of this research also differed with some studies which reported that female students performed significantly better than their male counterparts in academic achievement. Such studies include the following: Nworgu (1990), Obodo (1990), Osisioma (1995).

The research reports on male dominance in academic achievements especially in the sciences have attracted reactions from some researchers. According to Okeke (2001) the gender differences in academic achievement in favour of male students were not innate. She pointed out that such differences were rather due to sex-role stereo-typing in the society which ultimately tend to influence curriculum instruction in favour of the male students.

It appears, therefore, that with the results of this study, which revealed no significant difference between the mean academic achievement of male and female students; the use of Models for teaching map-work is likely to promote gender-equality. The result indicated that the method was not gender biased.

The Effect of Use of Models on The Interest of Gender Groups In Map-work

The data on Table 14 showed that the mean post-interest scores of the male ($\bar{x}$ = 78.1) and female students ($\bar{x}$ = 77.8) was almost equal, as that of male students is a little above that of female students. The results on the 'ANCOVA' table (Table 12) indicated that the difference between the mean interest scores of the male and female students were not statistically significant. There is, therefore, no significant difference in the mean post-interest scores of male and female students taught using models. This implied that the male and female students had equal interest in map-work when taught using models.

This finding is consistent with the findings of Mumaw (1984) as reported in Dean and Morris (2003) who found that in a regression analysis the variance of interest attributable to gender was negligible relative to other systematic individual difference variance within the entire sample. The finding also agrees with that of Nworgu (1990), Anaekwe (1997).

The result is in line with recent studies (Ezeliora, 2004), which indicated that in recent times, there has been explosion in female participation in higher education. Gender stereotypism (Okeke, 2001) has been regarded as a major hindrance to women participation in science and higher education. To counter such gender stereotypism, innovative strategies have been recommended for teaching and learning. The result of this study has proved that the models can be adopted as one of such effective strategies.

The results of this study, however, disagree with that of Agbaegbu (1999). He reported a significant gender influence on the interest in geography in favour of the male students. It also differed with the findings of Obioma and Ohuche (1984) in which male students showed greater interest in sciences than their female counterparts.

The Effect of The Use of Models on Academic Achievement of Students of Different Ability Levels In Map-work

The results on Table 10 showed that the high ability students taught map-work using models scored higher ($\bar{x}$ = 73.5) than their low ability counterparts taught using the same method ($\bar{x}$ = 61.2). Evidence from Table 8 revealed that mean difference was significant. This implied that the high ability students performed significantly better than their low ability counterparts in the achievement test in map-work.

The result agrees with the findings of Okoye (1995) where the high ability group performed significantly better than their low ability counterparts when taught using simulations. The result also agrees with that of Nwosu (1990), Njoku (1996). However, the finding contradicts that of Anikweze (1988). In his study, both high and low ability groups benefited equally from instructions when both models, games, simulations and lecture were used to teach them.

The Effect of The Use of Models on The Interest of Students Of Different Ability Levels In Map-work

The data on Table 13 indicated that the mean post-interest score of the high ability students ($\bar{x}$= 84.8) is higher than that of the low ability group ($\bar{x}$= 72.2). The ANCOVA table (Table 12) revealed that the difference in the mean post-interest score is statistically significant at 0.05 level of significance. This implied that the high ability students showed greater interest in map-work than their low ability counterparts taught using the same method. Ability level was thus a significant factor in students' interest in map-work when taught using models.

The result obtained agreed with that of Njoku (1996). He reported that the students' ability was a potent factor in their development of interest in chemistry practical activities. Njoku (1996) reported that high ability students developed significantly higher level of interest than their low ability classmates. The result obtained is also in line with that of Nwosu (1990) and Ajewole (1990).

The finding of the study, however, contradicts that of Okoye (1995) who reported that the low ability students taught geography with simulations method, showed higher mean post-interest score in geography and ultimately showed the greatest positive attitude to geography compared to their high ability counterparts taught using the same method.

The Combined Effect of Method and Gender on Academic Achievement and Interest In Map-work

Table 9 showed that the male students taught using models scored higher ($\bar{x}$ = 67.5) than their male counterparts taught using the conventional lecture method ($\bar{x}$ = 52.1). The female students in the experimental group achieved higher ($\bar{x}$ = 66.9) than their counterparts in the control group ($\bar{x}$ = 50.8). Table 8 revealed that the interaction of method and gender on academic achievement was significant.

That implied that use of models, for teaching map-work, had relative effects on the academic achievement of male and female students. Therefore, the academic achievement based on use of models was consistently higher across male and female students compared to that of male and female students taught using the conventional lecture method. This implied that male and female students achieved higher in map-work when models were used than when the conventional lecture method was used.

The data on Table 14 indicated that the male students taught using models had a higher mean post-interest score ($\bar{x}$ = 78.1) than their male counterparts taught using the conventional lecture method ($\bar{x}$ = 66.1). The female students in the experimental group had a higher mean post-interest score ($\bar{x}$ = 77.8) than the female counterparts in the control group ($\bar{x}$ = 65.2) taught with the conventional lecture method.

Table 12 indicated that the two-way interaction of gender and treatment was significant. That means that the treatment, the use of models, had some effects on the interest of the gender groups. Therefore, the interest of students taught using models was consistently higher across male and female students taught using models compared to the interest of male and female students taught with the conventional lecture method.

The Combined Effect of Method and Ability Levels on the Academic Achievement and Interest in Map-work

The data on Table 10 indicated that the high ability students in the experimental group scored significantly higher ($\bar{x}$ = 73.5) than the high ability students in the control group ($\bar{x}$ = 63.1) taught with the conventional lecture method. The low ability group in the experimental group had a higher mean academic achievement score ($\bar{x}$ = 61.2) than their counterparts in the control group ($\bar{x}$ = 44.0).

The data on Table 8 revealed that the two-way interaction of method and level was significant. That implied that the use of models had relative effects on academic achievement of high ability and low ability levels in the experimental group taught using models compared to their counterparts in the control group taught using the conventional lecture method. Therefore, the high and low ability groups achieved higher when models were used for teaching than when the conventional lecture method was used.

As indicated on Table 13, the mean-post-interest score of high ability group in the experimental group is higher than that of those in the control group. Similarly, the mean-post-interest scores of the low ability students taught using models is higher than that of their counterparts taught using the conventional method.

Table 12 indicated that the two-way interaction of ability level and treatment on interest was significant. This implied that method used (use of scale models) has some influence on the interest of ability groups in map-work. That means that the use models tend to positively influence the interest of students of different ability levels compared to the use of conventional lecture method.

Conclusion

The conclusions based on the results of this study are as follows: The use of scale models had a significant effect on the students' academic achievement and interest in map-work. The use of models was, therefore, more effective than the conventional lecture method for teaching map-work.

Gender was not a significant factor on the students' academic achievement and interest in map-work when taught using models. The male and female students therefore, showed the same level of achievement and interest in map-work when taught using models.

The students of high ability level taught using models performed significantly better and showed greater interest in map-work than those in the low ability group taught using the same method.

The combined effects of method and gender on achievement and interest in map-work was significant. There was a significant interaction between method and ability level on academic achievement and interest in map-work.

Educational Implications

The results of this study have a number of educational implications. This is with respect to teachers, educational administrators and planners, students and tertiary institutions. The implications are discussed below.

The results of this study have shown that the application of 'scale models' for teaching map-work has a significant effect on the academic achievement and interest of students in map-work. The implication of the findings of this study is that there is a need for geography teachers to develop interest on the use of models for teaching and learning map-work. This shall induce them into reducing the emphasis placed on the conventional lecture method when they can use models as a more effective alternative method of teaching map-work.

The research has revealed that scale models of any geographical feature can be created and used for teaching. The implication of this is that models can sometimes complement fieldwork in geography. Teachers may not always be able to embark on field work with the students for logistic reasons. It is however, expected that the students should be exposed to field work especially in geography. This can be done by making scale models of specific features of interest and bringing them to the classrooms for necessary observations by the students. This can even induce teachers into developing interest in embarking on fieldwork.

The findings of this research have implications on the educational administrators and planners. This is with respect to popularizing the findings for effective use for teaching and learning. This can be done through seminars, conferences, workshops, refresher-courses or in the course of schools' supervisions. Such provide opportunities for such dissemination of information on the results of research on such innovative methods of teaching. There is a need to popularize the findings especially the teaching and learning of various skills in map-work using models.

The results of the study has revealed that the students of high ability level and those of low ability level taught using models performed significantly better and showed greater interest in map-work than their counterparts taught using the conventional lecture method. The implication of this is that the academic achievement of the students, the interest and ultimately the attitude of students to map-work and geography is likely to change positively when teachers begin to adopt models as an alternative method of teaching geography.

The result of this study has provided empirical evidence to show that when models are used for teaching map-work, the students tend to develop interest in the subject. There is thus a need to sustain the interest in the students through the use of models.

The findings of the research have implications for the tertiary institutions, especially for teacher education. The result of this study is likely to attract the interest of tertiary institutions. There is a need to infuse the findings of this study into the curriculum in the course of curriculum planning, development, modification, curriculum evaluation or revision – for effective use for teacher education.

The study has revealed that gender was not a significant factor on students' academic achievement and interest in map-work. The result showed that both male and female students achieved equally and showed the same level of interest when taught with models. The implication of this result is that the use of scale models is likely to promote gender equality and thus eliminate gender related differences in geography.

This finding has other educational implications. The result gives credence to the claim that females are not inferior to males academically. Literature reviewed indicates allegation that the claim of male superiority over female in classroom behaviours influences curriculum instruction in favour of male learners and thus making the curriculum gender biased. The implication of the result of this study is that it will stimulate consciousness on gender related differences with respect to the curriculum, with a view to ensuring a necessary gender balance in the course of curriculum revision.

The population of females in Nigeria is very high. The nation stands to loose a potentially abundant labour force if females are not encouraged to improve their participation in educational activities. The use of models for teaching and learning geography is one of such means of improving and sustaining the academic achievement and interest of male and female students.

Limitations of the Study

The limitations, which might affect the generalization of the findings of this study are as follows:

1. The contents covered in the study were only five units of the senior secondary year two geography curriculum. Again, only senior secondary year two students were used for the study. All these may affect the generalizability of the results of the study.
2. Only four schools were used in the study which was also based on only one education zone of a state in Nigeria. Though experimental studies permit the use of small and manageable samples, the use of only four schools may limit the generalizability of the results of the study to the whole country.
3. Although four different geography teachers were trained and used for the study, other extraneous variables such as teaching experience, teacher personality etc. may still influence the results of the study despite all the measures taken to control the extraneous variables.
4. The presence of the experimental and control groups in the same school, (though introduced to effect homogeneity of school environment) may attract some intervening variables, such as spillover effect of information from experimental to the control groups and vice versa which may constitute some limitations to the generalizability of the results of the study.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. The procedures for the application of 'Scale Model' for teaching various concepts in map-work, should be incorporated into the Senior Secondary School Geography Curriculum; as well as in that of the teacher-education programmes in tertiary institutions. This should be done in the course of curriculum modification or renewal. This will enable the teachers to apply models appropriately to teach such concepts.
2. Efforts should be made to equip serving teachers with requisite knowledge, skills and competencies on the production and use of models. This can be done through organizing seminars, workshops, refresher-courses, etc. where the results of this study can be effectively utilized and disseminated.
3. Geography teachers should be encouraged to adopt use of models of various geographical features in teaching and learning geography with the students. The teachers should be allocated rooms where such models can be stored and preserved.
4. Geography teachers should be encouraged to adopt models as a means of eliminating gender related differences in the classrooms. The results of

this study have shown that boys and girls performed equally well in academic achievement as well as showed equal interest in map-work.

The application of models is, therefore, not gender biased. The use of models can, therefore, be used to eliminate, counter or minimize gender related differences within the classrooms. Teachers should, therefore, be encouraged to eliminate contents and instructional materials that bring about gender-related differences in the classrooms.

5. Teacher education programmes in colleges of education and other tertiary institutions should be made to inculcate in the students the processes of production and use of scale models for teaching various skills and concepts in map-work and other areas of geography.

Suggestions for Further Research

The suggestions for further research are as follows:

1. A replication of this study in other states of the federation or geographical areas. The whole country can be used for the study.
2. This study can be replicated using other variables, for instance – school location, retention, socio-economic background, etc.
3. Carrying out the study using topics in other areas of geography.
4. Replicating the study, locating the experimental and control groups in different schools.

5. Repeating the study, comparing the effects of use of models with exposure to fieldwork on academic achievement and interest in map-work.

Summary

The map is the geographer's main tool. However, studies have shown that map-work pose the greatest difficulty to geography students. This has largely been blamed on teaching method. There is, therefore, a need to find ways and means of improving on the academic achievement and interest of geography students in map-work.

The purpose of this study is to investigate the effects of the use of models on the academic achievement and interest of students in map-work. The research also sought to find out the influence of gender and ability level on academic achievement and interest of students in map-work. Six research questions and ten hypotheses were formulated for the study. The researcher reviewed the related literature.

A quasi-experimental design, specifically, the non-equivalent control group design was used for the study. Four mixed schools were randomly selected for the study from Awka Education Zone of Anambra State. A stratified random sampling technique was used in the selection. A total of one hundred and ninety seven senior secondary two students were involved in the study. Intact classes were used. The intact classes were randomly assigned to treatment conditions.

The regular geography teachers of the chosen schools were trained and used for the study. Measures were taken to control the extraneous variables. The lesson plans used were developed by the researcher. The experimental groups were taught using scale models, while the control groups used the conventional lecture method. The two groups were pre-tested prior to treatment and post-tested after the treatment which lasted for six weeks.

The following instruments were used for data collection: Map-work Achievement Test (MWAT); Map-work Interest Scale (MWIS), and three topographical map-sheets. The "MWAT" and "MWIS" were developed and validated by the researcher. The three topographical map-sheets were adapted and modified by the researcher to suit the needs of the study.

A reliability estimate of "0.97" was obtained for the Map-work Achievement Test (MWAT) using Kuder-Richardson formula 21. The Map-work Interest Scale (MWIS) had an internal consistency estimate of "0.82" computed using the Cronbach Alpha formula. The "MWAT" and "MWIS" were used for both the pre-test and the post-test. However, different topographical map-sheets were used for the pre-test and the post-test.

The data generated were analysed using the analysis of Covariance (ANCOVA), Means and the Standard Deviations. The hypotheses were tested at 0.05 significance level.

The results revealed that:

1. The use of models had a significant effect on academic achievement and interest of students in map-work.
2. The students taught map-work using models performed significantly better than their counterparts taught with the conventional lecture method.
3. The students taught using models showed greater interest in map-work than those taught using the conventional lecture method.
4. Gender was not a significant factor in academic achievement and interest in map-work when taught using models.
5. The students of high ability taught with models performed significantly better and showed greater interest in map-work than the low ability students taught with the same method.
6. There was a significant interaction between method and gender on academic achievement and interest of students in map-work.
7. There was a significant interaction of method and ability level on academic achievement in map-work.
8. There was also a significant interaction of method and ability level on the interest of students in map-work.

The findings of this study have implications with respect to teachers, students, educational administrators and planners as well as tertiary institutions. Based on the implications, it is recommended that the techniques of use of scale models for teaching concepts and skills in map-work should be infused into the school curricula. Efforts should be made to popularize the use of models among serving teachers, through seminars, workshops, refresher courses, conferences, etc. The limitations of this research were identified. Some suggestions for further research were made.

REFERENCES

Abadom, G.N (1986). The relationship between reasoning ability and achievement in Mathematics: A case study of form three students. *Nigerian Journal of curriculum studies.* 16 (4), 115-122.

Abegunde, M.A. (1977). Social Influences on the Teaching of High School Geography in Nigeria. P.O. Okunrotifa and K. D. Ola (eds), *Problems of Geography.* Ibadan: Oxford University Press.

Abegunde, M.A. (1987). Critical issues concerning the senior secondary school Geography and their relevance to the contemporary national problems. *Perspectives on Senior Secondary School Geography.* Ibadan: Jumak.

Abegunde, M.A. (1988). The promotion of Career opportunities through the Senior Secondary School Geography. F. C. Okafor, A. R. O. Jibunoh, M. A. Abegunde, O. D. Awaritefe and A. Akinbode (eds), *The New Geography: A handbook for practicing Teachers.* Warri: Award Press.

Abiodun, J. O. (1970). Central place functions and behavior in Ife Region. Ile-Ife: *Occasional Publications.* (1), 63-84.

Abiogu, G. C. (2005). Curriculum Issues and Instructional Material Production and Utilization for the Universal Basic Education (UBE) in Nigeria: Philosophical Implications. *Curriculum and Media Technology Research: A Journal of CUDIMAC* (University of Nigeria) *I* (1), 267-274.

Abler, R; Adam, J.S. & Gould, P. (1977). *Spatial organizations: The geographers' view of the world.* London: Prentice Hall.

Abumere, S. I. (1995). Relevance in geography revisited. *The Nigerian Geographical Journal.* 2 , 19-29

Aburime, E. F. (2004). Refocusing Research in Science, Technology and Mathematics Education: A case for mathematics laboratory. A. G. Akale (ed), *Proceedings of the 45th Annual conference of Science Teachers Association of Nigeria.* P. 183-193 . Ibadan: Heinemann Educational books.

Adebisi, I. A. (1988). Difficulty aspects of Map reading: A case study of ten secondary schools in Ibadan Municipal Local Government Area. F. C.

Okafor, et al (eds), *The new geography: A handbook for practicing Teachers*. Warri: Award Press.

Adebola, C. O.; Elefue, J. M.; Shodipo, J. T.; Elefue, J. E. & Danbaba, G. P. (1991). Strategies for enhancing the teaching of geography as a preparation for living. J. I. N. Okpala (ed), *Teaching Geography for living.* Nsukka: High school Geography Committee, University of Nigeria Nsukka.

Adegoke, K. A. (1988). Towards a Curriculum Model for fieldwork in Senior Secondary School Geography. F. C. Okafor, et al (eds), *The new geography: A handbook for practicing teachers.* Warri: Award Press.

Adejuyigbe, O. (1990). Issues of relevance in Geographical research with reference to Nigeria. B. Ayeni and A. Faniran (eds), *Geographical perspectives on Nigeria's development.* (238-252). Ibadan: Jumak.

Aderounmu, W. O. & Adetumberu, J. O. (1995). Management of Continuous Assessment under the 6-3-3-4 System of Education in Nigeria: Implications for the Geography Teacher. F. C. Okafor (ed). *The Nigerian Geographical Journal.* 2, 43-49

Adeyemi, E. O. (1984). An examination of the teaching of Map-work in Nigerian Secondary School. A paper presented at the Teaching of Geography Workshop, held at Oyo State College of Education, Ilesha.

Adeyemo, A. M. (1987). Instructional aids and the dilemma of effective teaching of geography in Secondary Schools. A paper presented at the Teachers' Workshop held at the College of Education, Ila-Oragun.

Adetumberu, J. O. (1983). The odds against the teaching of Map-work. A paper presented at the workshop in geography, University of Ilorin.

Adigwe, J. C. (1992). Gender differences in chemical solving problems among the Nigerian students. *Research in Science and Technology Education.* 10 (2)

Adinna, E. N. (1991). Teaching geography as an applied science: strategies for improvement. J. I. N. Okpala (ed). *Teaching geography for living.* Nsukka: The Nigerian Geographical Association, University of Nigeria.

Agbaegbu, C. N. (1999). Effects of peer and self assessment techniques on the students' academic achievement and interest in geography. *Un-published Ph.D. Thesis*, University of Nigeria, Nsukka.

Ajaegbu, H. I. (1976). A field work model in High School Geography. P. O. Sada; P. O. Okunrotifa and A. Faniran (eds). *Renewing the geography curriculum in Nigerian High School.* Benin City: Nigerian Geographical association.

Ajaegbu, H. I. & Faniran, A. (1977). *A new approach to practical work in Geography.* London: Heinemann educational Books.

Ajaegbu, H. I. & Faniran, A. (1979). *Fieldwork and the New Geography in High School Geography.* Ibadan: Institute of Education, University of Ibadan.

Ajewole, G. A. (1990). The effects of guided discovery and expository instructional methods on the students' transfer of learning. *Journal of Science Teachers' Association of Nigeria.* 26 (2), 59-67

Akorede, V. E. (1985). The Achievement of Geography objectives through the Development of Geography Curriculum. P. Okunrotifa and K. Ola (eds), *Problems of Geography Teaching in Nigeria.* Ibadan: Oxford University Press.

