

Utilization of Constructivist Instructional Method in Teaching Physics in Secondary Schools: Interaction Effects of Method and Location

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Abstract— In this study, the researcher investigated the interaction effects of method and location on academic achievement of secondary school physics students using constructivist teaching method. Pretest-posttest non-equivalent control group design was adopted. The study was conducted in Enugu North and East Local government Areas of Enugu state. The population of the study was 5,104 senior secondary one (SS1) Physics students. The sample size was 118 (60 males and 58 females). Stratified random sampling was used to draw two co-educational schools, one from Urban Schools and the other from rural schools. In each of the two schools sampled, two intact classes were randomly sampled from SS1 Physics students. One out of the two classes sampled was assigned to constructivist teaching method while control group was assigned to lecture method. Three research questions and three null hypotheses guided the study. The duration of the experiment lasted for four weeks. Data generated were analyzed using mean with standard deviation. Analysis of Covariance (ANCOVA) was used in testing the hypothesis at $P < 0.05$. The results of the study showed that the students' achievement in Physics was better when they were taught basic concept of electricity using constructivist teaching method than when they were taught using lecture method. The results also showed that location had a significant influence on academic achievement of Physics students in favour of urban schools. From the result of the study, significant ($p < 0.05$) interaction effect due to method and location on students' achievement in Physics was observed. Based on the findings some recommendations were made.

Index Terms— Constructivist Instructional method, Interaction effects, Physics Achievement and School Location.

I. INTRODUCTION

Science and technology act as a pivot on which national development hinges. Physics as one of the core science subjects is very crucial in this matter since it serves a requirement for scientific and technological advancement of any nation. Put in a different way, the technological potentials of any nation could be easily rated by the quality of its physics education.

This is so because in all facets of life, Physics concepts are applied in notable areas such as in industries, agriculture, electricity, telecommunication, computers, global positioning satellite, aviation and health, (Anamezie, 2015). From the ongoing, it is very glaring that physics as a science subject is very much required at secondary school level. Therefore,

there is much need to equip the Physics students at secondary school level with much required scientific skills and knowledge.

Unfortunately, it has been observed by many researchers that students' achievement in this subject area over the years has been poor. For instance, Agommuoh and Nzewi, (2003) noted that method of teaching among other factors has been identified as being responsible for the poor achievement in physics. It is a general opinion of many researchers that the methods adopted by teachers in presenting physics subject to students are bound to have significant influence on the achievement. (Snezana, Liljana & Milena, (2011); Aina and Jacobs, 2015), in their independent studies, observed that the use of lecture method by teachers has resulted to poor academic achievement in sciences. Sharing the same view, Bello (2012) asserted from his study that utilization of appropriate teaching method is likely to have a positive influence on the academic achievement of physics students. Sharing the same view, Opara, (2011) and Samaresh, (2017), in their independent studies discredited the use of conventional (lecture) method on the grounds that it has little or no effect on students' academic achievement. Activity-based method that involved students' participation in teaching and learning process is likely to yield a fruitful learning outcomes. Based on this backdrop therefore, the researcher investigated on constructivist instructional teaching method.

Constructivist theory posits that learners learn by expanding their knowledge by experiences and that all knowledge is constructed from a base of prior knowledge. This implies that learners are not blank slates and that knowledge cannot be imparted without the learner making sense of it according to the current conceptions (Piaget, 1978). In a similar view, Yagar, (1991) opined that constructivist teaching method helps the learner to make explorations, discover solutions to problems and making decisions, thereby connecting new knowledge to the already existing knowledge. By so doing, learners become active participants in the teaching-learning environment.

Samaresh (2017), noted in a different dimension that students exposed to constructivist model achieved higher in Sciences than those taught with traditional method. Also, Anamezie & Eze, (2015) and Akinyemi & Folashade, (2010) in their respective studies on effects of constructivist instructional approach on academic achievement established that this method of teaching is the most effective in

facilitating student's achievement in physics. From the ongoing, it could be concluded that constructivist teaching method offers the learner an opportunity to play a central role in mediating and controlling learning environment while the teacher guides and facilitates.

