EFFECTS OF USING SCALE MODELS FOR TEACHING MAPWORK IN GEOGRAPHY ON ACHIEVEMENT AMONG SENIOR SECONDARY SCHOOL STUDENTS IN LAFIA LOCAL GOVERNMENT AREA OF NASARAWA STATE

Vincent Yohanna Iwah
E-mail: vincentiwah@gmail.com
07068078015
Department of Educational Foundations,
Faculty of Education
Federal University of Kashere
Gombe State.

Abstract

The purpose of this study is to investigate the effects of using scale models on the academic achievement of students in the mapwork section of geography when segregated according to group, gender and ability. The population of the study comprised all the 2408 senior secondary II geography students in Lafia Local Government of Nasarawa State and the sample consisted of intact classes of 105 senior secondary II geography students, from four schools in Lafia Local Government Area Education Inspectorate. Random sampling technique was used to draw the school sample. The instrument used for data collection was Mapwork Achievement Test (MWAT) adopted by the researcher from Ezeh (2006) and validated by experts in measurement and evaluation and geography with reliability coefficient of 0.94 also determined. Quasi-experimental design, specifically, the pretest and posttest control group design was used. Data analysis was done using means, standard deviations and analysis of covariance. The results showed that there was a significant difference between experimental group when taught mapwork using scale models and the control group taught mapwork using the conventional lecture method. The result also indicate that gender was not a significant factor in students achievement when taught mapwork using scale models. Finally there was also no significance difference between the achievement gains of high ability and low ability students when taught mapwork using scale models. Based on the findings, it was concluded that: the use of scale models had a significant effect on the mean achievement score of student in mapwork and gender was not seen as a significant factor on the students achievement in mapwork when taught using scale model and finally, it was concluded that there was no significant difference between the high ability and low ability students when taught mapwork using scale models. Thus, the following recommendations were made: The use of scale models in teaching mapwork in Geography should be advocated and included in senior secondary school geography curricular and teachers be trained on how to use the scale models more correctly and frequently, scale models should be encouraged for use in various geographical features in teaching and learning geography so as to close the gab between high ability and low ability students and lastly geography students in tertiary institutions should be taught on how to produce models and the uses.

Introduction

Geography is often perceived by students as a difficult subject because of the abstract manner the subject is taught. As a consequence, enrollment into the subject is restricted to only the intelligent students (Ezeadu and Ezeh, 2008). Reports on students' performance at Senior Secondary Certificate Examinations in Geography, especially in practical Geography involving mapwork, have not been encouraging. WAEC Chief Examiners' reports have highlighted persistent poor performance of school certificate Geography candidates in mapwork (WAEC, 2007). This poor performance is attributed to factors such as wide coverage of the subject, topic difficulty, lack of or insufficient materials, inadequate qualified Geography teachers, and lack of interest on the parts of the students among others, particularly the uninteresting manner this important aspect of geography is being taught, leading to low students' enrollment in geography at the Senior Secondary School level (Ezeadu and Ezeh, 2008). A trend that is also evident at other various levels of the Teacher Training Colleges, Colleges of Education and the Universities where fewer students are opting for Geography as compared with those who opt for other disciplines of the social science and the liberal arts, with the female students worse hit.

Theory of Academic motivation propounded by Frymier (1970) was adopted by the researcher as the theoretical basis for poor enrolment and gradual improvement in students performance in geography. According to Frymier academic motivation is inferred like intelligence. Academic motivation can not be concretized by observing peoples' behavior, the presence or absence of academic motivation is generally determined. It may be pointed out that though both academic motivation and intelligence are inferred constructs, yet the main difference between intelligence and academic motivation is that while ability or intelligent summarizes observations about what an organism can do or ought to do, academic motivation summarizes what an organism or a pupil will do or wants to do. (https://shodhgang.inflibnet.ac.in).