Akpata, J. (1991). Activity based and child centered learning as a strategy of teaching geography in preparation for living. J. I. N. Okpala (ed), *Teaching Geography for Living.* Nsukka: The Nigerian Geographical Association, University of Nigeria.

Akpudo, G. I. (1977). Major factors leading to the decline of interest in choice of geography as a "WASC" Examination subject in Idemili Local Government Area of Anambra State. *Unpublished B.Ed. Project,* University of Nigeria, Nsukka.

Akuma, N. (2005). Availability and use of instructional materials for effective teaching and learning of geography in Ebonyi State Senior Secondary Schools. *International Journal of Art and Technology Education, 4* 1-11

Alaba, J. O. (1988). Problems and prospects of implementing the new Senior Secondary Schools' geography curriculum. A survey of Enugu and Udi

Local Government Areas of Anambra State. *Unpublished B.Sc (Ed) project.* University of Nigeria Nsukka.

Ali, A. (1983). An investigation of the characteristics of superior Nigerian Secondary Schools' science students vocationally interested in science. *Review of Education.* 8 and 9, Institute of Education, University of Nigeria, Nsukka.

Ali, A. (1985). Preparing Secondary School Mathematics' Teachers for identifying and teaching slow-learners. G. O. Obioma, et al (eds), *Issues in Teacher Education and science curriculum in Nigeria.* Curriculum organization monograph series. 2 272-287

Ali, A.; Ezeadi, S. & Ogbazi, J. N. (1988). *Introduction to educational measurement and evaluation.* Awka: Mek-Unique publishers.

Alonge, E. I. & Agusiobo, B. C. (1983). Effects of fieldwork on performance of different ability groups. *Journal of Research in Curriculum.* 1 (1), 79-86.

Anastasi, A. (1976). *Psychological Testing.* New York: Macmillan Publishing Co.

Anaekwe, M. C. (1997). The effects of students' interaction patterns on the cognitive achievement, retention and interest in chemistry. *Un-published Ph.D. Thesis*, University of Nigeria, Nsukka.

Anene, G. U. & Ndubusi, O. G. (1992). Test Development process. B. G. Nworgu (ed), *Educational Measurement and Evaluation: Theory and practice.* Nsukka: Hallman Publishers.

Anikweze, C. M. (1988). Evaluating the effectiveness of the use of models, games and simulations for teaching geography in Nigerian post primary schools. *Unpublished Ph.D. Thesis*, University of Nigeria, Nsukka.

Anikweze, C. M. (1991). Improving the study of geography in Nigerian Secondary Schools through the use of models, Games and simulations. J. I. N. Okpala (ed), *Teaching geography for living.* Nsukka: Nigerian Geographical Association, University of Nigeria.

Anikweze, C. M. (1995). Attitude of teachers and students to field studies in geography. *The Nigerian Geographical Journal.* 2 64-73

Apostel, L. (1969). Towards the formal study of models in the non-formal sciences. H. Freudenthal, (ed), *The Concept and the Role of the Model in Mathematics, Natural and Social Sciences.* Holland: Dordtrecht.

Arowosegbe, J. O., Egeronu, E. A., Iheanacho, R. O., Okeye, C. O. M. & Uche, O. M. (1981). A Survey of Teachers' methods of teaching Map-work in Geography in secondary schools in Enugu, Awka and Igbo-Etiti Local Government Areas of Anambra state. *Unpublished B.Ed project,* University of Nigeria, Nsukka.

Ayeni, B. (1988). Geographical knowledge, National development and the teaching of geography in Nigerian Secondary Schools. F. C. Okafor, et al (ed), *The New Geography: A handbook for practicing Teachers.* Warri: Award Press.

Ayeni, B. & Faniran, A. (1990). *Geographical perspectives on Nigerian development.* Ibadan: Jumak.

Azikiwe, U. (2005). Gender Influence on Academic Achievement in Language. *International Journal of Art and Technology Education* 4, 41-56. ISSN 1596-8510.

Bajah, S. T. & Bozimo, H. (1989). Low participation of girls in Science, Technology and Mathematics Education: Strategies for Redress. *A report on the national workshop on promoting science, technology and mathematics education among girls and women in Nigeria.* A publication of Women Education Branch of the Federal Ministry of Education. Lagos: 45-54.

Balogun, T. A. (1985). Interest in Science and Technology Education in Nigeria. *Journal of Science Teachers' Association of Nigeria.* 23 (1 and 2), 92-100.

Beckerman, T. M. & Good, T. L. (1981). The classroom ratio of high- and low-ability students and its effects on achievement. *American Education Research Journal,* 18 319-330.

Betty, Kam-fai & Lai-sim (1992). Group learning in Map-work. H. Schrettenbruner and J. V. Westrhenen. *Empirical Research and Geography Teaching.* Amsterdam: Nerdelandse, Geografusche.

Bhatia, H. L. (1980). *History of economic thought.* Sahibabad: Vikas Publishing House.

Blake, W. E. (1978). Right-left brain functions: Geographic implications. *Journal of Geography.* 2 73-246.

Bloom, B. S., Hastings, J. & Madaus, G. F. (1971). *A handbook of Formative and Summative Evaluation of Learning.* New York: McGraw-Hill.

Bloom, B. S. (1976). *Human characteristics and school learning.* New York: McGraw Hill.

Boden, P. (1976). Innovations in action. Eggleston, J. (ed). *Developments in Geography Teaching.* London: Open-Books.

Borg, W. R. & Gall, M. D. (1979). *Educational Research: An introduction.* New York: Longmans.

Bracht, G. H. (1970). Experimental factors related to Aptitude-Treatment interactions. *Review of Education Research.* 40 627-645.

Bredo, E. (2000). The social construction of learning. G. D. Phye (ed.) *Handbook of Academic Learning: Construction of Knowledge.* New York: Academic Press.

British Psychological Society (2002). *The British Journal of Educational Psychology.* 72 (1), 65-86.

Burke, J. D. (1983). Teaching styles in college geography. *Journal of Geography.* 82 (2)

Busari, O. O. (1991). Sustaining the students' interest in science: the influence of cognitive and teacher variables. *Journal of Science Teachers' Association of Nigeria.* 27 (1), 1-24.

Cammie, L. A. (1981). Introducing the basic Map and Globe concepts to young children. *Journal of Geography* 80 (2), 228-233.

Caroll, J. B. (1973). A model of school learning. *Teachers' College Record.* 64 723-734.

Chalton, K. E. (1975). A study of the pupils understanding of the Map-Symbolism, scale, direction and locations in Age-Range 8-13 years. *Unpublished, M.Phill Thesis.* University of Leeds.

Chauhan, S. S. (1987). *Advanced educational psychology.* New-Delhi, India: Vani Educational Books, Ansari Road.

Chris, K. (1983). Teaching contours using over-head projectors. *Journal of Geography* 82 (1), 34-38.

Chorafas, D. N. (1965). *Systems and stimulation.* New York: Methuen and Co.

Chorley, R. J. (1971). Models in Geomorphology. R. J. Chorley and P. Haggett (ed). *Models in Geography.* London: Methuen and Co.

Chorley, R. J. & Haggett, P. (1971). Models, Paradigms and the New Geography. R. J. Chorley and P. Haggett (eds). *Models in Geography.* London: Methuen and Co.

Commisie, Herziening, Eindtermen (1990). General Objectives of Dutch Geography Teaching for Students between 12 and 15 years of age. Joop, Shee and Henk (ed.) *Geographical Procedural Knowledge and Map Skills.* Amsterdan: Nederlands, Geographische Studies.

Cooley, M. W. & Lohnes, P. R. (1976). *Evaluation Research in Education.* New York: Irvington.

Crombach, L. J. (1951). Coefficient Alpha and Internal Structure of Tests. *Psychometrica* 16 297-334.

Daramola, S. O. (1983). The influence of location and sex difference on knowledge of basic physics by entering form three students in Kwara State secondary schools. *Journal of Science Teachers' Association of Nigeria* 2 (2), 126-132.

Davis, G. S. (1970). *The Psychology of Problem-Solving: Theory and Practice.* New York: Basic Books.

Dean, G. M. & Morris, P. E. (2003). The relationship between self-reports of imagery and spatial ability. British psychological society. *The British Journal of Psychology*. 91 (2), 245-273.

Diane, J. (1983). A Map-literacy project. *Journal of Geography*. 82 (1), 279-294.

Dompreh, C. (1977). *School Certificate Map-Reading for West Africa*. Accra: Feb-International Ltd.

Ehindero, J. O. (1984). The interaction of formal operational reasoning schemes with the discovery learning strategies in chemistry unit. *Journal of Science Teachers' Association of Nigeria*. 22 (2), 59-64.

Ekeke, O. G. (1987). Development and Validation of Geography Interest Inventory for Secondary Schools. *Unpublished M.Ed. Thesis*. University of Nigeria, Nsukka.

Eya, P. E. (1988). The relevance of the New Senior Secondary School Geography Curriculum to the needs of the Nigerian Child. F. C. Okafor et al (eds.). *The New Geography: A handbook for Practicing Teachers*. Warri: Award-Press Ltd.

Ezeh, D. N. (1992). Reliability and Validity of Tests. B. G. Nworgu (ed). *Educational Measurement and Evaluation: Theory and Practice*. Nsukka: Hallman Publishers.

Ezeh, M. O. (1988). Observational techniques: theoretical basis, structures, process, and applications. *Unpublished Manuscript*, Sub-Department of Science Education, University of Nigeria, Nsukka.

Ezeh, M. O. (1991). Development and preliminary validation of Teacher-Continuous Assessment effectiveness inventory for Senior Secondary Schools. *Unpublished M. Ed Project*. University of Nigeria, Nsukka.

Ezeife, A. N. (1990). Sex and environment as factors in Physics Achievement. *International Journal of Educational Research*. 4 17-24.

Ezeliora, B. (2004). Innovative programmes to Counter Gender in Science among primary school pupils. M. A. G. Akale (ed). *The proceedings of* *the 45th Annual Conference of Science Teachers' Association of Nigeria* (148-152). Ibadan: Heinemann Educational books.

Ezeudu, S. A. (1987). Development and preliminary validation of an instrument for evaluating the psychomotor outcomes of Senior Secondary School Geography. *Unpublished M. Ed Project.* University of Nigeria, Nsukka.

Ezeudu, S. A. (1989). The use of projects as evaluation strategy in geography teaching: A case study of schools in Nsukka Education Zone of Anambra State. A paper presented at the conference of the association for promoting quality education in Nigeria, Eha-Amufu College of Education, Eha-Amufu.

Ezeudu, S. A. (1992). Development and validation of some projects and instruments for evaluating the students' learning outcomes in the Senior secondary School Geography. *Unpublished Ph. D Thesis*. University of Nigeria, Nsukka.

Ezeudu, F. O. (1995). Effects of concept maps on students' achievements, interest and retention in selected units of Organic Chemistry. *Unpublished Ph. D. Thesis*, University of Nigeria, Nsukka.

Ezeudu, S. A. (2004). Welcome address presented at the opening ceremony of the Annual Conference of 'CUDIMAC'. University of Nigeria, Nsukka.

Faniran, A. & Oguntoyibo, P. (eds), (1981). *A handbook of Geography Teaching for Schools and Colleges*. Ibadan: Heinemann, educational books.

Federal Ministry of Education (1985). *National Curriculum for Senior Secondary Schools*. Lagos: NERDC.

Federal Ministry of Education, Science and Technology (1985). *A handbook on Continuous Assessment*. Ibadan: Heinemann educational books.

Federal Ministry of Education (1991). *National Curriculum Review Conference Proceedings*. Lagos: Macmillan Publishers, Implementation Committee, National Policy on Education.

Federal Republic of Nigeria (2004). *National Policy on Education.* Yaba – Lagos: NERDC Press.

Gagne, R. M. (1977). *The Conditions for Learning.* New York: Holk-Sounder International.

Garber, R. (1992). How do students in higher education perceive maps? H. Schrettebruner and J. V. Westrhenen (eds), *Empirical Research and Geography Teaching*. Amsterdam: Nederlandse, Geografische Studies.

Haggett, P. & Chorley, R. J. (eds). (1971). *Models in Geography*. London: Methuen and Co. Ltd.

Haggett, P., Cliff, A. D. & Frey, A. (1977). *Locational Models: locational analysis in Human Geography*. London: Edward Arnold (Publishers) Ltd.

Hamilton, F. E. (1971). Models of Industrial Location. P. Haggett and R. J. Chorley (eds). *Models in Geography*. London: Methuen and Co. Ltd.

Harnischfeger, A. & Wiley, D. E. (1976), The teaching-learning process in elementary schools: A synoptic view. *Review of Curriculum Studies*. 6 5-43.

Hawkins, M. L. & Larkins, G. A. (1983). Map skills and concepts units for the primary grades. *Journal of Geography*, 82 (2)

Hennings, G. (1981). Understanding time-space relationships through Map-construction in elementary grades. *Journal of Geography*, 80 (4), 129-153.

Henshall, J. D. (1971). Models of Agricultural Activity. R. J. Chorley and P. Haggett, *Models in Geography*. London: Methuen and Co. Ltd.

Howard, P. T. (1988). *Objective Tests in Geography in Map-work and Photograph Interpretation*. Lagos: Pilgrims books.

Husen, T. & Postlethwaite, T. N. (1991). *The International Encyclopedia of Education-Research and Studies*. Oxford: Pergamon Press.

Jibunoh, A. R. O. (1988). Team-Teaching: A strategy for enhancing the teaching of the Senior Secondary School Geography. F. C. Okafor, et al (eds.). *The New Geography: A handbook for practicing teachers*. Warri: Award-press.

Keeves, J. P. (1990). *Educational Research, Methodology and Measurement: An International Handbook*. Oxford: Pergamon Press.

Kephart, N. C. (1971). *The slow-learners in the classroom*. Ohio: Merill-Columbus.

Kerlinger, F. N. (1973). *Foundations of Behavioural Research.* New York: Rinebart and Winston Inc.

Kibel, B. M. (1972). *Simulation of the Urban Environment.* A.A.A. Commission on College Geography. Technical Paper 5.

Kimura, D. (1996). Sex, Sexual Orientation and sex hormones influence on human cognitive function. *Current Opinion in Neurobiology.* 6, 259-263.

Klausmever, H. H. & Godwin, W. (1976). *Learning and Human abilities – educational psychology.* New York: Harper International.

Kopolati, A. R. O. (1986). Response to the Demands of the new education system: The NERC's involvement in the development of the Senior Secondary School Geography Curriculum. A paper presented at the N.G.T.A. Conference held at Oyo State College of Education, Ilesha.

Mabogunje, A. L. (1990). Geography and National Reconstruction. B. Ayeni and A. Faniran (eds.) *Geographical Perspectives on Nigeria's Development* (55-63). Ibadan: Jumak (Nig.) Ltd.

Macdonald, A. M. (1981). *Chamber's Twentieth Century Dictionary.* London: The Pitman Press.

MacMahon, F. B. & MacMahon, J. W. (1991). *Psychology: The Hybrid Science.* Illinois: Dorsey Press.

Madu, I. A. (2002). *A handbook of field studies in Geography.* Enugu: Jomoe Enterprises.

Majasan, J. A. (ed.) (1971). *New dimensions in Nigerian High School Geography.* Ibadan: Institute of Education, University of Ibadan.

Majasan, J. A. & Adejuyigbe, O. (1973). Curriculum Innovations in Nigerian High School Geography. *Proceedings of the Conference on High School Geography held in Benin-City.* Ibadan: Institute of Education, University of Ibadan.

Mehrens, W. A. & Lehman, L. J. (1978). *Measurement and evaluation in education and psychology.* New York: Holts, Rinehart and Winston.

Miller, N. (1982). Improving the design of classroom Maps: Experimental comparison of alternative formats. *Journal of Geography.* 81 (1)

Mills, H. R. (1973). *Teaching and Training: A handbook for instruction.* London: Macmillan press.

Mkpa, M. A. (2003). Learner centred approach to classroom teaching: What is it and why? A paper presented at the orientation meeting of the Provosts of Colleges of Education and Chairmen of State Primary Education Board; *UNICEF, a field office, on capacity building for teachers at the primary school level.* Dannic Hotels, Enugu.

Moemeke, C. D. (2003). The Potency of fieldwork in development of problem-solving abilities in ecology by Senior Secondary School biology students. In M. A.G, Akale (ed). *The proceedings of the 44th Annual conference of science Teachers' Association of Nigeria* (131-134). Ibadan: Heinemann Educational Books.

Monkhouse, F. J. (1980). *A dictionary of Geography.* Bristol: Edward Arnold, Arrow Smith Ltd.

Monkhouse, F. J. & Wilkingson, H. R. (1986). *Maps and Diagrams,* London: Methuen and Co. Ltd.

Morgan, M. A. (1971). The Hardware Models in Geography. R. J. Chorley and P. Haggett (eds). *Models in Geography.* London: Methuen and Co. Ltd.

Nachmias, C. F. & Nachmias. D. (1992). *Research Methods in the social sciences.* London: Edward Arnold Ltd.

NERDC, (1985). *National curriculum on Geography for the Senior Secondary Schools.* Yaba - Lagos: NERDC.

Nigerian Geographical Association (1995). *The Nigerian Geographical Journal.* Ibadan: Stirling Horden publishing (Nig) Ltd.

Nimako, D. A. (1969). *Map-Reading for West Africa,* London: Longmans-Group Ltd.

Njoku, Z. C. (1996). Effects of instruction under different sex groupings on the students' skills acquisition and interest in chemistry practical activities. *Unpublished Ph.D. Thesis.* University of Nigeria, Nsukka.

Noel, E. and Smith, C. (2002). Personal understanding and target understanding: Mapping influences on the outcomes of Learning. In *British Journal of Educational Psychology.* 72 , (3), 321-339.

Nwagu, E. K. N. (1991). Development and standardization of Social Studies Achievement Tests (SSATS) for Junior Secondary Schools in Anambra State. Unpublished Ph.D. Thesis. University of Nigeria, Nsukka.

Nwana, O. C. (1979). *Educational Measurement for Teachers.* Lagos: Thomas Nelson (Nig) Ltd.

Nwana, O. C. (1981). *Introduction to Educational Research.* Lagos: Heinemann Educational books.

Nworgu, B.G. (1985). Expository and discovery methods of Teaching Secondary School Chemistry. T.O. Mgbodile; S. O, Ayodele; Akubue and G. O. Obioma (eds). *Issues in Teacher education and science curriculum in Nigeria*. Curriculum organization of Nigeria, Monograph series.

Nworgu, B. G. (1990). Evaluating the effectiveness of the resource materials types relative to the students' Cognitive Achievements retention and interest in Integrated Science. *Unpublished Ph.D. Thesis*, University of Nigeria Nsukka.

Nwosu, A. A. (1990). Acquisition of science process skills among Senior Secondary School Year One Biology students in Anambra State. *Unpublished Ph.D. Thesis*. University of Nigeria, Nsukka.

Obi, B. O; Nweke, C. A; Oguamanam, B. C. & Okonkwo, M. O (1995). The attitude of students to the teaching of Geography in Secondary Schools in Awka South Local Government Area of Anambra State. *Unpublished B.Sc. (Ed.) Project*. University of Nigeria, Nsukka.

Obioma, G. O. & Adibe, M. O. (1987). The effects of small group instructional technique on Mathematics Achievement of Junior Secondary School Slow-learners. *Journal of Science Teachers Association of Nigeria.* 25 (2), 92-96.

Obioma, G. O. & Ohuche, R. O. (1988). Research in Science and Mathematics Education and the National Development: Nigeria's experience in the last decade. A paper presented at the international conference on research and national development; University of Nigeria, Nsukka.

Obodo, G. C (1990). The differential effects of three teaching models on the performance of Junior Secondary School Students in some algebraic concepts. *Unpublished Ph.D. Thesis*. University of Nigeria, Nsukka.

Obu, T. N. (1993). Cognitive styles, problem-solving paradigm and achievements in Biology. An *Unpublished Ph.D. Thesis*, University of Ibadan, Ibadan.

Odumosu, S. (1984). Decline in geography. R. Ogumade and J.O. Oyeleke (ed), *Towards a concept-based Geography Teaching in Nigeria Secondary Schools.* Ibadan: Oxford University Press.

Offorma, G. C. (2004). Curriculum issues; Resource provision and the use in the Arts and language Teaching. Lead paper presented at the 'CUDIMAC' conference on curriculum innovation, instructional materials production and utilization, University of Nigeria, Nsukka.