Another area of great concern to researchers in students' academic achievement in secondary school physics is school location. In this study, school location refers to the area where a school is sited. Schools can be located in urban areas, semi-urban or in the rural areas. Urban areas are developed cities with adequate educational facilities, infrastructures and social amenities. Rural areas, on the other hand, are undeveloped areas where these basic facilities are lacking most of the time. Considering schools that are located near noisy areas such as big markets or located very close to busy amusement or public recreational parks, one concludes immediately that such schools are bound to be affected adversely when compared with schools that are located in quiet and conducive areas. Similarly, schools that had their locations at far away, off residential areas will automatically impose some problems associated with long distance journeys such as fatigue, lateness to school, among others on both students and staff of such schools and consequently the influence will be visible on academic achievement. These therefore suggest that the areas of location of schools are likely to have either positive or negative influence on such schools.

In the views of Nworgu, Ugwuanyi & Nworgu (2013), school location which is urban-rural setting is likely to influence Physics achievement as well as other science subjects as a result of the psychosocial influence it may have on teachers and students. He noted that schools located in government reserved area, for example, cannot be compared with those located in unsuitable areas such as motor garage, plain street, noisy environment and many more others. Such factors have the potentials of influencing teaching-learning outcomes. On another development, a study carried out by Ella and Ita, (2017), on the influence of school location on academic achievement of students in secondary schools, indicated that school location has significant effect on academic achievement in favor of urban schools. In a similar way, a study on inquiry method and students' academic achievement by Opara, (2011) showed that students who were taught using inquiry method in urban schools had higher rate of achievement in biology than those in rural areas. The result also showed that method has a significant effect on students' achievement in biology as well as a positive influence on students' interest and attitude in biology.

On the contrary, Zephania, Mark & Daniel, (2013), investigated influence of school characteristics on the achievement of secondary school chemistry students in the cognitive science process skills in Kenya. The findings of the study established that the school location has no significant influence on students achievement in chemistry. Sharing the same view, Musibau and Johnson (2010) on their independent study on the influence of school sex, location and type on students' academic performance posited that school type, sex and location had no significant influence on

students' academic performance. It is this contradicting views by researchers that informed the inclusion of location

II. PURPOSE OF THE STUDY

The main purpose of the study was to investigate the interaction effects of school location and method on as a variable to be investigated in this study.

A notable area of interest to the researcher in this study is interaction effect of method and school location on the students' achievement in physics at the secondary school level. The researcher investigated what the simultaneous effect of the independent variables will have on students' achievement in Physics. It was basically on this backdrop that that this study was informed. A study carried out by Jacob and Linus, (2017) the effect of gender on senior secondary school students' academic achievement in geography in Ganye educational zone in Nigeria showed that female students exposed to learning geography through mastery learning strategy performed better than their male counterparts. Also observed was a significant interaction effect of treatment and gender on students' achievement in geography.

In the same vein, Peter (2014) investigated the effect of gender on students' academic achievement in secondary school social studies and the findings showed that gender had no significant effect on students' achievement in social studies. On the significant interaction effect, the result indicated that treatment and gender on students' academic performance in social studies with respect to method and school setting indicated varying results. In a similar way, Achor and Ogbeba (2012), studied differential effect of prior knowledge of instructional objective on some urban and rural Benue senior secondary students' achievement in biology and noted that the urban students obtained significant higher scores in biology than their rural counterparts. The result also showed that the interaction effect of method and location, on achievement was significant.

This observation agrees with Agboghroma (2015), who established from the investigation on interaction effect of cognitive styles and instructional mode on students' knowledge of integrated science, that a significant interaction effect existed between cognitive style and instructional mode on students' knowledge of integrated science. The result also showed that there was a significant interaction effect of school setting and instructional mode on students' knowledge of Integrated Science. The indication was that school setting influences students' knowledge; those students in urban schools significantly outperformed students in rural schools. The study also established that instructional mode has a significant influence on students' knowledge in favour of guide-inquiry which is activity oriented. On a related study on the influence of gender and school location on students' conceptual understanding of force and motion, Nworgu, Ugwuanyi, and Nworgu (2013) asserted that gender and the interaction of gender and school location were significant factors in students' conceptual understanding of force and motion. The result further indicated that although gender was a significant factor, its effect was not consistent across location students' achievement in secondary school Physics.