Students' performance in Geography has become a thing of great concern due to its importance particularly the mapwork as its reading and interpretation is required for the understanding of other subjects such as history, social studies, economics. Looking at the objectives of Geography in Nigeria, it seems clear that their pursuance and realization would provide students with the critical skills and competences needed for national development. Not withstanding this perceived importance of the subject, it does not appear to be very popular to students. It has been observed that, the performance of candidates in the West African Secondary School Certificate Examination (WASSCE) in Nigeria is becoming poorer every year. A critical observation of students' results in Geography through a period of ten years by Amosun (2002) shows that there was no improvement as no year records even up to 40% pass at credit level (i.e. from A1-C6). This situation may not be unrelated to the fact that Geography is considered by many students to be a conceptually difficult subject with an extremely wide scope (Adegoke, 1987). It appears that students find practical Geography particularly difficult especially, the aspect of mapwork that requires the knowledge of mathematics. The poor academic achievement of students in the mapwork section of geography has largely been blamed on teaching method. (Ezeudu & Ezeh 2008). It is important to note that models are among the instructional methods recommended for teaching and learning of mapwork in Geography at senior secondary schools, but not commonly used. Models are concerned with simplifications, reductions, concretizations, experimentation, theory formations and explanations. Models also enable groups of phenomena to be visualized and comprehended which could otherwise not be either because of their magnitude or their complexity.

Models are of various classifications, however, two broad classification are recognized, particularly in geography and social sciences (Hagget & Chorley, 1971; Haget, Cliff & Frey, 1977). They are as follow: the conceptual model (also known as theoretical models, symbolic or mental models). Such models are generally derived from deductive reasoning. The other classification is the Hardware models. Such are also referred to as physical and constructions. Such model can be constructed. The examples are the "scale-models" and analogue.

Ola (1976) described the scale-models as objects mould of clay or plastic for the purpose of learning. He indicated that the students can be made to mould specific models of Geographical feature to be kept in the Geography rooms and used for teaching and learning. The scale models in its simplest conventional form can provide a three dimensional reproduction of the landscape or objects using materials such as superimposed layer of paper, card, pulp, wood, moulded-plaster, poster's clay, plastics etc (Monkhouse, 2015). The scale-models are therefore, models that can provide a three dimensional creation of specific features for teaching and learning.

Mapwork is given a special emphasis in geography education. The Geographers' main tool is the map. The acquisition of mapwork skills is therefore, fundamental in the undertaking of all geographical studies. Gender equality has been recognized as a necessary tool for development. According to Divine (2003) hardly has development been analyzed without mention made of gender and the negative effects of its in-equalities on sustainable development. Promoting gender equality and the empowerment of women is one of the social development goals, the ultimate goal of the Nigeria educational reforms (Ezeudu, 2008).

Furthermore, academic achievement is the extent to which a student, teacher or institution has attained their short or long-term educational goals. It is commonly measure through examinations or continuous assessments but there is no general agreement on how it is best evaluated or which aspects are most important. Relating academic achievement in geography to the use of scale model as a teaching method, it is said that the instinct of curiosity is the master instinct among children, experience proved, are curious to see things for themselves. their environment is full of things and object about which children want to know everything. They have questions of which they want answers. The geography teacher exploits this instinct through the use of scale models for teaching geography to make the teaching of geography interesting and meaningful hence improve performance. (https://ddceutkal.ac.in). While Academic ability is to degree of competence in educational activities (school) in such subject as Geography, maths, science and language. Academic ability is used for a successful career accomplishment as a result it lead to having many intellectual demands that allow you to use a high level of academic ability to accomplish the goal (https://1on03wordpress.com).

Research Design

The design that was used for this research was the Quasi- experimental design, specifically of the pretest and posttest control group design. This design was used because it was considered suitable for analyzing gain scores, that is, the difference between pretest and posttest scores. The use of Quasi experimental is justified because random assignment of subjects to experimental and control group as applied in the true experimental design (Nworgu, 2006) was not used as it was likely going to affect and disrupt the school programmes. The use of intact-classes was suitable for the design. The researcher thus used intact-classes for the research.

Population

The population for the study comprised all the 2,408 Senior Secondary II Geography students in Lafia Local Government Area of Nasarawa State of which 1321 were males while 1087 were females (Source: Education Area Inspectorate, Lafia).