Ogomaka, P. M. C (1989). Projects in Junior Secondary School Mathematics: Implications for teaching, learning and continuous assessment. *Unpublished Ph.D. Thesis*, University of Nigeria, Nsukka.

Ohuche, R. O. & Akeju, S. A. (1977). *Testing and evaluation in education.* Ikeja-Lagos: (AER), Sky-way Press Ltd.

Okafor, F. C. (1984). *Philosophy of education and Third World perspectives.* Lawrenceville, USA: Brunswick Publishing Company.

Okafor, G. A. (2000). Effects of note-taking patterns on students' academic achievement, interest and retention in geography. *Unpublished Ph.D. Thesis*. University of Nigeria, Nsukka.

Okafor, F. C. (1988). Towards a functional Senior Secondary School Geography. F. C. Okafor, et al (eds), *The New Geography: A hand book for practicing teachers.* Warri: Award-Press Ltd.

Okafor, F. C., Jibunoh, A. R. O., Abegunde, M. A., Awaritefe, O. D. & Akinbode, A. (1988) (eds), *The New Geography: a handbook for practicing teachers*. Warri: Award Press Ltd.

Okeke, E. A. C (2001). Women in Science, Technology and Mathematics Education in Nigeria. *Proceedings of science Teachers Association of Nigeria 42nd Annual conference-* Ilorin.

Okoye, R. (1995). Effects of teaching methods (Simulation and Lecture) on academic achievement and attitude in Senior Secondary School Geography. An *Unpublished Ph.D. Thesis*; University of Nigeria Nsukka.

Okoye, T. O. (1980). The problems and methods of teaching Map-work in Post Primary Schools in Nigeria. *Nigerian Geographical Journal;* 18 (2), 112-182.

Okpala, J. I. N. (1987). The feasibility of the reality-oriented, problem-solving questions in WASC Examination as a means to improving the teaching and learning of Map-work in Nigerian secondary schools. *Unpublished Ph.D Thesis;* London Institute of Education, University of London.

Okpala, J. I. N. (1988). Teaching styles in reading and interpreting topographical maps - the Nigerian experience. R. Gerber and S. Lidstone (eds). *Developing skills in geographical education.* Ibadan: An International geographical union publication and the Institute of Education University of Ibadan.

Okpala J. I. N. (1991) (ed). Teaching Geography for Living. *Proceedings at the Workshop on Senior Secondary School Geography.* Bendel State University, Abraka Campus. Nsukka: High School Geography Committee, Nigerian Geographical Association, University of Nigeria.

Okunrotifa, P. O. (1977). Recent trends in Geography Examinations. P.O. Sada et al (eds). *Renewing the Geography curriculum in Nigerian High School.* Ibadan: Nigerian Geographical Association, University of Ibadan.

Okunrotifa, P. O. (1987) *Evaluation in Geography.* Ibadan: Oxford University press.

Okwo, F. A. (2004). An Integrated Framework for Instructional Media Utilization in Nigeria. A lead paper presentation at the Second Annual National Conference organized by CUDIMAC on "Meeting the Challenges of Curriculum Innovation through the Instructional Materials Production and Utilization" held at the University of Nigeria, Nsukka.

Ola, K (1976). The use of Models, Simulations and Games in High School Geography. P. O. Sada; P.O. Okunrotifa; and A Faniran (eds), *Renewing the Geography curriculum in Nigerian High School.* Ibadan: Nigerian Geographical Association, University of Ibadan.

Onah, S. C. (2000). *A practical approach to Map-work for Senior Secondary Schools and Colleges.* Nsukka: Jobus international Press.

Onosanya, M. K. (1985). Beyond mastery learning: The effects of combining students' support system with feed back corrective learning outcomes in geography. *Unpublished Ph.D. Thesis;* University of Nigeria, Nsukka.

Orji, J. O. (1984). The effects of two reinforcement schedules on the academic performance of children in a primary science programme. *Unpublished M.Ed Thesis.* University of Nigeria, Nsukka.

Osho, I. (1990). The effects of problem-solving and conventional teaching strategies on achievement in social studies among Nigerian secondary school pupils. *(JOSIC)-Journal of Studies in curriculum* 1 (2), 53-63.

Osisioma, I. (1995). Effects of mode of concept mapping and gender on students' achievement and attitude towards Integrated Science. *Unpublished Ph.D Thesis.* University of Nigeria, Nsukka.

Oyeleke, J. O. (1988). Attitude of students towards learning geography in Nigerian Secondary Schools: A case study of Oranmiyan Local Government Area of Oyo State. F. C. Okafor, et al (eds), *The new Geography: A handbook for practicing Teachers.* Warri: Award press Ltd.

Peters-Harbour, V. F. (1999). Evaluation in the Affective and Psychomotor domains. H. V. F. Harbour-Peters, *Note-Worthy Points on Measurement and Evaluation.* Enugu: Snaap press Ltd.

Philips, D. C. (2000). *Constructivism in Education.* Chicago: National Society for the Study of Education.

Pophan, W. J. (1975). *Education Evaluation* New-Jersy: Prentice Hall.

Rice (1982). Development of a model in in-service programming for preparing Secondary School Administrators to be effective instructional supervisors. Dissertation, *University of Nevada. Dissertation abstracts International.* 43 (4); 2190A

Rogers, M. (1975). *An Introduction to Models in Geography.* London: Longmans Group.

Russel, I. L. (1970). Development of Attitude, Interest and Values. C. E. Skinner (ed). *Educational Psychology.* New-Delhi: Prentice Hall, Ltd.

Sada, P. O., Okunrotifa, P. O. & Faniran, A. (1975). *Renewing the geography curriculum in Nigerian High School*. Ibadan: Nigerian Geographical Association, University of Ibadan.

Sada, P. O. (1990). Geography in Nigeria: Perspectives and prospects. A. Faniran and B. Ayeni (eds). *Geographical perspectives in Nigeria's development* (197-209). Ibadan: Jumak (Nig) Ltd.

Saylor, M. & Alexander, C. N. (1976). Predicting achievement using intellectual academic, motivational and selected non-intellectual factors. *Journal of experimental education.* 45 (4), 44-4.

Schee, J. V; Dijk, H. V. & Westrhenen H. V (1992). Geographical procedural knowledge and map-skills. H. Schrettenbruner; and J. V, Westrhenen (ed). *Empirical Research and geography teaching.* Amsterdam: Nederlandse geografische, studies.

Schretternbruner, H. & Werstrhenen, J. V. (1992). *Empirical Research and Geography teaching.* Amsterdam: Nederlandse geogfrafische, studies.

Sills, D. L. (1986). *International encyclopedia of social sciences.* New York: The Macmillan company and free-press publishers.

Small, J. & Witherick, M. (1986). *A modern dictionary of geography.* London: Edward-Arnold Ltd.

Smith, D. C. (1979). Construction and Validation of attitudinal scale to assess attitude towards environmental issues. Dissertation *Abstracts International;* University of Virginia, U. S. A. 40 (2), 2019A

Stone, E. (1976). *An Introduction to Educational Psychology.* London: Methuen and Co. Ltd.

Tamir, P. (1987). Israeli High School Boys and Girls' Achievement and attitude towards science. Daniel, J. and Kahle, J. B. (eds), *Contributions to the fourth GASAT Conference.* GASAT. 4 (1), 139-149

Tancer, G. H. (1986). *An introduction to Map reading for West Africa.* Ibadan: Longmans, Evans-brothers Ltd.

Thorndike, R. L. & Hagen, E. (1977). *Measurement and Evaluation in Psychology and Education.* New York: John Wiley and Sons, Inc.

Ugwu, P. N (1993). Process Errors Committed by students improving some geometric theorems. *Unpublished M.Ed. Thesis;* University of Nigeria, Nsukka.

Umeakuka, O. A. (1997). Development of a recreation Model for industrial workers in Anambra State. *Unpublished Ph.D. Thesis,* University of Nigeria, Nsukka.

Underwood, J. M. (1981). Skilled Map-interpretation and Visual spatial ability. *Journal of Geography;* 82 (1); 55-60.

UNESCO (June, 1983). The problem-solving approach of environmental education. *Connect-Unesço-Unep: Environmental education Newsletter.* VII (2), 1-3.

UNESCO (August 1988). The problem strategies in environmental education. *Connect-Unesco-Unep: Environmental education Newsletter.* IX (3), 3-7.

Walberg, H. J. & Haetel, G (1990) (ed). *The International Encyclopedia of Educational Evaluation.* Oxford: Pergamon-press Plc.

Walford, R (1973). *New Directions in Geography Teaching,* London: Longmans Group.

West African Examinations Council (1998). *Notes for Training of Examiners on marking Essay papers;* Yaba - Lagos: Tests Development Division, WAEC.

West Africa Examinations Council (1998-2001). *Senior School Certificate Examinations: The Chief examiners' and moderators' Reports;* Yaba-Lagos: Tests Development Division, WAEC.

West African Examinations Council (1998-2003). *Regulations and Syllabuses for the West Africa Senior School Certificate Examinations (WASSCE) detailed syllabus;* Yaba - Lagos: WAEC, Lagos.

Williams, A. G. (1989). *Keynote address: "A report of the national workshop on promoting science, technology and mathematics among girls and* *women in Nigeria;* Lagos: A publication of women education branch, federal ministry of education.

Yalokwu, P. O (1988). The New Secondary School Geography Curriculum and its implications for improvement in teaching methodology. F. C. Okafor, et al (eds), *The New Geography: A handbook for practicing teachers;* Warri: Award press Ltd.

Yalokwu, P. O. & Madusun, I. O. (1991). An analysis of the status of human and material resources for geography teaching in secondary schools in Benin-city. J. I. N Okpala (ed). *Teaching geography for living.* Nsukka: Nigerian Geographical Association, University of Nigeria.

Yau, L. L., Wong, K. F., & Sim-ma, L. (1992). Group learning in Map-work. Schretternbruner, H. and Westrhenen, J. V. (eds); *Empirical research and geography teaching.* Amsterdam: Nederlandse, geografische studies.

APPENDIX 1

Sub-Department of Science Education
University of Nigeria
Nsukka.

Prof/DR/MR/MRS/REV/MISS,

Experts' Vetting and Face-Validation of
Map-work Achievement Test (MWAT)

I am a postgraduate student of Sub-Department of Science Education, University of Nigeria, Nsukka. I am developing a Map-work Achievement Test instrument. I am hereby requesting for your services as an expert in Geography/measurement and Evaluation. Could you please vet the items of the draft I have made.

As a guide I wish to suggest you use the following criteria: the suitability of each of the items in terms of – the scope; the content areas; concepts involved; language-expression; relevance; objectives, etc. I will be glad to welcome your criticism, comments and other corrections.

Yours Faithfully

Ezeh, Michael. O.

APPENDIX 2

MAP-WORK ACHIEVEMENT TEST - TRIAL TESTING

SUBJECT : Geography
CLASS : SS3
Time Allowed:
Sex of Student: Male [ ] Female [ ]
Instruction: Attempt all questions using the Map extract provided. Choose the correct answers from the alternatives lettered A – D. Circle the letter that bears the option you have chosen.

1. The areas above 1000 metres above sea level lie in the:
(A) North-East (B) East (C) North-West (D) South

2. The highest point on the map is in the
(A) North (B) South (C) East (D) West

3. The Vertical Interval of the map is:
(A) 100 (B) 50 (C) 150 (D) 200

4. The height of the town of Adeke above sea-level is approximately:
(A) 500 metres (B) 450m (C) 300m (D) 350m.

5. Which of the following towns is located in the highest attitude?
(A) Olodu (B) Bepodo (C) Owu (D) Aku

6. A steep slope on the Map is
(A) V to H (B) X to Y (C) D to X (D) C to D

7. If you walk from Adeke to Olodu you are going:
(A) Up a steep slope (B) Down a Hill (C) Into a Depression (D) Along a plain.

8. Which of these two points are not inter-visible?
(A) H and V (B) X and D (C) Q and V (D) D and Q

9. A convex slope on the Map is:
(A) AC (B) XC (C) DX (D) DY

10. The feature marked "B' in the West of Owu is a:
(A) Spur (B) Col (C) Ridge (D) Plateau

11. Which of the following statements is **NOT TRUE** of the relief of the Mapped area?
    a. The area generally consists of a huge Plateau.
    b. The main Highland runs from East to West.
    c. The Northern section of the area is generally low-lying.
    d. There is a main ridge that runs from South-East to the South-West.

12. The features marked "C" on the Map is a:
(A) Col (B) Pass (C) Gorge (D) Ridge

13. The highest point in the Mapped area is about
(A) 517m (B) 1100m (C) 650m (D) 850m

14. Which of the following settlements is located near a "Col"?
(A) Kwaye (B) Ijuoma (C) Adansi (D) Aku

15. The feature marked "A" on the Map can best be described as a:
(A) Spur (B) Plateau (C) Valley (D) Conical

16. The main River in the mapped area has its main tributaries from:
    a. Lowlands in the East
    b. Highlands in the South
    c. Highlands in the North-West
    d. Highlands in the North-East

17. The features marked "K" in the map is a:
(A) Plateau (B) Valley (C) Conical Hill
(D) Trigonometrical station

18. There are no settlements in North-west part of the mapped area probably because:
a. It has a rugged relief
b. It is on a Ridge
c. It is located on a swamp
d. It is in a Valley

19. The feature marked "W" in the map is a:
(A) Ridge (B) Knoll (C) Pass (D) Conical Hill

20. Highlands in the mapped area are located mainly in the:
(A) South (B) North (C) East (D) West

21. Lowlands in the mapped area:
a. Are located only in the North.
b. Can be found only in the South.
c. Can be located only in the East.
d. Cover most parts of the Map area

22. Which of these are not significant lowland features in the mapped area?
(A) A plain (B) Spur (C) Valley (D) Sandbars

23. Knolls are found around the:
(A) North-west (B) North-east (C) South-west
(D) Southern area.

24. Lowlands in the mapped area can best be described as:
(A) Flat (B) Undulating (C) Sandy slope
(D) Dissected

25. Which of these are not common features of lowlands in the mapped area?
a. They are flood plains
b. They are mainly River basins
c. They are coastal plains
d. They are undulating

26. The lowest point on the mapped area is about:
(A) 400m (B) 500m (C) 200m (D) 750m

27. Which of the following towns is not on a lowland area of the Map:
(A) Olodu (B) Kwaye (C) Gobi (D) Aku

28. Which of the following towns has the lowest attitude:
(A) Owu (B) Gobi (C) Bepodo (D) Aku

29. Which of these indicate the lowland feature "knoll":
(A) K (B) W (C) B (D) C

30. Which of these are **NOT** dominant lowland features associated with the mapped area?
(A) Valleys (B) Flood plains (C) Undulating
(D) Dissected plains.

31. Which of these is **not** true of the lowlands in the mapped area:
a. They have many dry valleys
b. They are River Valleys
c. They are Undulating
d. Most settlements are located there

32. If the points "V" and "H" are joined with a straight line the cross-section expected is:
(A) A steep slope (B) A plain (C) A dry Valley
(D) A Plateau

33. The space in between the features marked "W" and the feature "V" can best be described as:
(A) Col (B) Pass (C) Plateau (D) Gentle Slope

34. The Southern parts of the mapped area have few settlements because
a. It is mainly forest reserve
b. Because of their infertile soil
c. High incidence of River borne diseases
d. Of the Ridge in the area

35. "KWAYE" is located on a:
(A) Spur (B) River Valley (C) Ridge (D) Plateau

36. The largest number of settlement in the mapped area are located in:
(A) Lowland area (B) on the Ridge
(C) Plateau in the area (D) High relief area.

37. The distribution of settlements in the area is mostly influenced by
(A) Relief (B) Drainage (C) Vegetation
(D) Climate

38. Which of the following settlements is located near a Col?
(A) Adansi (B) Ijuoma (C) Owu (D) Aku.

39. There are no settlements immediately South of Owu because:
a. The area is a plateau
b. The are is Flat
c. Nobody wants to live there
d. The area has steep slopes

40. The largest settlement in the mapped area is located on a height approximately:
(A) 750m (B) 300m (C) 380m (D) 500m

41. Which of the following settlements has the lowest altitude
(A) Gobi (B) Ijuoma (C) Bepodo (D) Olodu

42. Which of these reasons do **not** represent why the areas around South-west are uninhabited?
(A) High relief area (B) Rugged relief
(C) Area liable to flooding (D) Steep slopes

43. Settlements in the mapped area tend to avoid the Ridges in the area because:
a. The ridge areas are not habitable
b. The areas experience volcanic eruption
c. Rivers take-off from the ridges
d. None of the above

44. A likely reason why "Olodu Town" has more means of transportation than "Aku Town" is:
a. Olodu is nearer a river than Aku
b. Olodu is a bigger settlement than Aku
c. Olodu is located on a pass
d. Olodu is on a lowland area while Aku is a Highland area.

45. Which of these transport routes are found only in the lowland sections of the mapped area.
(A) Footpaths (B) Rivers (C) Roads (D) Streams.

46. Which of these is **NOT TRUE** of the relationship between relief and Transportation in the mapped area:
    a. The main road passes at the foot of a Ridge.
    b. Roads tend to avoid High relief areas in the South
    c. Major transportation routes are dominant in the Lowland areas.
    d. Transportation routes are not influenced by relief in the Map area.

47. A likely reason why there are no major roads running from North to South is because:
    a. A swamp is located in the North-west.
    b. There is a ridge in the South.
    c. There are Rivers that can be used for transportation.
    d. Lowland areas in the Mapped area are water-logged.

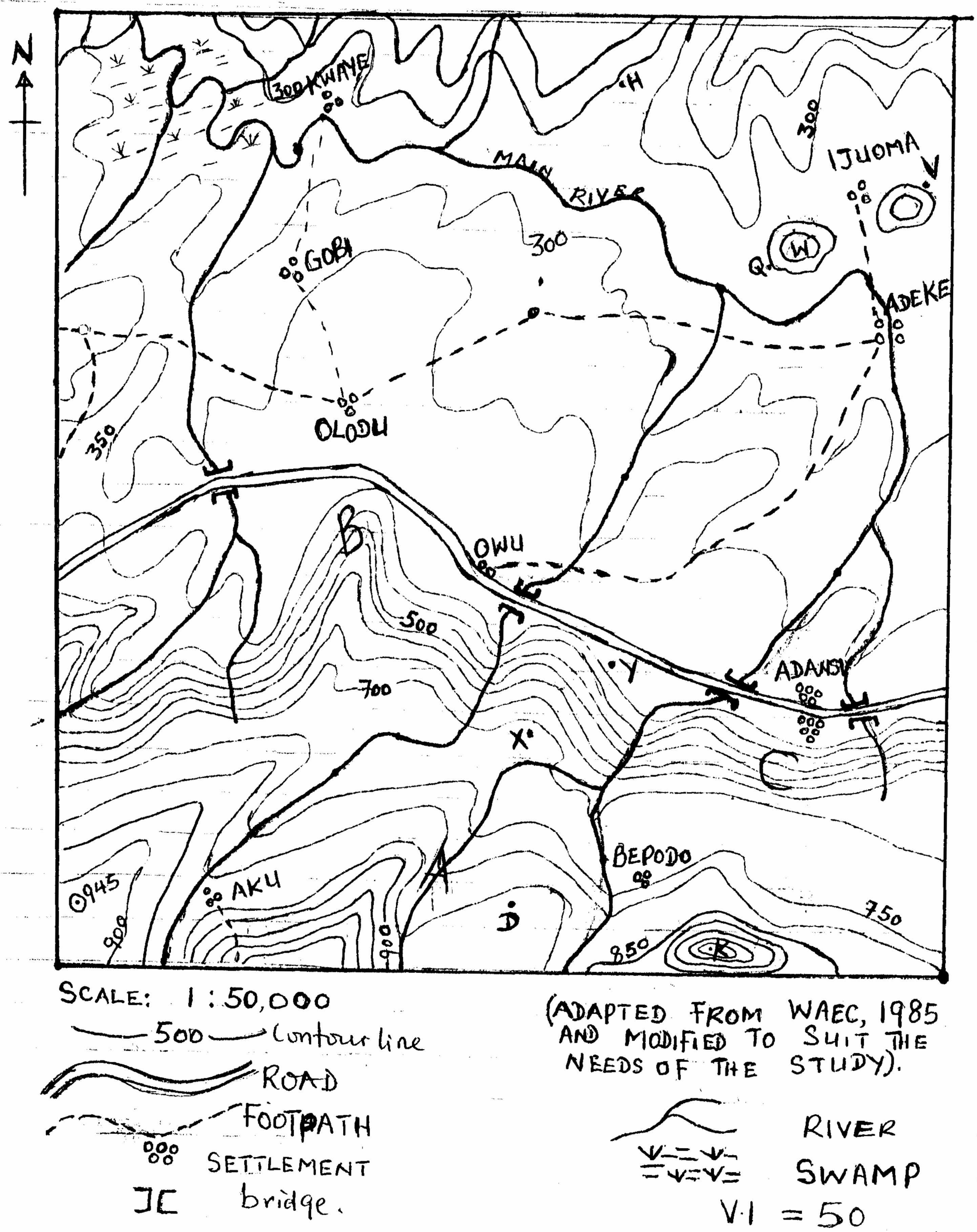
48. The pattern of transportation in the mapped area is mostly influenced by relief because:
    a. There are Rivers on the Lowland areas
    b. A Ridge runs from East to West.
    c. Most transport routes are located on the lowland areas.
    d. There are more transport routes in the High relief area.

49. A remarkable feature in transportation in the mapped area include the following except:
    a. There is no difference in the distribution of transport routes – in the Low and Highland areas.
    b. Transport routes are concentrated more on the Lowland than on Highland areas.
    c. There are more transport routes in the Highland areas compared to Lowland areas
    d. The main road in the Map area tends to avoid rugged relief areas.

50. A possible reason why the major road in the mapped area run from the east to west is:
    a. There is the main River Basin in the North
    b. To avoid the ridges in the South.
    c. To pass through the foot of the Hills.
    d. None of the above.

Map Extract A: The Map Extract for MWAT.

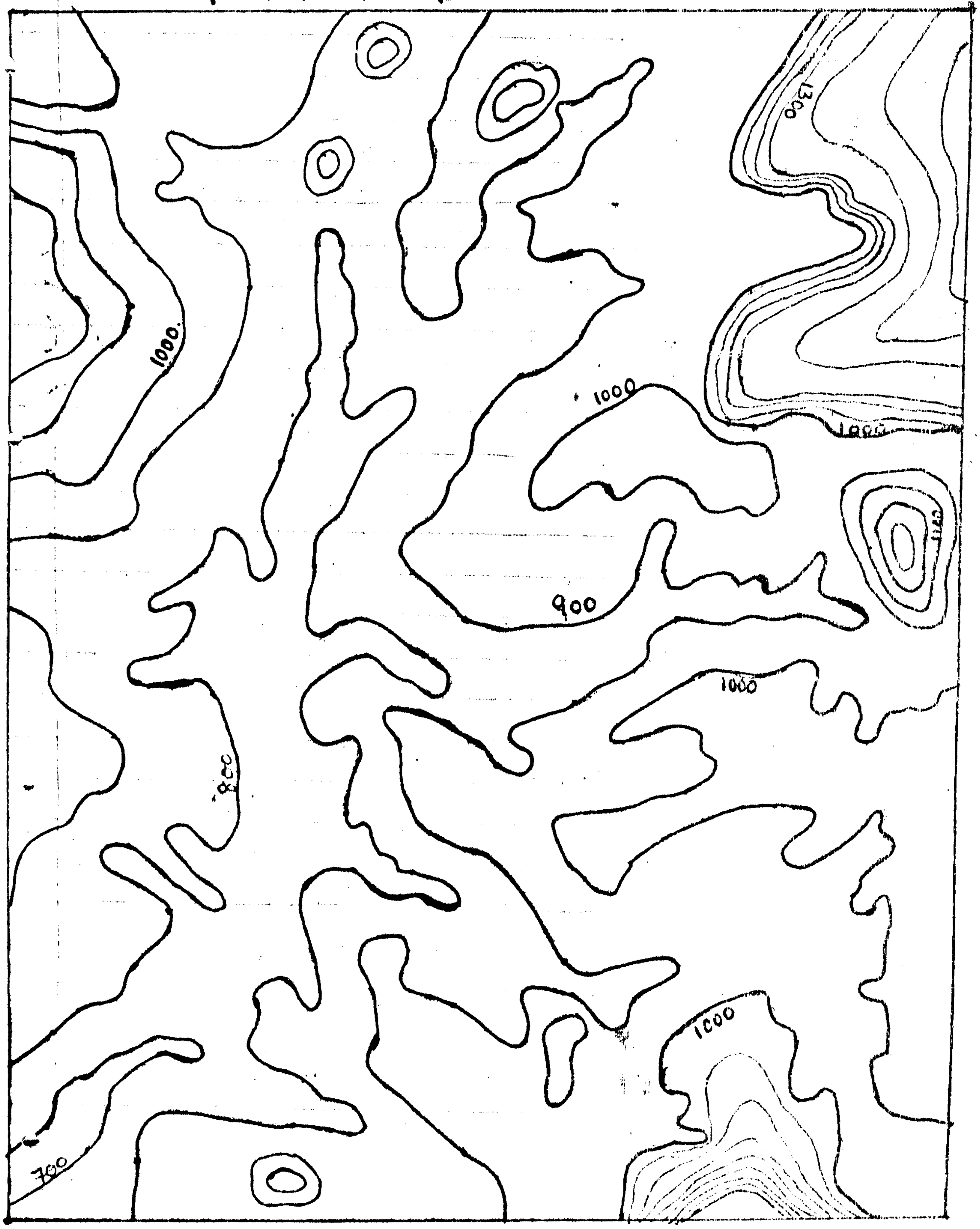
UMUKO DISTRICT



(ADAPTED FROM WAEC, 1985 AND MODIFIED TO SUIT THE NEEDS OF THE STUDY).

APPENDIX 4: Map Extract B.

EKPUIANA BASIN.



SCALE: 1:12500

ADAPTED FROM:
FEDERAL SURVEY DEPARTMENT, (1978) AND MODIFIED.

APPENDIX 5

ITEM ANALYSIS OF THE MWAT-TRIAL TEST

Difficulty Index: $P = \dfrac{NU + NL}{2N}$

Discrimination Index $D = \dfrac{NU - NL}{N}$

Where: NU = number in the upper ⅓ of the group.
NL = Number in the lower ⅓ of the group.
N = Total number of students in either the upper or lower ⅓ of the group.

Item No	Key to Correct Answer	Upper ⅓	Lower ⅓	Difficult Index	Discrimination Index	Remarks
1	D	7	3	0.42	0.33	GOOD
2	B	8	4	0.50	0.33	GOOD
3	B	8	5	0.54	0.25	GOOD
4	C	9	3	0.5	0.5	GOOD
5	D	7	2	0.38	0.42	GOOD
6	B	5	1	0.25	0.33	GOOD
7	D	8	2	0.42	0.50	GOOD
8	D	4	1	0.21	0.25	BAD
9	D	9	4	0.54	0.42	GOOD
10	A	7	3	0.42	0.33	GOOD
11	A	6	2	0.33	0.33	GOOD
12	D	8	3	0.46	0.42	GOOD
13	B	10	6	0.67	0.33	GOOD
14	B	7	5	0.50	0.17	BAD
15	C	6	2	0.33	0.33	GOOD
16	B	11	5	0.67	0.50	GOOD
17	C	10	5	0.63	0.42	GOOD
18	C	9	4	0.54	0.42	GOOD
19	B	11	4	0.63	0.58	GOOD
20	A	10	7	0.71	0.25	BAD
21	D	5	1	0.25	0.33	BAD
22	D	10	5	0.63	0.42	GOOD
23	B	3	2	0.21	0.08	BAD

24	B	7	3	0.42	0.33	GOOD
25	C	8	3	0.54	0.42	GOOD
26	C	9	5	0.58	0.33	GOOD
27	D	7	2	0.38	0.42	GOOD
28	B	8	1	0.38	0.58	GOOD
29	B	5	1	0.25	0.33	GOOD
30	D	10	3	0.54	0.58	GOOD
31	A	6	2	0.33	0.33	GOOD
32	B	9	2	0.46	0.58	GOOD
33	A	3	1	0.17	0.17	BAD
34	D	11	5	0.67	0.50	GOOD
35	B	6	2	0.33	0.33	GOOD
36	A	7	1	0.33	0.50	GOOD
37	A	10	6	0.67	0.33	GOOD
38	B	4	3	0.29	0.08	BAD
39	D	9	4	0.54	0.42	GOOD
40	C	7	2	0.38	0.42	GOOD
41	B	5	2	0.29	0.25	BAD
42	C	10	3	0.54	0.58	GOOD
43	A	9	2	0.45	0.58	GOOD
44	D	8	1	0.38	0.58	GOOD
45	C	7	4	0.46	0.25	BAD
46	D	7	3	0.42	0.33	GOOD
47	B	10	8	0.75	0.17	BAD
48	C	10	6	0.67	0.33	GOOD
49	C	9	3	0.50	0.50	GOOD
50	B	7	1	0.33	0.50	GOOD

APPENDIX 6

THE MAP-WORK ACHIEVEMENT TEST (MWAT)

Subject: Geography. Class. ....
Time Allowed: ....
Name of School: ....
Name of Student:..
Sex of Student: Male [ ] Female [ ]

INSTRUCTION:
Attempt all questions using the map extract provided. Choose the correct answers from the alternatives lettered A-D. Circle the letter that bears the option you have chosen.

1. The areas above 1000 metres above sea-level lie in the:
(A) North-East (B) East (C) North-west (D) South.

2. The highest point on the mapped area is in the
(A) North (B) South (C) East (D) West

3. The vertical interval of the map is:
(A) 100 (B) 50 (C) 150 (D) 200.

4. The height of the town of Adeke above sea-level is approximately:
(A) 500metres (B) 450m (C) 300m (D) 350m

5. Which of the following towns is located in the highest Altitude
(A) Olodu (B) Bepodo (C) owu (D) Aku.

6. A steep slope on the map is:
(A) V to H (B) X to Y (C) D to X (D) C to D

7. If you walk from 'Adeke' to 'Olodu' you are going:
(A) Up a steep slope (B) Down a Hill (C) Into a Depression
(D) Along a plain.

8. A convex slope on the map is:
(A) A-C (B) X-C (C) D-X (D) D-Y

9. The feature marked "B" in the West of Owu is
   (A) a spur (B) a col (C) a ridge (D) a plateau.

10. Which of the following statements is NOT TRUE of the relief of the mapped area?
    a. The area generally consists of a huge plateau.
    b. The main highland runs from East to West.
    c. The Northern section of the area is generally low-lying.
    d. There is a main Ridge that runs from the South-east to the South-west.

11. The feature marked "C" on the map is a:
    (A) Col (B) Pass (C) Gorge (D) Ridge.

12. The highest point in the mapped area is about:
    (A) 517m (B) 1100m (C) 650m (D) 850m

13. The feature marked 'A' on the map can best be described as a:
    (A) Spur (B) Plateau (C) Valley (D) Conical Hill.

14. The main River in the mapped area has its main tributaries from:
    (A) Lowlands in the East
    (B) High lands in the South
    (C) High lands in the North-West
    (D) High lands in the North-East.

15. The feature Marked "K" in the map is a
    (A) Plateau (B) Valley (C) Conical Hill
    (D) Trigonometrical station.

16. There are no settlements in the North-West part of the map area probably because:
    (A) It has a rugged relief (B) It is on a ridge
    (C) It is located on a swamp (D) It is in a valley

17. The feature marked "W" in the map is a:
    (A) Ridge. (B) Knoll (C) Pass (D) Conical Hill

18. Which of these is NOT a significant lowland feature in the mapped area?

(A) A plain (B) Spur (C) Valley (D) Sandbars

19. Lowlands in the mapped area can best be described as:
(A) Flat (B) Undulating (C) Sandy (D) Dissected.

20. Which of these are NOT common features of lowlands in the mapped area?
(A) They are flood plains
(B) They are mainly River Basins
(C) They are coastal plains
(D) They are undulating.

21. The lowest point on the mapped area is about:
(A) 400m (B) 500m (C) 300m (D) 250m

22. Which of the following towns is not on the lowland area of the map?

(A) Olodu (B) Kwaye (C) Gobi (D) Aku.

23. Which of the following towns has the lowest altitude:
(A) Owu (B) Gobi (C) Bepodo (D) Aku

24. Which of these indicate the lowland feature "knoll"
(A) 'K' (B) 'W' (C) 'B' (D) 'C'

25. Which of these are NOT dominant lowland features associated with the mapped area?
(A) Valleys (B) Flood plains
(C) Undulating plains (D) Dissected plains

26. Which of these is NOT true of the lowlands in the mapped area?
(A) They have many dry valleys
(B) They are River valleys
(C) They are undulating
(D) Most settlements are located there.

27. If the points "V" and "H" are joined with a straight line the cross-section expected is:
(A) A steep slope (B) A plain (C) A dry valley
(D) A plateau

28. The Southern parts of the mapped area have few settlements because:
    (A) It is mainly a forest reserve:
    (B) Because of their infertile soil
    (C) High incidence of River borne diseases.
    (D) Of the Ridge in the area.

29. "Kwaye" is located on a:
    (A) Spur (B) River valley (C) Ridge (D) Plateau.

30. The largest number of settlements in the mapped area are located in:
    (A) Low-land areas (B) On the Ridge
    (C) Plateau in the area (D) High relief area.

31. The distribution of settlements in the area is mostly influenced by:
    (A) Relief (B) Drainage (C) Vegetation
    (D) Climate

32. There are no settlements immediately South of Owu because
    (A) The area is a plateau
    (B) The area is flat
    (C) Nobody wants to live there
    (D) The area has steep slopes.

33. The largest settlement in the mapped area is located on a height approximately:
    (A) 750m (B) 300m (C) 380m (D) 500m

34. Which of these reasons does NOT represent why the area around South-west are uninhabited?
    (A) High relief area
    (B) Rugged relief
    (C) Area liable to flooding
    (D) Steep slopes.

35. Settlement in the mapped area tends to avoid the Ridges in the area because
    (A) The ridges are not habitable
    (B) The areas experience volcanic eruption
    (C) Rivers take-off from the Ridges.
    (D) None of the above

36. A likely reason why "Olodu" town has more means of transportation than 'Aku' town is
   (A) Olodu is nearer a River than Aku
   (B) Olodu is a bigger settlement than Aku
   (C) Olodu is located on a pass.
   (D) Olodu is on a lowland area while Aku is on a highland area.

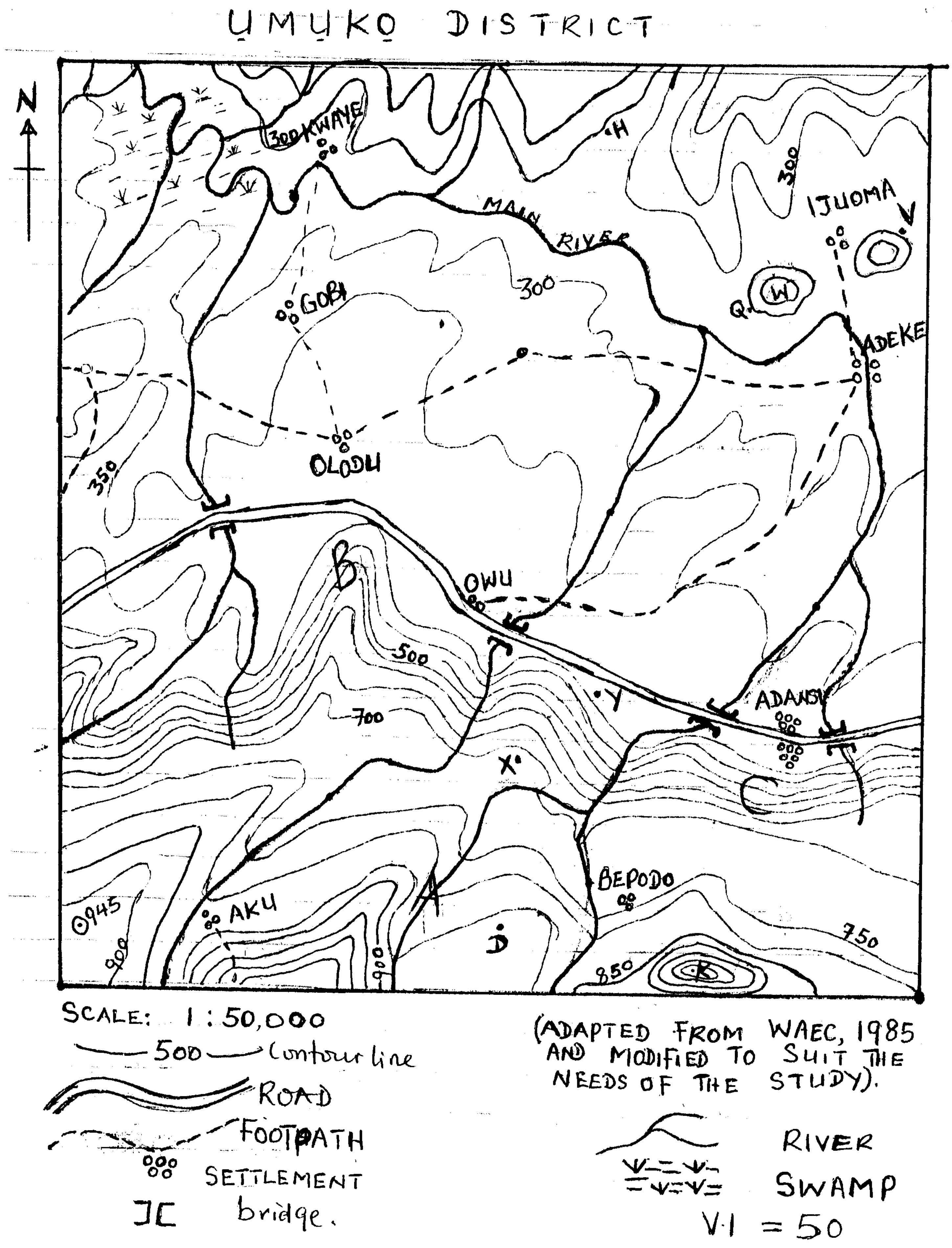
37. Which of these is NOT TRUE of the relationship between relief and transportation in the mapped area:
   (A) The main road passes at the foot of a Ridge.
   (B) Roads tend to avoid High relief areas in the south.
   (C) Major transportation routes are dominant in the lowland areas.
   (D) Transportation routes are not influenced by relief in the map area.

38. The pattern of transportation in the map area is mostly influenced by relief because:
   (A) There are Rivers on the lowland areas.
   (B) A Ridge runs from East to West.
   (C) Most transport routes are located on the lowland areas.
   (D) There are more transport route in the high-relief areas

39. A remarkable feature in transport in the mapped area include the following, except:
   (A) There is no difference in the distribution of transport route in the Low and Highland areas.
   (B) Transport routes are concentrated more on the lowland than on highland areas.
   (C) There are more transport routes in Highland areas compared to the lowland areas
   (D) The main road in the map area tends to avoid rugged relief areas.