Sample and Sampling Procedure

The sample consisted of the use of intact classes of SS II geography students from four mixed (co-educational) schools in Lafia Local Government Area of Nasarawa State. The entire schools were listed and a simple random sampling was used to select the four mixed schools from the list. The four mixed (co-educational) schools chosen for the study were given the pretest and from their mean scores, the two schools with nearly similar ability were chosen for the experiment. The two intact classes of 54 and 51 students per class were randomly assigned to experimental and control groups respectively.

Instrumentation

An achievement test termed Mapwork Achievement Test (MWAT) was adopted by the researcher from Ezeh (2006) and used for data collection. The “MWAT” is based on five content areas of mapwork chosen for the study and a 30 item, multiple -choice test instrument with a response format of choosing the correct answer by shading it. The researcher also used a topographical map sheet of Umuko district adopted from Ezeh (2006) for the MWAT. The instrument has two sections; the first section is made up of the participant data such as registration number and gender the second section containing the 30 mapwork achievement test items.

Tools for the Experiment: The lesson plans were prepared by the researcher to cover the five content areas of map work chosen for the research for both experimental treatment and the conventional lecture methods (control group). Week 1 covers contours/vertical interval; Week 2:- contour representation: highland relief feature, week 3:- contour representation: lowland relief feature; Week 4:- relating relief to settlement and Week 5:- relating relief to transportation respectively. These were contained in both the experimental lesson plans and the conventional lecture methods lesson plans simultaneously for the five weeks.

Validation of Instrument

The instrument "MWAT" with a satisfied necessary Psychometric properties was adopted from Ezeh (2006). 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.

In the course of face validation the items were subjected to criticism and vetting under the following criteria: relevance, suitability, content areas identified, repetitions, set-objectives, use of language and ambiguity. Since the instrument was fully adopted, the researcher did not consider it necessary to carry out further scrutiny of any other criteria.

The content validity of the instrument was ensured by applying a table of specification on the instrument, based on the Bloom's 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.

The test blueprint (table 3) 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

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Table 1: Test Blueprint for the Map work Achievement Test (MWAT)

CONTENT AREA %	Objective 100%	Level Lower order	High order	Total Terms
Contours/vertical interval	16.66%	3	2	5
Contour representation: Highland relief feature	22.33%	4	3	7
Contour representation: Lowland relief feature	26.66%	4	4	8
Relating relief to settlement	20%	2	4	6
Relating relief to transportation	13.33%	2	2	4
Total	**100%**	**15**	**15**	**30**

The instruments were tested and from the results of the trial testing, item 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.

Reliability of Instrument

In order to reestablish the reliability of the Mapwork Achievement Test instrument, a trial test was carried out and an estimate of internal consistency was applied using the Split-half method with the Spearman rank order correlation associated with Spearman Brown correction formula. The Split-half method gives an estimate of the degree of internal consistency of the test instrument. To compute the reliability coefficient, the test instruments were administered to a sample of thirty (30) students of GSS Lafia East, Lafia. The scores obtained were subjected to split-half method. The reliability co-efficient obtained was "0.94". This indicates that the instrument has high reliability.

The experimental group was taught mapwork using scale models. The control group was taught using the conventional lecture method. The groups were randomly assigned to treatment conditions. Prior to the treatment, a pre-test was administered to the two groups. Steps were taken to control all the possible extraneous variable to the study, this include visitation to the schools before the experiment, using a well arranged intact classes and the use of ANCONA as a statistical tool in order to eliminate unwanted variables.

After five (5) weeks of treatment, a post-test was administered to the two groups. The administration of the test was done with the assistance of the regular geography teachers in the schools.

Data Analysis

Mean and standard deviation were used to answer the research questions. The Analysis of Co-variance (ANCOVA) was used for testing the hypotheses at (0.05) level of significance. ANCOVA was considered appropriate statistics for testing the hypotheses because the pretest scores

were used as covariates and the difference on how each of the groups performed was observed in the ANCOVA results. The pre-test and the post-test scores were then compared to determine the influence of the treatment conditions on the dependent variables of interest.