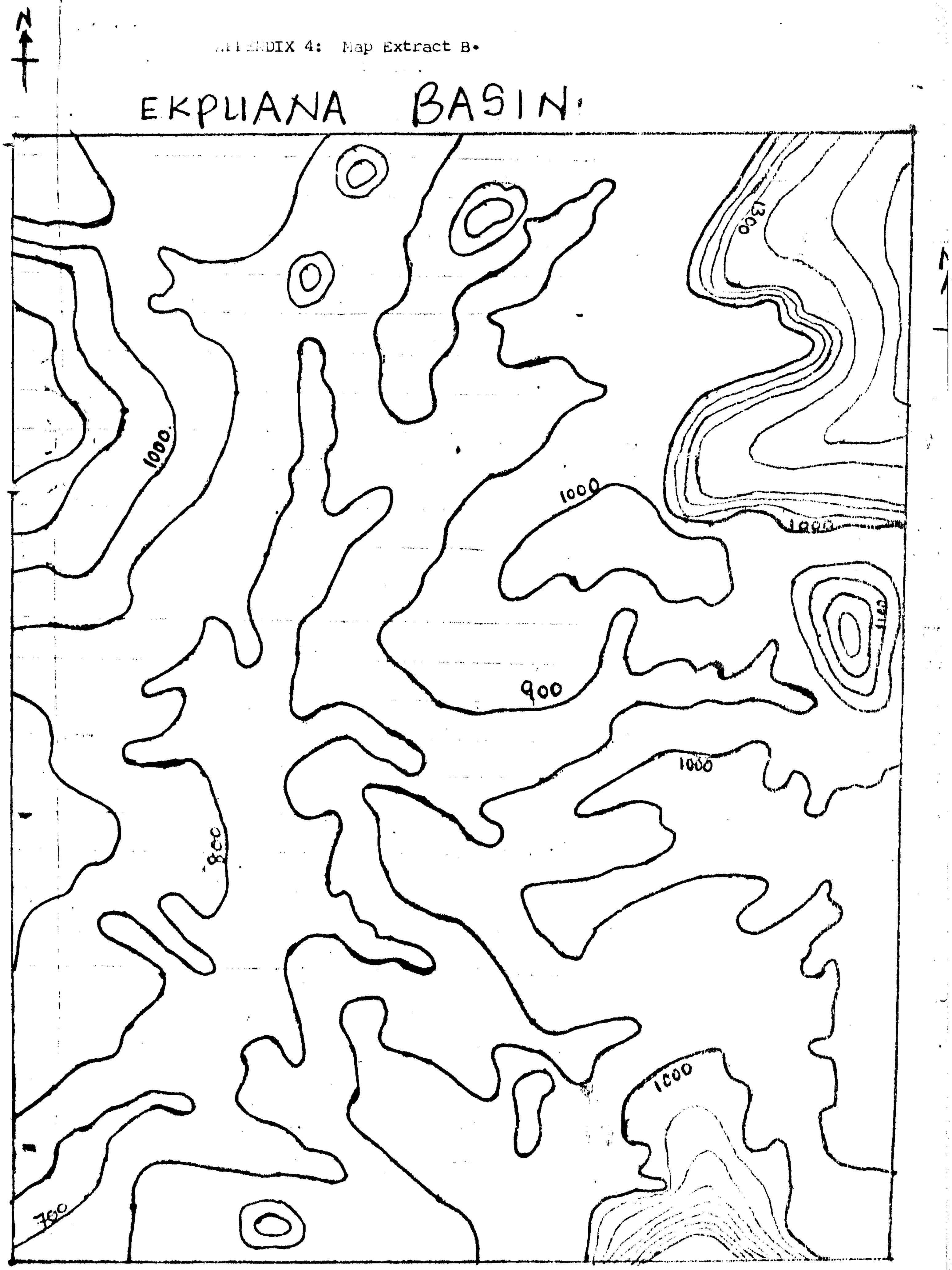
40. A possible reason why the major road in the mapped area runs from East to West is:
   (A) There is the main River Basin in the North.
   (B) To avoid ridge in the South
   (C) To pass through the foot of the Hills.
   (D) None of the above.

Map Extract A: The Map Extract for MWAT.



APPENDIX 4: Map Extract B.

EKPLIANA BASIN.



SCALE: 1:12500

ADAPTED FROM:
FEDERAL SURVEY DEPARTMENT,
(1978) AND MODIFIED

APPENDIX 7

DETERMINING THE RELIABILITY COEFFICIENT OF THE MAP-WORK ACHIEVEMENT TEST (MWAT) - USING KUDER-RICHARDSON FORMULA 21

$$rxx = \frac{n}{n-1}\left[1 - \frac{\bar{x}\left(n - \bar{x}\right)}{nS_x^2}\right]$$

The Students' scores on the 'MWAT'.

56,	26,	28,	46,	30,	36,	44,	39,	36
14,	50,	29,	36,	37,	32,	34,	40,	34
20,	48,	35,	28,	47,	30,	32,	34,	37
48,	38,	30,	35,	44,	38,	35,	36,	40

The calculations of the Mean, Standard Deviation and the Variance of the Total Test Scores.

x	F	FX	$\bar{x}$	$x - \bar{x}$	$(x - \bar{x})^2$	$\sum f(x - \bar{x})^2$
56	1	56	36.2	19.8	392.04	392.04
50	1	50	36.2	13.8	190.44	190.44
48	2	96	36.2	11.8	139.24	278.48
47	1	47	36.2	10.8	116.64	116.64
46	1	46	36.2	9.8	96.04	96.04
44	2	88	36.2	7.8	60.84	121.68
40	2	80	36.2	3.8	14.44	28.88
39	1	39	36.2	2.8	7.84	7.84
38	2	76	36.2	1.8	3.24	6.48
37	2	74	36.2	0.8	0.64	1.28
36	4	144	36.2	-0.2	0.04	0.16
35	3	105	36.2	-1.2	1.44	4.32
34	3	102	36.2	-2.2	4.84	14.52

x	F	FX	$\bar{x}$	$x - \bar{x}$	$(x - \bar{x})^2$	$\sum f(x - \bar{x})^2$
32	2	64	36.2	-4.2	17.64	35.28
30	3	90	36.2	-6.2	38.44	115.32
29	1	29	36.2	-7.2	51.84	51.84
28	2	56	36.2	-8.2	67.24	134.48
26	1	26	36.2	-10.2	104.04	104.04
20	1	20	36.2	-16.2	262.44	262.44
14	1	14	36.2	-22.2	492.84	492.84

$\sum F = 36$ $\sum fx = 1302$ $\sum f(x - \bar{x})^2 = 2455.04$

$$\bar{x} = \frac{\sum fx}{\sum fx}$$

$$= \frac{1302}{36}$$

$$\bar{x} = 36.2$$

$$S.D = \sqrt{\frac{\sum f(X - \bar{X})^2}{N - 1}}$$

$$= \sqrt{\frac{2455.04}{36 - 1}}$$

$$S.D. = \sqrt{70.144}$$

$$= 8.375$$

$$S.D = 8.4$$

$$Variance = (8.375)^2$$

$$= 70.144$$

$$= 70.1$$

Determining the Estimate of Reliability of the instrument (MWAT) using the Kuder- Richardson formula 21.

$$rxx = \frac{n}{n-1}\left[1 - \frac{X\left(n - \bar{X}\right)}{nsx^2}\right]$$

Where

rxx = (K-R:21) Estimate of Reliability.

n = Number of items of the Instrument

$\bar{x}$ = Mean of the total Test score

S_x^2 = Variance of the total Test score

n = 40

$\bar{x}$ = 36.2

S_X^2 = 70.1

$$rxx = \frac{n}{n-1}\left[1 - \frac{\bar{X}\left(n - \bar{X}\right)}{nsx^2}\right]$$

$$rxx = \;= \frac{40}{40-1}\left[1 - \frac{36.2(40-36.2)}{40(70.1)}\right]$$

$$= \frac{40}{39}\left[1 - \frac{137.56}{2804}\right]$$

$$= (1.025)(0.951)$$

$$0.974775$$

$$rxx = 0.97$$

APPENDIX 8

MAP-WORK ACHIEVEMENT TEST (MWAT) – (USED FOR THE PRE-TEST)

Subject: Geography Class ....
Timed Allowed: ....
Name of School: ....
Name of Student: ....
Sex of the Student: Male [ ] Female [ ]

INSTRUCTION

Attempt all questions using the map extract provided. Choose the correct answers from the alternatives lettered A-D. Circle the letter which bears the option you have chosen.

2. The areas above 1000 metres above sea-level lie in the:
(A) East (B) North-East (C) West (D) South-East.

2. The highest point on the mapped area is in the:
(A) South-West (B) North-East (C) South (D) East

3. The vertical interval of the map is:
(A) 100m (B) 50m (C) 150m (D) 200m

4. The height of the town of 'Yapo' above sea-level is approximately:
(A) 500m (B) 200m (C) 300m (D) 100m

5. Which of the following towns is located on the Highest altitude?
(A) Yapo (B) Sida (C) Segot (D) Sofia

6. A steep slope on the map is:
(A) Y to B (B) X to Y (C) A to B (D) A to Y

7. If you walk from Odu to Yapo you shall walk
(A) down a Hill (B) across a River valley
(C) into a depressive (D) along a ridge.

8. A concave slope on the map is:
(A) B-A (B) W-P (C) A-P (D) B-X

9. The feature marked "C" west of Kabe is:
(A) a spur (B) a valley (C) a ridge (D) a col

10. Which of the following statements is NOT TRUE of the relief of the mapped area?
(A) The area generally consists of mountains.
(B) The main highland runs from North to South-East.
(C) The Western section of the area is generally low lying
(D) These are lowlands in the North-East.

11. The feature marked "W" on the map is a:
(A) Spur (B) Knoll (C) Ridge (D) Pass

12. The highest point on the mapped area is about:
(A) 700m (B) 800m (C) 900m (D) 1100m

13. The feature marked "T" on the map can best be described as a:
(A) Spur (B) Plateau (C) Valley Conical Hill

14. The main River in the west of the mapped area has its main tributaries from:
(A) Lowlands in the West.
(B) Highlands in the South
(C) Highlands in the North-west.
(D) Highlands in the North.

15. The area marked "▵" on the mapped area is:
(A) Trigonometrical station.
(B) A conical Hill
(C) A plateau
(D) A Gap.

16. There are no settlements in the South-west part of the mapped area probably because:
(A) It has a rugged relief
(B) It is on a ridge.
(C) It is located on a swamp
(D) It is in a valley.

17. The feature marked "V" on the map is a:
(A) Plateau (B) Ridge (C) Spur (D) Escarpment

18. Which of these is NOT a significant lowland feature in the mapped area?
(A) A plain (B) Spur (C) Valley (D) Sandbars.

19. Lowlands in the mapped area can best be described as:
(A) Flat (B) Undulating (C) Sandy (D) Dissected.

20. Which of these are not common features of lowlands in the mapped area?
(A) They are generally Sandy.
(B) They are mainly River basins
(C) They are Undulating
(D) They are flood plains.

21. The lowest point on the mapped area is about.
(A) 300m (B) 100m (C) 200m (D) 400m

22. Which of the following towns is not on the lowland area?
(A) Yapo (B) Odu (C) Sida (D) Kabe.

23. Which of the following towns has the lowest altitude?
(A) Sida (B) Segot (C) Sofia (D) Oruk

24. Which of these indicate the lowland feature "knoll"?
(A) "P" (B) 'W' (C) "V" (D) "C"

25. Which of the followings are not dominant lowland features associated with the mapped area?
(A) Valleys (B) Flood plains (C) Undulating plains
(D) Dissected plains

26. Which of these is 'Not True' of the lowlands in the mapped area?
(A) They are River valleys
(B) They have many dry valleys
(C) They are undulating
(D) They have swamps

27. If the points A and B are joined with a straight line the cross-section expected is:
(A) A steep slope (B) A Conical Hill
(C) A plain (D) A plateau

28. The South-Western parts of the mapped area have few settlements mainly because:
(A) There are infertile soils in the area.
(B) There is high incidence of River borne diseases.
(C) The area has rugged relief
(D) The area is covered with swamps.

29. Sida is located on a:
(A) Ridge (B) Plateau (C) Spur (D) Valley

30. The largest number of settlements in the mapped area are located on:
(A) Lowland areas
(B) The Ridge
(C) The plateau in the area.
(D) High relief area.

31. The distribution of settlements in the mapped area is mostly influenced by
(A) Relief(B) Drainage (C) Vegetation
(E) Climate

32. There are no settlements in the North of the mapped area probably because:
(A) It is a high relief area.
(B) It is a mountainous area
(C) There are flood plains in the area.
(D) The area has dissected plateaux.

33. The town of 'Odu is located on a height approximately
(A) 250m (B) 900m (C) 100m (D) 400m

34. A possible reason why the Railway line from Segot to Odu has to pass through the town of 'Kabe' is:
(A) Because of areas liable to flooding
(B) To avoid high relief in the South

(C) Because of plantations of Kabe
(D) As a result of the ridge at Kabe.

35. Which of the following does not appear to have influenced the distribution of settlements in the mapped area?
(A) Transport routes
(B) Relief
(C) Steep slopes
(D) Distance from the sea

36. A likely reason why Kabe town has more means of transportation than Sida town include the following, **except**
(A) Kabe is on a Railway terminus.
(B) Kabe is a bigger settlement.
(C) Kabe is on a lowland area while Sida is on a highland area.
(D) Kabe is located on a Ridge.

37. Which of these is NOT TRUE of the relationship between relief and transportation in the mapped area:
(A) The major transportation routes are mainly on the lowland areas
(B) The transportation routes tend to avoid the high relief areas.
(C) The transportation routes are not influenced by the relief of the mapped area.
(D) Railway lines are restricted to the lowland areas.

38. The pattern of transportation in the mapped area is mostly influenced by relief because:
(A) There are Rivers on the lowland areas.
(B) A ridge runs from North to South-East.
(C) Most transport routes are found on the lowland areas.
(D) The number of transport routes in Highland and lowland areas are equal.

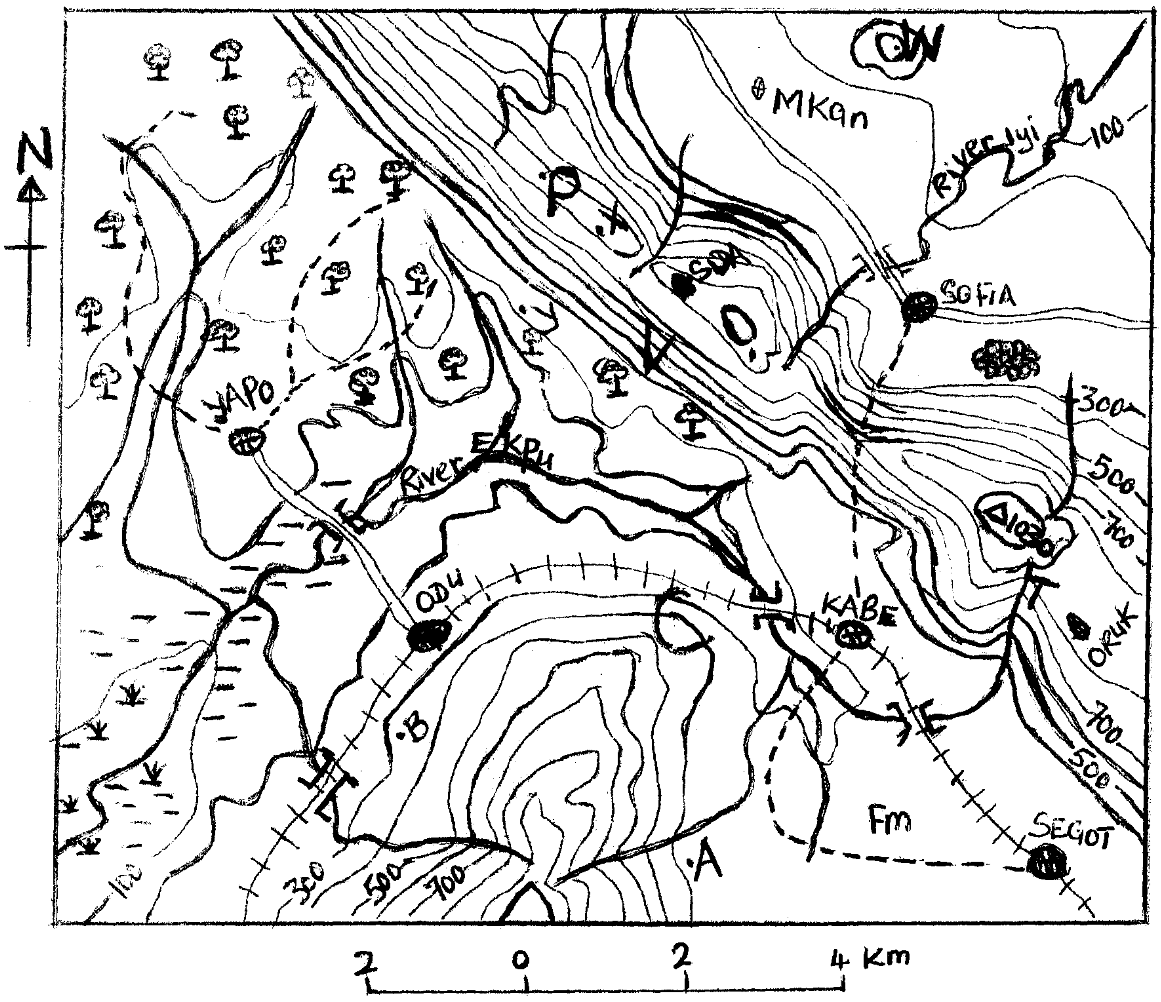
39. A remarkable feature in transportation in mapped area include the following except:
(A) The distribution of transportation routes in the high and lowland areas are the same.
(B) Transportation routes are concentrated more on the lowlands than on the Highland areas.

(C) The only Railway line in the mapped area is found in the lowland area.
(D) The main roads in the mapped area tend to avoid rugged relief areas.

40. A possible reason why major roads in the mapped area are not found in the North-west of the area is:
(A) The area is a River valley and a likely forest reserve.
(B) The area is swampy.
(C) There is a ridge in the whole area.
(D) None of the above.

Map Extract C.

THE AGBANA BASIN.



	Trees		Road
	Quarry		Railway
	River	300	Contour Line
	Town		Swamp
	Foot path	N·1	100
Fm	Farm	JC	Bridge

Adapted from WAEC, 1986 and modified to suit the needs of the study.

APPENDIX 10
THE COVERING LETTER ATTACHED TO MWIS FOR THE EXPERTS' RATING ON THE SUITABILITY OF THE ITEMS OF THE INSTRUMENT.

Sub-department of Science Education
University of Nigeria
Nsukka.

Professor/Dr/Mr/Mrs/Miss

____
____
____

Sir/Madam,

EXPERTS' RATINGS OF THE MAP-WORK INTEREST SCALE.

I am a post graduate student of the sub-department of science education, University of Nigeria, Nsukka. I wish to develop an instrument (MWIS) which can be used to evaluate the interest of students in the map-work section of geography. I am hereby requesting for your services as an expert in measurement and evaluation/geography. Use the five point rating scale provided to rate the suitability of each of the items for inclusion in the instrument.

The following criteria may serve as a guide: relevance, simplicity of expression; double barreled statements; statement of fact or opinion; ambiguity; vagueness, and other considerations. The researcher will be happy to welcome your corrections, suggestions and other in-puts.

Thanks for you cooperation

Your faithfully

Ezeh Michael. O

APPENDIX 11.

MAP-WORK INTEREST SCALES (MWIS).

THE EXPERTS' RATING ON THE SUITABILITY OF THE ITEMS OF THE INSTRUMENT.

Could you please rate the suitability of each of the items listed below for inclusion in the instrument (MWIS).

INSTRUCTION:

Tick (✓) Each of the statements using the appropriate scale values provided. The criteria provided on the covering letter may serve as a guide in scoring each of the items of the instrument.

The suitability of each of the items is scored as follows on the rating scale: Very good statement = 5; Good = 4; Fair = 3; Poor = 2; and very poor statement is scored 1 (one).

		SUITABILITY OF THE ITEMS				
		Very Good	Good	Fair	Poor	Very Poor
ITEM NO	STATEMENTS	5	4	3	2	1
1	Map-work is easy to understand.					
2	I attend map-work lessons regularly.					
3	Map-work should not have relevance to the course I wish to study.					
4	Map-work periods should be assigned to other subjects.					
5	I always fell like sleeping during any map-work lesson.					
6	I do not like doing assignments on map-work					
7	I like listening to discussions involving mapped plans to buildings.					
8	Map-work lessons are usually interesting to me.					
9	I prefer map-work to any other areas of Geography.					

		Very Good	Good	Fair	Poor	Very Poor
ITEM NO	STATEMENTS	5	4	3	2	1
10	I frequently like to take permission to leave the class when we have map-work lesson.					
11	I attempt to interpret any topographical maps I come across.					
12	I admire topographical maps I see in people's rooms and offices.					
13	Map-work increases my interest in geography.					
14	Map-work periods are usually boring to me.					
15	I do not often like collecting the topographical mapsheets shared during the map-work lessons.					
16	I will encourage other students to develop interest in map-work.					
17	I enjoy using my free periods to study map-work.					
18	If map-work had not been compulsory I would not have like to answer question from that section.					
19	If the map-work teacher fails to come to the class on time, I can go to the staff room to call him/her.					
20	I do not fail to do any of my assignments on map-work, unlike other subjects.					
21	I feel relieved when the geography teacher fails to come for the map-work lesson.					
22	Map-work lessons involve students in series of activities so that sometimes one does not know when the time is up.					
23	I prefer geography syllabus that does not have map-work as a section.					

		Very Good	Good	Fair	Poor	Very Poor
ITEM NO	STATEMENTS	5	4	3	2	1
24	I take interest in handling maps during the map-work lessons.					
25	I would like the school to increase the time allocated to map-work on the school time table.					
26	The aspects of map-work I hate are more than the aspects I like.					
27	I participate attentively in map-work lessons more than in any other subject.					
28	I do not take interest on anything involving maps.					
29	I would like to take courses in map-work no matter the course I study at higher level.					
30	I always wish that lessons in map-work continue when its time is up.					
31	Map-work increases my interest in geography					
32	I hate map-work because my friends do not show interest in it.					
33	I don not enjoy reading books on map-work.					
34	The methods of teaching map-work negatively affect my interest in it.					
35	I would like to study a map-work related course at a Higher level.					
36	I like using maps to approximate distance of my places of interest.					
37	Map-work periods are usually noisy and un comfortable to me.					
38	I secretly engage my self with other assignments during the map-work lessons.					
39	I ensure that I secure maps to use when the teacher shares the topographical mapsheets for the map-work lesson.					
40	I find it difficult to do any extra studies on map-work apart from the normal lessons on map-work.					

APPENDIX 12

THE MAP-WORK INTEREST SCALE (MWIS)

MWIS ITEM ANALYSIS BASED ON EXPERTS' RATINGS.

Item No	Median	Semi Interquatile Range (S.I.R)	Mean $\bar{x}$	Standard Deviation	Items Rejected
1	4.5	0.55	4.4	0.60	
2	4.3	0.60	4.3	0.76	
3	2.3	0.90	2.5	1.1	✓
4	4.2	0.48	4.3	0.63	
5	4.75	0.48	4.6	0.70	
6	3.8	0.50	4.0	0.74	
7	3.75	0.85	3.8	1.0	✓
8	4.3	0.60	4.3	0.97	
9	3.9	0.67	3.8	0.93	
10	4.17	0.54	4.2	0.70	
11	3.9	0.67	3.8	0.82	
12	4.0	0.79	3.9	1.1	✓
13	3.9	0.63	3.9	0.81	
14	4.3	0.54	4.3	0.64	
15	3.5	0.75	3.5	1.0	✓
16	4.3	0.60	4.3	1.1	
17	3.9	0.67	3.8	1.2	
18	3.9	0.67	3.8	0.92	
19	4.25	0.70	4.2	0.83	
20	3.5	0.75	3.4	1.2	✓

Item No	Median	Semi Interquatile Range (S.I.R)	Mean x̄	Standard Deviation	Items Rejected
21	4.1	0.63	4.1	0.79	
22	4.3	0.60	4.3	0.76	
23	4.17	0.54	3.8	0.79	
24	3.17	1.10	3.1	1.0	✓
25	4.6	0.54	4.5	1.6	
26	4.1	0.63	4.1	0.74	
27	4.3	0.55	4.3	0.65	
28	4.2	0.49	4.3	063	
29	4.3	0.50	4.0	0.74	
30	4.2	0.54	4.1	0.89	
31	4.3	0.60	4.3	0.97	
32	3.0	1.1	2.9	1.7	✓
33	4.3	0.60	4.2	1.1	
34	2.8	1.0	2.8	1.3	✓
35	4.1	0.45	4.1	0.67	
36	4.1	0.63	4.1	0.79	
37	3.5	0.88	3.9	1.1	✓
38	4.3	0.60	4.3	1.1	
39	2.5	1.0	2.6	1.0	✓
40	3.9	0.75	3.8	1.0	

S.D (Standard Deviation) $= \sqrt{\frac{\sum f(x-\bar{X})^2}{N-1}}$

$Q = Quartile$

Q_1 (first quartile) $= L_1 + \dfrac{(\frac{N}{4} - F)i}{f}$

The (Median) Q_2 (second quartile) $= L_2 + \dfrac{(\frac{2}{4}N - F)i}{f}$

Q_3 (Third quartile) $= L_3 + \dfrac{(\frac{3}{4}N - F)i}{f}$

Semi-Interquatile range (SI.R) $= \dfrac{Q_3 - Q_1}{2}$

Where:

	L_1	= Lower limit of the interval within which Q_1 lies.
	L_3	= Lower limit of the interval withing Q_3 lies
	N	= Total number of cases or the total frequencies.
	F	= Cummulative frequency below the interval within which the desired quartile lies.
	i	= size of class interval.
	f	= Frequency of cases in the interval with which the desired quartile lies

APPENDIX 13

THE MAP-WORK INTEREST SCALE (MWIS)

The questionnaire is designed to find out how you feel about map-work in geography. The information you give shall be, specifically, used for the purpose of research. There are no right or wrong answers. You are, therefore, requested to be as honest and as sincere as possible in giving your opinion.

Thanks for your cooperation.

Yours sincerely,

Ezeh Michael. O
Sub-department of Science Education
University of Nigeria, Nsukka.

PERSONAL DATA.
Name of School ....
Local Government Area ....
Type of School: Boys [ ] Girls [ ] Mixed [ ]
Name of Student ....
Sex of Student: Male [ ] Female [ ]
Class of Respondent ....

INSTRUCTION

Tick (✓) the extent to which you agree with each of the statements below; using the four (4) points scale values provided: strongly Agree = 4; Agree = 3; Disagree = 2 and strongly disagree = 1.

Item No		SA	A	D	SD
1	Map-work is not as difficult as some people believe.				
2	I enjoy participating in map-work Lessons.				
3	It is better to use map-work periods, on the school time table for other subjects.				

4	I always feel like sleeping during any map work Lessons.				
5	I do not like doing assignments on map-work.				
6	Map-work Lessons are usually interesting to me.				
7	I usually like to take permission to miss classes when we have map-work lessons.				
8	If my father wants me to choose any three areas of study of interest to me, I Will include map-work.				
9	I take interest in attempting to interpret geographical features using the map.				
10	Map-work increases my interest in geography.				
11	Map-work lessons are usually boring to me.				
12	I encourage my friends to develop interest in Map-work.				
13	I use my free periods to study map-work.				
14	If map-work had not been compulsory, I would not have liked to answer questions from that section.				
15	If the map-work teacher fails to come to the class on time, I can go to the staff room to call him/her.				
16	I am always happy if the teacher misses a map-work lesson period.				
17	Map-work lessons involve interesting practical experiences.				
18	I prefer a geography syllabus that does not have map-work as a compulsory section.				

19	The time allocated to map-work on the school time table should be increased.				
20	The aspects of map-work I hate are more than the aspects I like.				
21	I participate attentively in map-work lessons, more than in any other subject.				
22	I do not take interest in anything involving maps.				
23	I would like to apply map-work skills in solving related problem of every day life.				
24	I always wish that lessons on map-work continue when its time is up.				
25	The belief that map-work is not as interesting as some other subjects is wrong				
26	I don not enjoy reading books on Map-work.				
27	I would like to study a map-work related course at a Higher level.				
28	I like using maps to know the distances of places of my interest.				
29	I secretly engage myself with other assignments during the map-work lessons.				
30	I do not do any extra studies on map-work outside the class lessons on map-work.				

APPENDIX 14

ITEM STATISTICS FOR THE RELIABILITY COEFFICIENT OF THE MAP-WORK INTEREST SCALE (MWIS)

Items of the Instrument

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Students			*	*	*		*				*			*	
1	1	2	4	3	3	1	3	2	2	1	3	1	3	3	1
2	3	1	2	4	3	1	4	1	1	1	2	1	2	3	1
3	2	3	1	1	2	1	2	1	1	1	3	1	1	1	4
4	3	3	2	3	3	2	2	1	2	2	3	1	2	3	1
5	3	2	3	2	3	2	4	2	1	1	3	1	2	3	1
6	3	2	1	2	1	2	1	2	2	2	2	1	1	2	1
7	3	3	3	2	2	2	2	2	1	2	3	2	1	2	2
8	2	2	2	3	2	1	2	1	2	1	2	2	1	1	1
9	2	1	2	2	1	2	1	1	2	2	1	2	2	1	2
10	3	2	2	3	2	1	2	2	2	1	2	2	1	1	1
11	2	3	3	2	2	2	2	2	1	2	2	2	2	2	2
12	3	3	2	3	3	1	3	2	2	1	2	1	2	3	1
13	3	2	2	3	3	2	3	4	3	2	2	4	3	1	2
14	2	3	2	2	2	1	2	2	2	2	2	2	2	2	1
15	3	2	3	3	4	2	4	1	2	1	2	2	4	2	3
16	2	3	2	2	2	1	2	2	2	2	2	1	2	2	1
17	3	3	3	3	2	2	4	2	1	2	4	3	1	3	2
18	2	1	2	2	2	1	2	2	2	2	2	2	2	2	1
19	3	3	3	4	3	2	3	1	2	1	4	2	1	3	2
20	2	1	2	3	2	1	3	2	1	2	3	2	2	3	3
21	2	2	3	2	2	2	2	1	2	2	2	2	1	2	2
22	2	2	1	2	3	1	2	1	2	1	2	1	2	1	2
23	3	3	2	3	3	4	3	3	3	2	3	3	3	3	2
24	2	2	2	2	2	2	2	2	2	2	3	2	2	1	2
25	2	1	2	3	2	1	2	1	2	2	2	1	2	1	2
26	2	2	2	3	2	1	2	3	2	2	4	2	2	1	2
27	1	2	3	3	3	2	4	2	1	2	4	3	2	4	3
28	2	1	2	2	2	1	2	2	1	2	2	2	1	1	2
29	1	2	1	2	1	2	2	1	1	1	2	2	2	1	2
30	2	1	3	2	1	2	3	1	2	2	1	1	3	2	2
31	2	1	1	2	1	2	2	2	2	2	1	2	2	4	2
32	2	1	2	2	1	2	2	3	2	2	2	2	2	2	2
33	2	2	1	1	3	2	1	2	1	2	1	2	2	1	2
34	3	4	3	3	4	2	1	2	2	3	2	3	2	3	2
35	1	2	1	2	2	2	4	2	2	2	2	3	2	3	2
36	2	1	2	2	1	2	2	3	2	2	3	2	2	2	3
S.D	0.64	0.83	0.77	0.69	0.91	0.62	0.81	0.76	0.55	0.62	0.82	0.72	0.76	0.99	0.71
Variance	0.41	0.70	0.60	0.47	0.83	0.38	0.66	0.58	0.31	0.38	0.68	0.52	0. 58	0.98	0.51

Items of the Instrument

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total	Total
Student	*		*		*		*				*			*	*		
1	2	3	4	2	2	3	4	3	3	3	2	3	1	2	2		72
2	3	4	3	4	2	2	3	2	2	3	4	3	3	2	4		74
3	3	2	3	2	1	3	1	2	2	2	1	3	2	1	1		54
4	2	3	3	4	2	3	3	2	3	4	3	3	2	3	2		75
5	3	2	2	3	4	3	2	2	3	2	3	4	2	3	1		72
6	2	3	1	3	2	3	1	2	3	2	1	2	3	2	2		57
7	3	3	3	1	2	3	3	2	3	3	3	2	3	3	3		72
8	2	2	2	3	2	3	3	1	2	2	3	4	4	3	3		64
9	1	2	1	1	2	1	2	2	1	2	3	1	3	2	1		49
10	2	2	2	3	2	3	3	1	2	2	2	1	3	2	3		60
11	3	3	2	1	2	2	2	2	2	1	3	2	3	2	3		64
12	2	4	2	3	2	3	3	1	3	2	1	2	2	3	2		67
13	3	3	3	4	3	1	2	4	2	3	4	3	2	1	2		79
14	2	2	2	3	2	2	3	2	2	2	1	2	2	1	3		60
15	2	3	2	1	2	3	2	2	1	1	3	3	3	2	2		70
16	2	2	2	1	2	2	3	3	2	2	2	1	1	2	2		57
17	3	2	3	4	2	2	3	2	1	2	3	2	3	3	3		76
18	3	2	3	2	3	1	3	3	2	1	4	2	3	2	3		64
19	4	3	2	3	2	2	3	2	3	3	3	3	2	3	4		79
20	2	2	3	2	3	1	2	3	2	1	1	2	2	2	2		62
21	3	1	2	2	2	2	2	2	2	4	1	1	2	2	2		59
22	1	2	1	3	2	1	2	2	1	2	1	2	1	3	2		51
23	2	4	3	3	3	1	2	3	2	1	2	3	3	1	2		78
24	2	1	2	2	3	2	2	2	2	2	3	2	1	1	4		61
25	2	1	2	3	2	1	3	3	1	2	3	2	2	1	3		57
26	2	1	2	1	3	2	2	3	3	1	2	2	2	3	3		64
27	3	2	3	2	2	1	3	3	4	3	2	3	2	4	3		79
28	2	1	3	2	3	2	2	3	1	1	2	1	2	1	1		52
29	1	1	3	2	2	2	1	2	1	1	2	1	3	2	1		48
30	2	2	1	2	3	1	2	1	2	2	1	1	2	2	2		54
31	4	2	3	2	1	2	2	1	2	3	2	2	1	3	4		62
32	3	2	2	2	2	2	2	1	1	2	2	2	1	2	3		58
33	2	1	2	1	2	3	1	1	2	2	1	3	2	1	2		51
34	3	1	4	2	3	4	2	3	2	1	2	3	2	3	3		77
35	1	2	1	1	2	2	1	1	2	1	1	2	1	2	3		55
36	3	1	2	2	3	2	2	1	1	2	3	2	1	2	2		60
S.D	0.78	0.89	0.76	0.94	0.72	0.80	0.74	0.79	0.88	0.88	0.95	0.82	0.88	0.85	0.86		
Varianc	0.58	0.79	0.58	0.88	0.52	0.64	0.55	0.63	0.77	0.77	0.90	0.67	0.64	0.73	0.75	18.99	

* = Negative item

The calculations of the Standard Deviation and the variance of the total Test scores of the 'MWIS'

X	F	FX	$\bar{x}$	$X - \bar{x}$	$(X - \bar{x})^2$	$\sum f(X - \bar{x})^2$
72	3	216	63.7	8.3	68.89	206.67
74	1	74	63.7	10.3	106.09	106.09
54	2	108	63.7	-9.7	94.09	188.18
75	1	75	63.7	11.3	127.69	127.69
57	3	171	63.7	-6.7	44.89	134.67
64	4	256	63.7	0.3	0.09	0.36
49	1	49	63.7	-14.7	216.09	216.09
60	3	180	63.7	-3.7	13.69	41.07
67	1	67	63.7	3.3	10.89	10.89
79	3	237	63.7	15.3	234.09	702.27
70	1	70	63.7	6.3	39.69	39.69
76	1	76	63.7	12.3	151.29	151.29
62	2	124	63.7	-1.7	2.89	5.78
59	1	59	63.7	-4.7	22.09	22.09
51	2	102	63.7	-12.7	161.29	322.58
78	1	78	63.7	14.3	204.49	204.49
61	1	61	63.7	-2.7	7.29	7.29
52	1	52	63.7	-11.7	136.89	136.89
48	1	48	63.7	-15.7	246.49	246.49
58	1	58	63.7	-5.7	32.49	32.49
77	1	77	63.7	13.3	176.89	176.89
55	1	55	63.7	-8.7	75.69	75.69

$\sum fx = 2293$

$\sum f(X - \bar{x})^2 = 3155.68$

$$\bar{x} = \frac{\sum fx}{\sum f}$$

$\sum f = 36$

$$= \frac{2293}{36}$$

$\bar{x} = 63.7$

$$S.D = \sqrt{\frac{\sum f(X - X\bar{X})^2}{N - 1}}$$

$$= \sqrt{\frac{3155.68}{36 - 1}}$$

$$= \sqrt{\frac{3155.68}{35}}$$

$$= \sqrt{90.16}$$

$$S.D = 9.495$$

$$= 9.5$$

$$Variance = (9.495)^2$$

$$= 90.2$$

Determining the estimate of reliability of the instrument (MWIS) using the Cronbach's Alpha Reliability Coefficient.

$$\alpha \text{ (}Alpha\text{)} = \frac{n}{n-1}\left[1 - \frac{\sum S_1^2}{S_x^2}\right]$$

Where:

S_1^2 = Variance of a single Item of the Instrument.
N = Number of Items of the Instrument.
S_x^2 = Variance of the Total Test Score.

S_1^2 = 18.99
N = 30
S_x^2 = 90.2

$$\alpha = \frac{n}{n-1}\left[1 - \frac{\sum S_1^2}{S_x^2}\right]$$

$$= \frac{30}{30-1}\left[1 - \frac{18.99}{90.2}\right]$$

$$= \frac{30}{29}[1 - 0.210532]$$

$$= (1.03448)(0.78947)$$

$$= 0.81669$$

$$= 0.82$$

APPENDIX 15

SCHOOLS USED FOR THE STUDY

1. Community Secondary School, Umuokpu
2. Community Secondary School, Ichida
3. Kenneth Dike Memorial Secondary School, Awka
4. Community Secondary School, Obeledu

APPENDIX 16

The Photographs of the scale models used in the study.

A= [illegible]ntle Sloped side
B= The Steep Sloped side.
C= The Valley side
D= The Convex sloped side
E= The Concave sloped side.

APPENDIX 17

LESSON PLANS FOR USE OF MODELS

NOTES OF LESSON FOR THE 2ND WEEK
SUBJECT : Geography (Map-work)
CLASS : SS 2
DURATION: 70 mins
TOPIC : The Concepts: Contours and Vertical Interval.

Specific Objectives:

At the end of the lesson, the students should be able to do the following:

i. Explain the term vertical interval (contour interval)
ii. Identify vertical interval of any given map.
iii. Say what contour lines are.
iv. Identify contour lines of specific maps given.
v. Shade areas within given contour lines.

Instructional Materials:

Scale models of landscape features, rulers, pins, thread, markers, map-extracts.

Entry Behaviour:

The students are familiar with map scales and map orientation – the sixteen (16) cardinal points of the compass. The teacher asks a few questions on these topics treated earlier.

Instructional Procedure:

STEP I –

The teacher introduces the topic, writes it down on the chalkboard. The teacher groups the students into four and distributes four "models" to the leaders of each group appointed earlier. Hands over the following materials to each group leader: thread, pins, ruler, marker, a model.

STEP II –

The students observe and describe the models individually. The model shows a conical hill with a steep slope on one side, a gentle slope on the other as well as a valley side. Let the students say the sides they will choose if they were to climb to the top and give reasons for their answers. Let them say the effects the valley side will have on the hill. If the valley contains water, stream or river what should be the direction of flow and why? If you wish to show the conical hill on paper without drawing this shape, will it be possible? The teacher tells the students that there are methods of representing such features on paper. Ask the students to listen attentively and participate fully as we go on with the procedure.

STEP III -

The teacher gives instructions to the students on what to do on the model provided to achieve the objectives of the lesson. The students in each group carry out the instructions. Ask them to measure the vertical height of the model, from the base to the apex using a ruler. The group leader guides each group. The model is measured 25cm high.

The teacher checks for correct measurements among the groups. Ask the groups to mark-out a five centimeter interval along the vertical height. They should use pins to mark every five centimeter interval. Call the interval, vertical interval (V.I.). Based on this ask the students to say what vertical interval means. Let them go round the model and do the same thing. Let them observe that the heights are of equal measurements; example 0-5=5cm; 10-15=5cm; 20-25=5cm. Teacher concludes that vertical intervals on a map are differences in height between any two adjacent contour lines or two levels above sea level. Let the students note that the point marked with pins which indicates different heights measured can be described as "Spot-heights". Let the students observe that the heights above the ground are always equal for any spot along the same line of pin round the model.

STEP IV –

Ask the students to join all pins representing points of the same height using the thread provided. Let them describe the line and say what they represent. The teacher confirms that the lines represent all points or areas of the same height above the ground. Let the students know that such lines on "a map" are known as "contour lines" or "contours". Let the students say what contour lines are, individually. Let the students complete the marking of places of equal heights above the ground. Ask them to use the marker provided and mark along the lines of thread already joined, to make the lines joining equal heights clearer and distinct. Remove the thread, thereby exposing the colours of all the lines round the model.

STEP V –

The teacher uses the model to ask questions on steps three and four – to lead the students into explaining what they have observed. Let the students give examples of vertical intervals using practical examples. Let them know that such intervals are also called 'contour' intervals. Let them know that contours or contour lines are specifically used to connote lines "on paper or map" (to represent definite heights) joining all places or points of equal height above sea level. Ask the students to observe, closely the shapes of lines drawn round the model as they pass across steep sides as well as those on the gentle slopes and say whether they have observed any differences on the wideness of the lines on the two areas. In which side are the lines wider apart? In which are they closer together?

STEP VI -

Ask the students to sketch the shape of the conical hill model on paper using the experience they have gained. The teacher sketches on the chalkboard to illustrate contours in concentric rings similar to the shapes of lines on the Hill model. The students cross check theirs with that of the teacher. The teacher fixes the heights of the contours. He indicates methods of numbering of contour lines. For instance, they can be written above or in between contours. Let the students use the sketch to identify the steep (closely spaced contours) and gentle slopes (widely spaced contours).