Results

Presentation and Analysis of DataUnder this, data collected were analyzed and the result of the study presented. This contains three research questions with their tables of analysis on mean and standard deviations for descriptional analysis. This also contains three hypotheses with a table each containing the F-value and level of significance for drawing conclusion or inference

Presentation of Data

The results are presented according to the research questions and the hypotheses
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Research Question One

What is the difference in the mean achievement scores of experiential group taught with the use of scale models compared with their counterparts taught with the conventional lecture method?

Table 2: Means and Standard Deviations of the Students' Pretest and Posttest Scores by Groups.

Group		Pretest	Posttest	Achievement Gain
Experimental	Mean	5.59	16.13	10.54
	N	54	54	
	SD	1.796	3.508	
Conventional:		5.59	10.96	5.37
	N	51	51	
	SD	2.080	2.254	

Table 2 indicates that the overall mean achievement posttest score for the experimental group in the posttest (taught using models) was ($\bar{x}$=16.13) with a standard deviation of 3.508. The mean posttest score for the control group in the posttest (taught using the conventional lecture method) was ($\bar{x}$ =10.96) with a standard deviation of 2.254. 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 was also higher in the experimental group than that of the control group. From the data in the table, therefore, the students taught using models had higher mean achievement gain of (10.54) than those taught using the conventional lecture method with (5.37). In order to take a decision on this, hypothesis one was tested.

Hypothesis One

There is no significant difference in the mean achievement score of students in the experimental group taught mapwork using scale models and that of those in the control group taught with conventional lecture method.

This hypothesis was tested by subjecting data from the posttest and pretest for the experimental and control groups to analysis of covariance. The analysis result is presented in Table 3

Table 3: ANCOVA Test of Significance Difference between Experimental and Control Groups

Source	Type III sum of Squares	df	Means Squares	F	Significance value
Corrected Model	978.511	2	489.255	79.433	0.000
Intercept	860.706	1	860.706	139.740	0.000
Pretest	227.763	1	227.763	45.096	0.000
Group	699.747	1	699.747	113.608	0.000
Error	628.251	102	6.159		
Total	21082.000	105			
Corrected Table	1606.762	104			

Table 3 shows that the calculated F- ratio for the group treatment on students' achievement in mapwork is 113.608 which is significant at 0.000. This value is significant beyond 0.05 level of significance (F calculated, 1df, 0.05a=113.6>F critical=3.84). 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 mapwork using models and that of those taught using the conventional lecture method.

This implied that the experimental group taught mapwork using the scale models gained significantly higher than the control group taught using the conventional lecture method. The implication is that the use of scale models is more effective than the conventional lecture method for teaching mapwork.

Research Question Two

What is the difference in the mean achievement gain scores of male and female students when taught mapwork using scale models?

To answer this research question, the researcher compared the achievement gains of male and female subjects treated with scale models

Table 4: Means and Standard Deviations of Experimental Students' Posttest and Pretest Scores by Gender.

Gender		Pretest	Posttest	Achievement Gain
Male	Mean	5.71	16.00	10.29
	N	28	28	
	SD	1.410	3.232	
Female	Mean	5.69	16.65	10.96
	N	26	26	
	SD	1.975	3.463	

The data in Table 4 reveal that the female students had a slightly higher mean score ($\bar{x}$=16.65) than their male counterparts ($\bar{x}$ = 16.00) when taught map work using scale models. The female students also had a higher standard deviation of 3.463 compared to that of the male students' 3.232. The data from the table also indicate that male students had almost similar mean achievement gain of 10.29 with their female counterparts having 10.96. The data suggested that the performance of the two gender groups may have been equal.

Hypothesis Two

There is no significant difference in the mean achievement gain scores between male and female students taught mapwork using the scale model.

This null hypothesis was tested by subjecting data from the posttest and pretest for the male and female gender of experimental group to analysis of covariance.

Table 5: ANCOVA test of Significance Difference between Male and Female Gender of Experimental Group.

Source	Type III Sum of squares	df	Mean square	F	Significance value
Corrected Model	220.524	2	110.262	15.317	0.000
Intercept	388.868	1	388.868	54.021	0.000
Pretest	214.761	1	214.761	29.834	0.000
Group	6.234	1	6.234	0.866	0.356
Error	367.124	51	7.199		
Total	14961.000	54			
Corrected table	587.648	53			

The data in Table 5 indicate that the computed F-value for the effect of gender on treatment is 0.866 and a significance value of 0.356. This value was not significant at the 0.05 level of significance (Fcal, 1df, 0.05a=0.866<Fcri=3.84). The null hypothesis was, therefore, not rejected. This means that there is no significant difference in the mean achievement gain between the male and female students taught map work using the scale models. They therefore, achieved

equally when taught using scale model. This is because the use of scale models is practical and not gender biased.

Research Question Three

What is the difference in the achievement gains of high ability students with that of low ability students in mapwork taught using scale models.

The Research Question was answered by comparing the mean achievement gain scores of the high ability students and low ability students of experimental group as shown in Table 6.

Table 6: Means and Standard Deviations of the High Ability and Low Ability Students of Experimental Group Posttest and Pretest Scores.

Ability		Pretest	Posttest	Achievement Gain
High	Mean	7.44	18.06	10.62
	N	16	16	
	SD	0.629	2.792	
Low	Mean	4.84	15.22	10.38
	N	37	37	
	SD	1.280	2.800	

The data in the Table show that the mean posttest score of the high ability students taught mapwork using scale models is ($\bar{X}$=18.06) with a standard deviation of 2.792 while the low ability students of the same group have a mean posttest score of ($\bar{x}$ = 15.22) with a standard deviation of 2.800. The data suggest that, the high ability students had slightly higher mean achievement gain score of 10.62 than the low ability students with 10.38 and therefore performed slightly better. Final decision will be determined by testing the hypothesis.

Hypothesis Three

There is no significant difference in the achievement gains scores between high ability students and low ability students taught mapwork using scale models.

This Research hypothesis was tested by subjecting data from data from the posttest and pretest for the high ability and low ability students of experimental group to analysis of covariance.

Table 7: ANCOVA Test of Significance difference between High Ability and Low Ability Students of Experimental Group.

Sources	Type III sum of Squares	Df	Mean square	F	Significance value
Corrected Model	172.205	2	86.102	13.560	0.000
Intercept	158.032	1	158.032	24.887	0.000
Pretest	81.715	1	81.715	12.869	0.001
Ability	0.025	1	0.025	0.004	0.950
Error	317.493	50	6.350		
Total	14186.000	53			
Corrected total	489.698	52			

The data on Table 7 show that the F– value calculated on the effect of treatment on ability level of the students is 0.004 and a significance of 0.950 (F calculated, 1df, 0.05a = 0.004<F critical=3.84). This value is therefore not significant at 0.05 level of significance. The null hypothesis is, therefore accepted. This implied that there was no significant difference between the achievement gains of high ability students with that of low ability students in mapwork when taught using scale models. The high ability students and low ability students taught mapwork using scale models therefore gain equally. This is because the method is concrete and practical which make the teaching more advantageous to the low ability students as it makes learning clearer and simple.

Discussion of findings

On the effects of the use of scale models on the mean achievement score of students in mapwork, the experimental and the control groups in Table 3 had equal mean scores in the pretest before treatment. The result in Table 2 also reveals that the students taught mapwork using scale models scored higher mean (x =16.13) in the achievement test than those taught using the conventional lecture method (x= 10.96). The table, therefore indicates that the students taught using models had higher mean achievement gain of (10.54) than those taught using the conventional lecture method with (5.37).The result in Table 3 showed that there was a significant effect of treatment on the students' academic achievement in mapwork. This conclude that students taught mapwork using scale models achieved better than those taught using the conventional lecture methods. The findingis in agreement with that of Ezeh (2006). In his study, the results revealed a significant difference in academic achievement with the experimental group showing superiority over the control group taught using the conventional method. The result of this study added more strength to psychological learning theories such as Kurt-Kuffka, Wolfgang Kohler, Gestalt psychologist–Max-Wertheimer e.t.c which placed emphasis on the development of insight in learning situation (Noel & Smith 2002) cited in Ezeh (2006). The use of concrete material such as scale models played an important role in the development of insight. The use of models, therefore creates room for insightful learning experience (Ezeh,2006). The result of this study is also in agreement with the assertion by Jean Piaget as cited in Ezeh (2006) that concepts develop from concrete to abstract as the learner draws from his experience when concrete materials are used for teaching.