STEP VII -

Introduce the map extract – "Ekpuana Basin" (Appendix 4) designed for exercises on the lesson. Distribute the maps to the individual students. Let them use the maps to answer the teacher's questions. Ask them to indicate the vertical (contour) interval of the map. Let them trace specific contours: for example, 1000 metres contour lines. Let them indicate features found along the different heights above sea-level.

Evaluation:

The students ask general questions on the lesson. The teacher asks the students the following questions:

1. What are contours or contour lines?
2. What is a vertical interval of a map? Give examples, using the map extract, the Ekpuana Basin.
3. Identify the vertical interval. Shade all places below 800 metres contour line, using the Map Extract provided.
4. Shade all places above 1300 metres contour line.

The students take down the chalkboard summary.

NOTES OF LESSON FOR THE 3RD WEEK.

SUBJECT	:	Geography (Map-work)
CLASS	:	SS 2
DATE	:	
DURATION	:	70 mins
TOPIC	:	Contour representation of highland relief features.

Specific Objectives:

At the end of the lesson the students should be able to do the following:

1. Identify the following highland relief features on a topographical map: gentle slope, steep slope, concave and convex slopes, ridge, plateau, conical Hill.
2. Represent the above relief features correctly using contour lines
3. Describe, correctly, the highland relief features on a given topographical map.

Instructional Materials:

Two scale models: A conical Hill and an upland model with concave and convex slopes. Map extract - the Ekpuana Basin and other map sheets.

Entry Behaviour:

The students had studied contours and vertical intervals. The teacher asks questions on these concepts treated in the previous lessons.

Instructional Procedure:

STEP I -

The students describe the lines on the "Conical Hill Scale Model" used in the previous lesson - on the steep side and the gentle sloped side. The teacher guides. The lines, on a map, representing points of the same height are known as contours. Ask them to compare the "spacing" of the lines (in form of contours) on the steep and gentle sides. The students should be able to observe correctly and report that - widely spaced lines (contours) are seen on the gentle sloped side. On the steep side of the conical Hill model, the lines tend to be "closely spaced". It should, therefore, be concluded that the lines are closely spaced because the slope is steep. They are widely spaced because the slope is gentle. Direct the attention of the students to the lines on the model on the steep and gentle slopes. The teacher concludes that on a map, steep slopes are shown with closely spaced contour line. Gentle slopes are represented by widely spaced contours.

STEP II -

The teacher unveils the second model: an upland scale model with "concave and convex" sides. Ask the students to identify the gentle and steep slopes on the model. Let them compare the two models. The students compare and give their descriptions. The teacher directs the attention of the students towards discovering the sequence of occurrence of different steep and gentle slopes on the model complex.

The teacher writes correct descriptions on the chalkboard. The student volunteers help to sketch the contour representation on the chalkboard. For example, a gentle slope is at the foot of the hill (widely spaced contours on paper) followed by steep slope at the higher elevation (closely spaced contours on paper). On the other side, at the lower elevation there is a steep slope (closely spaced contour) which at a higher elevation changed to a gentle slope (widely spaced contours on a map) towards the summit. Let the students realise that the former is referred to as a concave slope while the latter is called a convex slope.

STEP III -

The teacher asks the students to sketch contour lines that represent a gentle slope, steep slope, convex and concave slopes. Let them explain the relationship. The teacher inspects and corrects.

STEP IV -

The teacher sketches closely spaced contours in two separate cases. The second set of contour lines are closely spaced but elongated covering a wide area. The teacher asks the students to compare the two sets of contour lines. The teacher also asks the students to, individually, describe the type of "Relief Features" which the second set of contours show. The pupils give their responses. The teacher records. The teacher indicates the correct responses. He concludes that the correct description of a feature with closely spaced contours, that are also elongated, is known as a "ridge".

STEP V -

Using the first models, the students sketch the shape of contours that represent a 'Conical Hill'. These are contours that are roundly shaped. Let the students indicate what the model will look like if contour lines are not found at the higher ground. That is, if there are wide spaces at the areas that show the summit of the upland areas. The students give their responses. The teacher lets the students know that such a model will have flat top. It is therefore a 'Plateau'. Let the students know that Plateau, in most cases, have steep slopes and leveled summit. Ask the students to make models of plateau.

Evaluation:

The students ask general questions on the lesson. Ask the students to draw contour lines in their exercise books that represent a steep and gentle; convex and concave slope, a ridge, a conical hill and a plateau. Introduce the map extract: Ekpuana Basin and other maps. Involve the students in an identification exercise of specific features as named above on the map extract.

NOTES OF LESSON FOR THE 4TH WEEK.

SUBJECT	:	Geography (Map-work)
CLASS	:	SS 2
DATE	:	
DURATION	:	70 mins.
TOPIC	:	Contour representation of lowland relief features.

Specific Objectives:

At the end of the lesson, the students should be able to do the following:

iii. Identify the following lowland relief forms, valleys, spurs, undulating plains, knolls on a given topographical map.

iv. Use contour lines to represent such features correctly.

v. Interpret a given topographical map correctly with regards to lowland relief features.

Instructional Materials:

Scale models, topographical map extracts (the Ekpuana Basin and other map sheets).

Entry Behaviour:

The students are familiar with the contour representations of High Land relief features. The teacher asks questions based on the interpretation of highland relief forms.

Instructional Procedure:

STEP I -

The teacher presents the 'Conical Hill Model'. Ask the students to take a close look at the valley side and describe the effect of the valley side on the Hill. Which directions does the water flow when it rains? Let them sketch a contour representation of the Hill with the valley side. Ask them to use the lines shown on the Hill model as a guide. Let them realise that the shape using contour lines will be roundish in shape with roughly a "V" shape on the valley side. The students cross-check their diagrams. Let the students realise that a "Cross-section" of the contour representation will produce the Hill Model.

STEP II -

Based on "Step I" above, the teacher concludes that valleys can be represented by roughly "V" shaped contours on a map. In topographical maps, therefore, contour lines having the shape of "roughly V", is therefore either a Valley or a "Spur". A Spur is a projection of highland, beside a valley, into the lowland. Let the students see such examples on the models provided. Let the students realise that whether the V-shaped features are Valleys or Spurs depends on the numbering of the contour lines. If the "Vs" are pointing upwards, the features are valleys. If they are pointing downwards, they are Spurs.

The teacher directs the attention of the students to the models presented. Ask them to indicate on the valley side the direction of flow of water. This shows that the 'V' shape points towards the higher ground when the structure is a Valley and the reverse is the case when the structure is a Spur.

STEP III -

Ask the students to identify valleys and Spur using the map extracts provided. The teacher observes and indicates correct answers when necessary. Draw more contour lines on the chalkboard and let the students indicate Valleys and Spurs. Let them differentiate between "dry" and wet valleys.

STEP IV -

Ask the students to draw the contours representation of the Conical Hill Model. Assuming that the hill is smaller than the present models ask them to represent it using Contour lines. Let the students compare the smaller and the bigger hills. Let them realise that the main difference is on the height. Let the students realise that the smaller hill is known as a "knoll" if it is small, round and isolated. A knoll, therefore is small, round and isolated hill. The contour forms may therefore be more roundish than that of a Conical Hill. Let the students identify "Knolls" in topographical map sheets provided.

STEP V -

Let the student compare widely spaced (Contour) lines with closely spaced lines on the hill model. Let them indicate the areas where "Plains" are located - whether flat or undulating plains. Use the lines on the hill model for the identification. Let the students realise that most plains are usually referred to as undulating plains because it may be difficult to come across plains that are flat. Let the students realise that the more lines are widely spaced, the more they become plains. The teacher concludes that contour lines on a map that are widely spaced represent plains of different types.

STEP VI -

Distribute topographical map sheets to the students. Let them identify undulating plains and knolls in the maps as well as indicate the directions where they are found. The teacher guides and corrects.

Evaluations:

The teacher allows the students to ask general questions on the lesson. Let the students identify specific lowland features - Valleys; Knolls; Spurs; Undulating plains - using the map extract provided - the Ekpuana Basin - as well as the "WAEC" topographical map sheets provided.

NOTES OF LESSON FOR THE 5^{TH} WEEK

SUBJECT	:	Geography (Map-work)
CLASS	:	SS 2
DATE	:	
DURATION	:	70 mins.
TOPIC	:	Relating relief to settlement.

Specific Objectives:

At the end of the lesson the students should be able to do the following:

i. Describe the relief of a given topographical map correctly.
ii. Identify the settlement patterns in the map accurately.
iii. Explain the effects of high relief on settlements.
iv. Explain the effects of low relief on settlements.
v. Describe, comparatively, the effects of relief (highland and lowlands) on settlements correctly.

Instructional Materials

Models of Relief features; Map extracts (Ekpuana Basin); topographical Map sheets.

Entry Behaviour:

The students are familiar with the representations of Low-land and Highland relief features using contours. The teacher asks questions on identification of relief features using the topographical maps.

Instructional Procedure:

STEP I -

Ask the students to identify relief forms indicating the highland and lowland relief features. The teacher writes down correct responses on the chalkboard. For instance, Highland-relief forms include - A ridge, plateau, mountains, hills concave and convex slopes, steep and gentle slopes etc. Lowland relief features include the following: Valleys, Spur, Knoll, Col and pass etc.

STEP II -

The teacher presents the two scale models to the students in their groups. Give this assignment. Ask the students to, individually, choose three different locations on the model, in order of preference, where they may wish to locate settlements on the models if they are given the chance. Secondly the students should write down the reasons why they have decided to choose each of the three locations. Thirdly, the students should indicate the form of relief they have chosen; for instance a Valley, a Plain, a Plateau, a Gentle slope, etc.

STEP III -

The students report and discuss their choice of settlement locations on the Relief models and their reasons for their choice. The teacher writes down relevant points made on the chalkboard. The teacher leads the students into comparing the advantages and disadvantages of building settlements in the lowland areas compared to highland areas, write down important points on the chalkboard. Most students are likely to choose lowland areas first for siting of settlements for the following advantages: easy accessibility; cheap road construction; easy transportation and movements, etc. The disadvantages should include: flooding of homes; farms; industries; security problems, etc. for settlements sited in low relief areas.

STEP IV -

Ask the students to sketch relief forms they have chosen for settlement locations using Contour lines and indicate the locations on the contour map. Distribute some map extracts, let the students indicate positions for siting of settlements giving reasons for their answers in relation to the relief.

Evaluation:

The students ask general questions on the lesson. The teacher distributes the topographical map sheets to the students. Ask the students to identify the major settlements in the mapped area. Let them indicate the relief features where the settlements are located. Let the students identify the uninhabited areas of the map and indicate the relief form where they are found. Let the students relate the distribution of settlements to relief. Ask them to give reasons why settlements tend to avoid some relief areas.

NOTES OF LESSON FOR THE 6TH WEEK.

SUBJECT :	Geography (Map-work).
CLASS :	SS 2
DATE :	
DURATION:	70 mins.
TOPIC :	Relating Relief to Transportation

Specific Objectives:

At the end of the lesson the students should be able to do the following:

1. Identify the relief features of highlands and lowlands on a given map sheet.
2. Describe, correctly, the patterns of distribution of transportation routes in the high and lowland areas.
3. Give reasons for the patterns identified above.
4. Relate the patterns of transportation seen on the given map to high and low relief areas.
5. Explain the effects of relief on transportation in a given map area.

Instructional Materials:
Models of relief features, Map extracts (Ekpuana Basin and other topographical Map sheets).

Entry Behaviour:

A review of previous lessons.

Instructional Procedure:

STEP I -

Direct the attention of the students to the models presented to them. Assuming that there are settlements located at the top of the Model Hill, at the middle and at the foot of the Model Hill, ask the students to discuss the means of transportation or movement to the different settlements identified. The teacher gives a guideline to the discussion, for instance, in terms of the gradient of the relief, difficulties in road construction, cost of linking the settlements with means of transportation, explain how the transportation means are affected by highlands and lowlands, etc. The students hold the discussions based on the models before them.

STEP II -

Based on the above discussions, the students indicate the directions or positions on the model where possible transportation routes can be constructed on the model. Let the students choose the best possible transportation options. Ask the students to take a decision on the best transportation options among the three settlements outlined, located on different relief levels. The teacher draws the conclusion.

STEP III -

Introduce a topographical map to the students. Let them identify the means of transportation on the map, for instance - footpaths, minor and major roads, railways, water, etc. Indicate lowland and highland areas on the map.

Evaluation:
Ask questions based on topographical maps provided. For instance, let the students explain how the transport routes in the area are affected by relief of the map area. Let them explain why some transport routes are dominant in some area and not seen in some area. Let them describe the distribution of the means of transportation in the mapped area relating such to the relief features of the area.

NOTES OF LESSON FOR THE 7TH WEEK.
SUBJECT : Geography (Map-work)
CLASS : SS 2
DATE :
DURATION: 70 mins.
TOPIC : Map interpretation using Relief Models made by the students.

Specific Objectives:

At the end of the lesson, the students should be able to do the following:

i. Construct a relief model correctly.
ii. Sketch correctly a contour representation of the relief model constructed.
iii. Draw contour lines that represent all the features (highland and lowland features) on the relief model.
iv. Explain the possible effects of relief on settlement on the model made.
v. Describe the likely effect of relief on transportation on the relief model.

Instructional Materials:

Relief models; topographical maps.

Entry Behaviour:

The teacher asks questions on the previous lessons.

Instructional Procedure:

STEP I -

Ask the students to submit their assignments on the construction of Relief models. The students were assigned to, individually, make relief models which should have the following: Highland and Lowland features; steep slope, a gentle, concave and convex slopes, a ridge, a plateau, a valley side and a Spurs. They were asked to use the approach adopted in the class to determine the contour representations and the vertical intervals. They are also to sketch the contour representations of each of these highland and lowland relief features and submit in their exercise books.

STEP II -

The students submit their exercise books where the relief representations were drawn. Discuss the assignment with the students. Let them indicate the measurements used as well as the vertical intervals. Using the relief models presented, the teacher discusses the contour shapes based on the models seen. The students explain their models. They indicate flat tops for plateau surfaces as well as sketch their contour representations. The students, individually, come forward with their Relief models to explain features on it and draw the appropriate contour representations of the features as well as the specific relief models.

STEP III -

The students, individually, discuss settlement and transportation in relation to the specific relief model. The teacher ask questions and the students respond individually using their specific models. The questions relate to indicating settlement locations and transport routes and giving reasons for such locations. Indicating the areas that will likely be favoured in the distribution of transportation and settlement locations, as well as relating such distribution to the relief of the mapped area.

Evaluation:

Let the students ask general questions on the lesson. Using the topographical maps provided, let the teacher ask the following questions:

i. Identify the vertical interval of the map.
ii. Identify the Highland relief features dominant on the mapped area.
iii. Indicate the Lowland relief features on the map.
iv. Relate the settlement types on the map to the relief of the mapped area.
v. How are the transportation routes in the mapped area affected by the relief?

APPENDIX 18

THE LESSON PLANS FOR THE USE OF CONVENTIONAL (LECTURE) METHOD

NOTES OF LESSON FOR THE 2ND WEEK.

SUBJECT :	Geography (Map-work)
CLASS :	SS 2
DATE :	
DURATION:	70 mins.
TOPIC :	The Concepts: Contours and Vertical intervals.

Specific Objectives:

At the end of lesson, the students should be able to do the following:

1. Identify the heights of specific points or places above sea-level (spot-heights).
2. Indicate points of equal height above sea-level.
3. Join points on paper of equal height correctly.
4. Explain the term "Contour line".
5. Explain the term vertical interval (contour interval) with examples.
6. Shade areas within given contour lines correctly.

Instructional Materials:

Photographs of relief features, map extracts.

Entry Behaviour:

The students are familiar with Map scales and map-orientation-directions and bearings. The teacher asks questions on these topics treated earlier.

Instructional Procedure:

STEP I -

The teacher displays the photographs of relief features for the students. Ask the students to identify features associated with Highlands and Lowlands using the photographs as a guide. For instance, land forms associated with highlands include

- Ridge, Gorge, steep and gentle slopes, concave and convex slopes, escarpment, plateaux, massifs, col (Saddle), peak, water-divide, inselberg, etc. The features associated with lowlands include the following: valleys, spurs, knolls, pass (gaps), plains, col (Saddle), etc. Let the students realise that these features can be represented on paper in two dimensional form.

STEP II -

Let the students realise that there are methods of representing these relief features on the map. Let them know that the principal method of doing such is by use of "Contour lines". There are other methods of showing relief, such as trigonometrical station, spot-height, Bench mark, layer colouring, Hill-shading, Hachuring. However, contours are the most important method of representation of relief features.

Explain the term 'Contour line' to the students. Let the students realise that contour lines are lines on the map which join all points or places of equal height above sea level. The sea-level is usually taken as the starting point in all measurements as it usually has a perfect level surface. Contour lines are usually accurately measured to join all places of equal heights.

STEP III -

Involve the students in joining of points of equal heights above sea-level. The teacher indicates points in the chalkboard. Let the students realise that the points are assumed to have been measured. Let them come forward, individually, and join the points of equal heights. Let the students realise that these points are known as "Spot-heights". Spot-heights are heights on the ground which have been measured. They are not marked on the ground. They are marked on topographical maps with dots "(.)" with the heights they indicate, written near them.

STEP IV -

Involve the students in the interpretation of the contour map made by joining the Spot-heights. Ask the students to do the following using the contour map on the chalkboard. Trace the 50m contour. Indicate the pattern of increase or decrease in height of the mapped area. Indicate the highest and the lowest areas in the map. Find out the difference in height between the first and the second contour lines. Do the same for the second and third; fourth and fifth and sixth and seventh contour lines. What have you found out? You can discover that the difference is always the same and that the difference is always 50 m. Let the students realise that difference is known as the "Vertical interval" or "Contour interval". Let the students explain the term vertical interval individually. The teacher summarizes that vertical interval or contour interval is the difference or vertical distance between two contour lines. It is usually a regular interval.

STEP V, STUDENTS' ACTIVITY

The teacher distributes map extracts to the students. He gives instructions on what the students should do. The students do the following: Identify the vertical interval of the map; trace specific contour lines as instructed by the teacher, indicate the lowest and the highest points on the map area, identify some relief features through which specific contour lines pass, ask other relevant questions on the lesson.

Evaluation:

The teacher allows the students to ask questions. Ask the following questions:

1. What are contour lines?
2. What is a vertical interval on a map? Give example.
3. Using the map extract provided
    a) identify the vertical interval, shade all places below 800 metres contour line.
    b) shade all places above 300 metres contour line.

Let the students take down the chalkboard summary.

NOTES OF LESSON FOR THE 3RD WEEK
SUBJECT : Geography (Map-work)
DATE :
CLASS : SS 2
DURATION: 70 mins.
TOPIC : Contour representation of Highland relief features.

Specific Objectives:

At the end of the lesson, the students should be able to do the following:

i. Indicate and sketch contour lines that represent highland relief features such as gentle and steep slopes; convex and concave slopes; conical hills; plateaux.
ii. Identify specific highland relief features on topographical maps.
iii. Describe, correctly, the highland relief features on a given topographical map.
iv. Answer questions on the topic correctly.

Instructional Materials:

Pictures of relief features, map extracts, topographical map sheets.

Entry Behaviour:

The students have studied contours and vertical interval.

Instructional Procedure:

STEP I -

Direct the attention of the students to the photographs of relief features. Ask the students to identify various types of highland relief features using the photographs as well as include those that are not on the pictures presented. The teacher writes down correct answers on the chalkboard. The correct identifications should be made to include the following: Ridge, Gorge, Concave and Convex slopes, Escarpment, Plateaux, Mountains, Gap (pass), Water-shed or Water-divide, Peak, Inselbergs, etc. Let the students know that these features can be represented on the map by using contour lines.

STEP II -

Ask the students to observe as the teacher illustrates contour representations of different highland relief forms. For instance, gentle slopes are represented by widely spaced contour lines. Draw these on the chalkboard as the students observe, when these extend over a relatively large area; they represent in most cases undulating plains. Give examples of such plains using contour lines.

STEP III -

The teacher illustrates contour representation of "Steep Slopes". These are represented by closely spaced contour lines. Draw such contours for the students to see. Ensure that the contour lines are numbered in order to indicate increase in heights of slopes. Let the students know that "Ridges" can be represented in a similar manner, except that the closely spaced contours have to extend over a large area. Draw such examples on the chalkboard. Let the students realise that "escarpments" are represented the same way like ridges. Ridges are associated with hills, while escarpments are associated with mountains.