With regard to the influence of gender on the mean achievement gains scores when taught mapwork using scale models. The result in Table 4 revealed that the difference between the mean scores of male students ($\bar{x}$=16.00) and that of female students (x= 16.65) in the experimental group are closely related though in favour of the female students. The mean achievement gains are also almost the same with (10.29) for male and (10.96) for female indicating the same performance. The result shown on Table 5 showed that the difference was not significant. This mean gender was not a significant factor in students academic achievement in mapwork as both gender achieve equally when taught mapwork using scale models.

The result of the study is in agreement with that of Amosun (2002). Amosun on his studies the three models of group learning strategies, mathematical ability and gender as determinant of students' learning outcome in mapwork. He reported that there was no significant difference in the academic achievement of gender on all the dependent measures. However, the findings differed with the results obtain by Kimura (2002) and Okafor (2000). In their studies gender was indentified to be relevant factor in academic achievement.

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 stero-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 gain of male and female students;the use of models for teaching mapwork is likely to promote gender-equality. The result indicated that the method was not gender biased.

Lastly, on the influence of ability on the mean achievement gains scores when taught mapwork using scale models. The results in Table 6 indicates that the high ability students taught mapwork using scale models score a slight higher achievement mean of (x=18.06) than the low ability students taught mapwork using the same method (x = 15.22). Evidence from the table shows that, the mean achievement gain difference is slightly higher in the high ability students with (10.62) from the low ability students with (10.38). This implied that high ability perform slightly better than the low ability students in mapwork achievement text when taught using scale models.

The result from Table 7 agrees with the findings 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. However, the findings contradicts that of Okoye (1995) where the high ability group performed significantly better than their low ability counterparts when taught using simulation. It also appeared, therefore, that with the result of this study and that of Anikweze (1988) which revealed no significant difference between the mean achievement scores of high ability and low ability students in mapwork achievement test when taught using scale models. The use of scale models will promote ability equality in mapwork. The result indicate that the method was not ability biased as it was more concrete and practical as it agree with psychological learning theories such as Kurt-Kuffka, Wolfgang Kohler, Gestalt psychologist e.t.c that placed emphasis on the development of insight in learning situation which played and important role in the use of concrete materials.

Summary of Major Findings

The major findings of this study were the following:

1. Students from experimental group taught mapwork using scale models scored significantly higher than those in the control group taught mapwork using conventional lecture method.

2. There was no significant difference in the mean achievement scores between the male and female students taught mapwork using scale models. This mean they achieved equally.

3. There was no significant difference between the achievement gains of high ability students and low ability students in mapwork when taught using scale models.

Conclusions

The conclusions based on the results of this study are as follows:

The use of scale models had a significant effect on the mean achievement score of students in mapwork. The use of scale models was, therefore, more effective than the conventional lecture method for teaching mapwork.

Gender was not a significant factor on the students achievement scores in mapwork when taught using scale models. The male and female shows the same level of achievement. The students of high ability achieved the same with the students of low ability. The study found out that there was no significant difference between the high ability and low ability students when taught mapwork using scale models.

Recommendations

Based on the major findings of the study, the researcher recommended as follows:

1. The use of scale models for teaching mapwork in geography should be advocated and be included in the senior secondary school geography curriculum and teachers to be trained on how to use scale models more correctly and frequently through teacher-education programmes in tertiary Institutions.
2. Teachers should be encouraged and be trained in the use of model more frequently so as to maintain the closed gab between the male and female gender on the achievement gains in mapwork from the study. The application of models is not gender biased.
3. Geography teachers should be encouraged to adopt the use of models for all various geographical features in teaching and learning geography with the students as it will close the gab between high ability and low ability.
4. Teaching of geography students on how to produce models and the uses, should be included in the tertiary education and teacher education curriculum of geography.

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