STEP IV -

Distribute the topographical map sheets. Ask the students to identify gentle slopes, steep slopes, plains and ridges, using the map sheets.

The students should indicate by raising their hands, individually, when they see any of the features.

STEP V -

The teacher illustrates the representations of concave and convex slopes. Let the students know that concave slopes start with gentle slopes at the lower elevation but followed by steep slopes at the upper part of the Hill. The reverse is the case for convex slopes. That is, convex slopes have steep slopes at the lower part of the Hill but as one climbs to the higher level it changes to gentle slopes as one gets to the summit. Ask the students to draw the contour representations of the concave and convex slopes. A volunteer comes forward to the chalkboard while others observe. The concave slopes have widely spaced contours at the lower elevations followed by closely spaced contours at the higher elevations of the hill. Convex slopes have closely spaced contours at the foot of the hill, followed by widely spaced contours towards the top.

STEP VI -

The teacher gives examples of contour representations of Conical Hills and Plateaux. For conical hills, the contours are round and widely spaced at the lower ground, but closely spaced at the upper part of the hill. Knolls are represented by contours that are round or concentric. Plateaux, sometimes referred to as table land is characterised by comparatively level surface and steep slopes on either sides. Plateaux are represented by a number of closely spaced contours and comparative absence of contours towards the centre. The teacher draws contours that represent conical hills, knolls and plateaux on the chalkboard.

STEP VII -

The teacher asks the students individually to come forward to the chalkboard to sketch the contours representation of different highland relief features treated in the lesson. The teacher asks questions using the topographical map sheets involving the students in identification of highland relief features using the map sheets.

Evaluation:

The students ask general questions on the lesson. Using the students' exercise books, the students draw contour representations of specific highland relief features. Using the map extract – the Ekpuana Basin – the students identify specific highland relief features as indicated by the teacher.

NOTES OF LESSON FOR THE 4TH WEEK.

SUBJECT :	Geography (Map-work)
DATE :	
CLASS :	SS 2
DURATION:	70 mins.
TOPIC :	Contour Representation of Lowland Relief Features.

Specific Objectives:

At the end of the lesson, the students should be able to do the following:

i. Identify the following lowland relief features: Valleys, Spurs, Undulating plains, Knolls, on a given topographical map.
ii. Use contour lines to represent such features.
iii. Interpret a given topographical map correctly with regards to lowland relief features.

Instructional Materials:

Photographs of Relief features, topographical map sheet, map extracts.

Entry Behaviour:

The students have studied contour representation of highland relief features.

Instructional Procedure:

STEP I -

The students take a close look at the photographs of landscape features and identify lowland features seen. Let the students indicate other lowland features. These should include the following: Valleys, Spurs, col (saddle), plains, for example, undulating plan; Gap (pass).

STEP II -

The teacher illustrates contour lines that represent valleys and spurs on maps. Let the students realise that valleys and spurs are represented by nearly "v" shaped contour lines on maps. Draw such contours on the chalkboard. Let the students note that the direction where the apex of the "v" points determines whether the "v-shaped" features are valleys or spurs. If the "v"-shaped features points upwards (higher-level) the features are valleys. If they point downwards the features are spurs. Let the student remember that valleys may be dry or wet-depending on whether they contain water. The teacher draws more contour lines representing valleys and spurs on the chalkboard. Let the students realise that 'spurs' are projections of highlands into the lower ground which usually occur in between valleys.

STEP III -

The teacher gives examples of contour forms that represent plains. Let the students recollect that widely spaced contours represent gentle slopes. Similarly widely spaced contours represent plains. It is important to determine the vertical intervals, in the case of plains the vertical intervals are usually small. Let the students realise that most plains are usually undulating plains, as it may be difficult to come across flat plains. Draw examples of contour representations of different types of plains on the chalkboard. Let the students identify plains on the photographs of land scape in the class. Let them note that plains are generally of low elevation.

STEP IV -

Identify "knolls" on the photographs presented in the class. Let the students realise that knolls are isolated hills. They are usually small, round hills - usually found isolated in lowlands. Knolls are represented on the map by contours that are round or concentric in shape. They may be two concentric rings of contour lines. The teacher draws examples of the contour representation on the chalkboard - for the students to see.

STEP V: PUPILS' ACTIVITIES -

The teacher wipes the drawings on the chalkboard and calls the students, individually, to come forward to the chalkboard to sketch the contour representations of lowland relief features. Distribute the topographical map sheets to the students. Let them identify lowland features on the map indicating the directions where such are found.

Evaluation:

Using the map extract provided, let the students identify specific lowland features: Valleys, Knolls, Spurs, Undulating plains in the map area. Let them identify such features using the topographical maps provided.

NOTES OF LESSON FOR THE 5TH WEEK.

SUBJECT	:	Geography (Map-work)
DATE	:	
CLASS	:	SS 2
DURATION:		70 mins.
TOPIC	:	Relating Relief to Settlement.

Specific Objectives:

At the end of the lesson, the students should be able to do the following:

1. Describe the relief of a given topographical map correctly.
2. Identify the settlement patterns in a map accurately.
3. Explain the effects of high relief on settlements.
4. Explain the effects of low relief on settlements.
5. Describe, comparatively, the effects of relief on settlements correctly.

Instructional Materials:

Photographs of relief features showing settlements, map extracts, topographical maps.

Entry Behaviour:

The students are familiar with representations of highland and lowland relief features using contour lines. The teacher asks questions on identification of relief features on a given topographical maps.

Instructional Procedure:

STEP I -

Present the photographs of landscape to the students. Ask the students to locate settlements in the photographs of landscape presented. Let them indicate the type of relief feature where such settlements are found. For instance, at the foot of hills; on the lowland areas; on top of the hills; at the slope, etc. Ask the students to suggest possible reasons for such settlements. For instance, is it to avoid steep slopes or rugged relief areas; for cultivation; for easy transportation, etc. Let them suggest the occupation of people in the area.

STEP II -

Based on the discoveries on Step I above, the teacher asks the students to attempt representing similar features on the pictures as well as locating such settlements. The students draw contour lines that represent different lowland and highland relief features indicating where settlements are sited using the appropriate conventional signs. The teacher inspects and passes judgements. Let the students realise that different purposes for settlements should be considered; for instance farming, industries, schools, home-stead, mast, mosque or church, quarrying, etc.

STEP III -

Distribute the topographical map sheets to the students. Ask them to identify the major and minor settlements in the area as well as indicate the types of highland or lowland features where they are sited. The students, individually, respond to the teacher's instruction. Ask them to give reasons why such settlements are located where they are in relation to the relief of the mapped area.

Evaluation:

Using the map extract, ask the students to indicate two places they would like to site settlements as well as two places they would not like to site settlements giving reasons for their answers.

Using the topographical map sheets, let the students identify four areas where settlements are located indicating the type of relief features in the area. Let them also identify two areas that are not inhabited indicating the types of relief in the areas as well as suggesting reasons for avoiding the areas.

NOTES OF LESSON FOR THE 6TH WEEK

SUBJECT	:	Geography (Map-work)
CLASS	:	SS 2
DATE	:	
DURATION	:	70 mins.
TOPIC	:	Relating Relief to Transportation

Specific Objectives:

At the end of the lesson, the students should be able to do the following:

i. Identify the relief features of highland and lowland areas on a given map.
ii. Describe, correctly, the pattern of distribution of transportation routes in the highland and lowland areas.
iii. Give reasons for the patterns identified above.
iv. Relate the pattern of transportation seen on the given map to the highland and lowland relief areas.
v. Explain the effects of relief on transportation in a given map.

Instructional Materials:

Photographs of relief features showing transportation routes; map extracts; topographical maps.

Entry Behaviour:

The students are familiar with relating relief to settlements. The teacher asks questions on representation of relief features using contours as well as locating settlements on a given topographical map.

Instructional Procedure:

STEP I -

Ask the students to indicate transportation routes on the pictures of landscape presented. Let them suggest locations where minor or major transport routes can be sited. They should give reasons for their answers. Which relief features are found in the areas you have chosen for siting of transportation routes?

STEP II -

Distribute the map extract to the students. Let them indicate, using the map provided, the areas where they think transportation routes can be better located. They should indicate the direction as well as the relief dominant in the area. For instance, Railway line can be constructed in areas of very low elevation on the map, between 700 and 800 metres above sea level. In a similar manner let the students indicate where major and minor roads as well as footpaths can be appropriate. Let the students attempt to distribute the following transportation routes to the area: Footpaths, Minor roads, Secondary roads, Main roads, Railways, on the basis of relief.

STEP III -

Distribute the topographical map sheets to the students. Let them use them to identify various transportation routes, indicate the relief features where they are found and suggest possible reasons why they are located there. Let the students explain why transport routes are not seen in some areas of the map.

Evaluation:

The teacher responds to general questions on the lesson. Let the students answer the following questions using the topographical maps provided.

i. Indicate the areas where highlands and lowlands are found.
ii. Compare the distribution of transport routes in highland areas with that in lowland areas.
iii. Give reason for the location of transport routes predominantly in the lowland areas of the map.
iv. What should be the consequence of having more transport routes in the highland area?

v. Suggest where you would like a major road to be sited in the area. Give reasons for your suggestion.

NOTES OF LESSON FOR THE 7TH WEEK
SUBJECT : Geography (Map-work)
CLASS : SS 2
DATE :
DURATION: 70 mins.
TOPIC : General Revision

Specific Objective:

At the of the lesson, the students should be able to do the following:

i. Use contours to represent specific relief features correctly.
ii. Identify the vertical intervals of given maps.
iii. Relate settlements and transportation of given topographical maps to the relief.

Instructional Materials:

Topographical Map Sheets.

Entry Behaviour:

The teacher asks questions on the previous lessons.

Instructional Procedure:

STEP I -

The teacher arranges the class in four groups. Give two topographical map sheets to the students. Let the students identify the vertical intervals of the maps; determine the lowest points on the map area as well as the highest points. In which directions is the highest and lowest points? Let them find out the trigonometrical station on the map. Compare the vertical or contour intervals of the two maps. Shade all areas in the North-East above 1500 metres contour line. The teacher goes round to inspect what the students have done.

STEP II -

The teacher uses students volunteers to illustrate the representation of relief features using contour lines. Call out students to the chalkboard to give such examples. The students do that individually. The teacher corrects when necessary. Remind the students that the numbering of the contours can be in between the lines or above the lines. Let them note that gentle slopes are represented by widely spaced contours, steep slopes by closely spaced contours. In concave slopes, gentle slopes are seen on the lower ground while steep slopes occur at the upper part of the hill. In convex slopes the reverse is the case. In concave slopes therefore, widely spaced contour lines are followed at the higher elevation by closely spaced contours. The reverse is the case for convex slopes. Let the students represent plateaux and conical hills.

STEP III -

Remind the students that valleys and spurs are represented by relatively "v-shaped" contours. The apex of the "v-shape" is used to determine whether the structure is a valley (when it points upwards) or a spur (when it points downwards to a lower level). The students draw various shapes that represent valleys and spurs on the chalkboard.

STEP IV -

The teacher reminds the students that representing plains on a map is characterised by contours of very low elevation and widely spaced. Most plains are usually undulating plains. Let them remember that "Knolls" can be represented by contour lines that are round or concentric in shape. The students draw the contour representations of these features.

STEP V -

Introduce the topographical map sheets. Let the students identify various highland and lowland relief forms. Let the students identify settlement patterns as well as transportation routes on the map area. Ask the students to associate the relief of the map area with the distribution of the routes. The students answer the questions individually. The teacher moderates.

Evaluation:

The teacher responds to general questions from the students. Using the second topographical map provided, let the students respond to the following questions:

i. Identify the vertical interval of the map.
ii. Identify the dominant highland relief features on the mapped area.
iii. Indicate the lowland relief areas on the map.
iv. Explain the relationship between the relief and the settlement types in the map area.
v. How are the transportation routes in the mapped area affected by the relief of the area.

APPENDIX 19

RECORDED CLASS ROOM INTERACTIONS AND ACTIVITIES IN THE TEACHING-LEARNING SITUATIONS

Subject: Map-work in Geography
Topic: The Concepts: Contours and Vertical Interval
Class: SS 2
Duration: 80 mins.
Industrial Materials: Scale Models of Conical Hills; Rulers; Pins; Thread; Marker; Map-extracts.

Specific Objectives:

At the end of the lesson, the students should be able to do the following:

i. Explain the term Vertical Interval (Contour Interval)
ii. Identify the Vertical Interval of any given map
iii. Say what contour lines are
iv. Identify specific contour lines of given maps
v. Shade areas within given contour lines

The Interactions

Teacher: Groups the students and names group leaders. Writes down the topic on the chalkboard.

Students: Group leaders collect Instructional Materials. Adjustments in the groups.

Teacher: Gives instructions for activities to start. Describe the feature (scale model of a Conical Hill) before you.

Students: Some hands up.

Student 1: It is a moulded object using paper.

Student 2: It is a moulded land feature.

Teacher:	Describe the feature using real-life situations of what you are looking at.
Student 3:	The feature is a mountain.
Student 4:	No! It is a plateau.
Student 5:	It is a Hilly ground.
Student:	It is a flat land and a hilly area.
Teacher:	It is a Conical Hill. It is not a mountain. A mountain is always higher than a hill. Indicate where you have seen this type of hill.
Students:	Many hands up.
Student 1:	Umunachi.
Student 2:	Ogbunike.
Student 3:	Eziowelle.
Students:	Chorusing of responses and noise.
Teacher:	Quietens the class; rejects chorused responses; asks the students to indicate reactions by raising of hands only.
Students:	4, 5, 6, 7: indicate places where they have seen relief features of the type like the scale model in the class.
Teacher:	If you are to climb the summit of the hill model with a bicycle, which side will you choose to reach the summit and why?
Student 1:	This side; indicating the gentle sloped side.
Student 2:	That side – pointing at the valley side.
Student 3:	A bicycle cannot pass through the valley because of the gutters.

Student 4: The other side – indicating the steep side – because it is shorter.

Student 5, 6, 7: Reactions on the answer given, stated that the side is steep and as a result bicycle cannot climb it.

Teacher: Identifies the sides mentioned correctly and by their correct names. For instance: the gentle slope; steep slope; valley side; low-land area etc. Asks the students to use these correct names while referring to the specific areas. Accepts correct answers with reasons for the answers; rejects wrong answers.

Teacher: Can you represent this conical hill model on paper without drawing it?

Students: No! Yes! No! Yes!

Teacher: Any relief feature can be represented on paper without drawing it. It is part of what we are going to achieve at the end of this lesson. The group leaders will now lead their groups in what we are going to do as I give the instructions.

Students: Groups get materials ready; cluster around the 'scale model'.

Teacher: Measure the height of the scale model.

Students: Start the measurement. Others observe and contribute ideas. Arguments on the correct placement of the ruler. Noise as some students struggle for places closer to the scale model.

Teacher: Inspects every group; controls noise and gives necessary corrections. Instructs that measurement starts from "zero" and not from the end of the ruler.

Students: Groups announce the result of their measurements.

Teacher: Announces the correct measurement of the scale model: "25cm". Inspects for the correct measurements.

Students: Invite teacher to their groups to see the way they have measured to arrive at the correct measurement.

Teacher: Introduces the student groups to another stage in the process. Gives this instructions: Mark-out points at every "5cm" interval -on the scale model and along the vertical height of the model. Use pins to denote the points. Let the points marked using "pins" be made at four major positions of equal heights round the scale model.

Students: Mark-out 5cm vertical heights along the height of the scale model and at four major positions of equal heights. Argument on correct measurements as the students measure turn by turn -in their groups.

Teacher: Inspection of the groups at work. Ensures correct measurements of equal heights round the scale model-using "pins" to mark the points of equal heights.

Students: Indicate measurements made. Show the measured heights marked with pins -round the scale model. For instance;5cm,10cm,15cm,20cm,25cm above sea-level; shown at different positions round the scale model.

Teacher: What do the pins represent?

Students: Hands up.

Student.1; Showing specific pins indicates the heights they represent. E.g.: 5cm, 10cm, 15cm.

Student.2; Showing pins on another side indicates the heights they represent. E.g.: 20cm, 25cm, 15cm etc.

Student: 3,4,5,6,7: Show the heights which specific pins represent.

Teacher: These heights represented by pins are known as "spot -heights" on maps. They are usually represented by "dots" on maps. The heights of particular places are usually measured above sea-level. Sea-levels are used as a standard for measuring heights because they are almost flat.

Students: Repeat the concept spot-height after the teacher - a number of times.

Teacher: Join all the points (spot-heights) of equal height using the thread provided.

What height does each of the lines represent?

Student 1: 5cm height.
Student 2, 3, 4, 5: 15cm, 20cm, 25cm, 10cm heights respectively.

Teacher: Acknowledges correct answers. Inspects the joined heights using thread - and corrects errors.

Students: Raise hands. Invite teacher to see the equal heights they joined using threads.

Teacher: (Gives another instruction.) Use the marker provided and mark round all thread that join all points of equal heights - to make it distinct and clearer.

Students: Use marker to mark the lines of equal heights.

Teacher: What are the lines called, in your own opinion?

Student 1: They join pins with equal height.

Teacher: What do the pins represent?

Student 2: They represent different heights.

Teacher: So, what are the lines called?

Student 3: Lines of equal height.

Teacher: Good, another person.

Student 4: The line joins places of equal height.

Students: Hands up.

Student 5: The lines join places of equal height above sea-level.

Teacher: The lines are known as Contour lines on Maps - or Contours. They are used to represent all places of equal height above sea-level on Maps.

Teacher:	Identify two lines that are close to each other and indicate the differences between their heights.
Students:	Identify differences among the heights.
Student 1:	0-5 = 5cm; 5-10 = 5cm.
Student 2:	20 - 25cm = 5cm.
Student 3:	10 - 15cm = 5 cm.
Teacher:	What can you say about the differences?
Students:	Many hands up.
Student 4:	The differences of vertical heights are equal.
Teacher:	Very good. As can be observed, the differences among the vertical heights (Vertical Interval) are usually equal. What is the difference called?
Student 5:	Vertical difference.
Student 6:	Interval.
Teacher:	The difference in height between any two adjacent contours on maps is known as vertical interval or Contour Interval.
Student:	Yes! I wanted to say that.
Students:	Repeat the terms: Vertical Interval or Contour Interval.
Teacher:	Reminds the students that the marks on the scale model being used is simply to remind them of how they can be used to represent specific features on maps. Describe the lines on the Scale Model on the specific sides of the Model Hill. For instance, on the Gentle Sloped side; on the Steep Side and on the Valley Side; Conical hills like the one in use.
Student 1:	The lines cover every part of the Hill.
Teacher:	No! I mean, how do the lines look at the steep side, gentle slope and valley

side? Observe well.

Students: Hands up.
Student 2: At the steep side, the lines are smaller and bigger on the gentle slope.
Student 3: The lines are nearer each other on the sides that are steep. They are farther apart at the gentle sloped side. Conical hills have round shaped contours.
Students: Chorus: Yes!
Student 4: The lines are wider apart at the gentle sloped side and closer together at the steep sloped slide.
Student 5: Lines that are round are Conical Hills.

Teacher: Accepts correct answers and draws the conclusions. Based on the correct answers, widely spaced contours represent gentle slopes or undulating lowlands; closely spaced contours represent steep slopes. Gives examples using sketches on the chalkboard – round shaped contours represent Conical hills as shown by the type in the class.

Students: Come forward to the chalkboard to draw sketches of contours that represent steep and gentle slopes and conical hills.

Teacher: Number the contours drawn by the students on the chalkboard, indicating the heights. Heights written above or in-between the contour lines.

Students: Observe and note the ways contours are numbered.

Teacher: Draws some contours on the chalkboard with numbers and asks the students to interprete the features.

Distributes map extracts to the students. Asks the students to identify the Vertical Interval, shade specific areas, identify any Conical Hills, Steep and Gentle slopes.

Students: Hands up.

Student 1: The Vertical Interval is 200 metres.
Student 2: There is a Conical Hill in the South East.
Student 3: Indicated area shaded which indicated over-shading.

Teacher: Inspects and gives the correct answers and general corrections.

Evaluation:
The students do the following assignments. Distribute the Map Extract Ekpuana Basin (Appendix 4). Ask the following questions using the Map Extract:

1. What is the Vertical Interval of the Map?
2. Trace the 800 metre Contour line using asterix.
3. Shade all areas above 1000 metres in the North-West.
4. Give an example of a Conical Hill on the Map.