Specifically, the study determined:

1. The effect of school location on students' achievement in Physics.

2. The influence of method on students' achievement in Physics.

3. The interaction effects of school location and method of teaching on students' achievement in Physics.

Research Questions:

The following research questions guided the study.

1. What are the mean achievement scores of Physics students in the experimental group and those in the control group in Physics achievement test (PAT)?

2. What are the mean achievement scores of Physics students in urban and rural schools in Enugu education zone?

3. What are the interaction effects of school location and method of teaching on students' achievement in physics?

III. HYPOTHESES

The following null hypotheses were formulated and tested at .05 level of significance.

HO₁: There is no significant difference between the mean achievement scores of SS1 students taught basic concept of electricity using constructivist instructional method and those taught the same topic using lecture method.

HO₂: There is no significant difference between mean achievement scores of SS1 physics students in the urban schools and those in rural schools when taught with constructivist instructional method and when taught using lecture method.

HO₃: There is no significant interaction effect of school location and method on students' achievement in physics when taught with constructivist instructional method and when taught using lecture method.

IV. METHOD

In this study, the researcher adopted pretest posttest non equivalent control group. There was no randomization of the research subjects into equivalent ability groups. Instead, intact classes were used. The population for this study comprised all senior secondary school one (SS1) Physics students in Enugu education zone of Enugu state. The population of SS1 students in this Education zone 5,104.

There are three local government areas in Enugu education zone. They are Enugu North, Enugu East and Isi-uzo local government areas. The study was conducted in Enugu North and Enugu East local government areas of Enugu State. The choice of the two local government areas was based on the fact that location was a factor in the study and there was need for the areas of the study to be of different features (urban and rural). In these local government areas, Enugu North is purely urban and for Enugu East, some parts are urban while some parts are rural and the school used for the study in this area fall within the rural area of Enugu East.

The sample size used for the study was 118, of which 58 were females and 60 were males. The sample was obtained by multi-stage sampling techniques. Purposive random

sampling technique was used to draw two co-educational schools from Enugu Education Zone. Stratified random sampling was used to draw two schools, one from the urban and one from the rural areas.

The instrument used for data collection was Physics Achievement Test (PAT). PAT was a forty (40) multiple choice response items developed from Electricity concept. It had four options A-D for the research subjects to make a choice of right or wrong answer to a particular question. The instrument used for this study was face validated by three experts. One expert in the measurement and evaluation was selected and the other two were selected from Physics Education, all from Science and Computer Education of the Faculty of Education, in Enugu State University of Science and Technology, Enugu. Table of specification was used to establish the content validity. The reliability of the Physics Achievement Test (PAT) was determined using the Kuder-Richardson Formula (K-R 20) and the internal consistency index obtained was 0.76.

A pre-test was administered to all the SS1 Physics research subjects before the actual experiment. After the pre-test, the actual experiment which lasted for four weeks commenced following the normal school time table. The research subjects in both constructivist instructional method and lecture method were both given the PAT. In each school chosen, both the treatment and the control groups were taught using constructivist instructional method and lecture method respectively. Data collected were analyzed using mean with standard deviation. Analysis of covariance (ANCOVA) was used in testing the hypotheses set for the study at 0.05 level of probability.

V. RESULTS

The results are thus presented below according to research questions and hypotheses

Research Question One

What are the mean achievement scores of Physics students in the experimental group and those in the control group in Physics Achievement Test (PAT)?

Table I: Mean achievement scores of Physics students in PAT by method. n=118

	Experimental group(n=56)		Control group n=62	
	Mean	S.D	Mean	S.D
Posttest	21.96	4.15	18.39	5.52
Pretest	17.27	4.99	17.08	7.39

The result in Table I above shows that students in the experimental group that were taught with the constructivist instructional method achieved higher(21.96) than those taught with lecture method(18.39) in the control group.

Research Question Two

What are the mean achievement scores of Physics students in urban and rural schools in Enugu education zone?

Table II: Mean achievement scores of Physics students in PAT by school location.

	Urban n=59		Rural n=59	
	Mean	S.D	Mean	S.D
Posttest	23.92	3.55	16.25	6.19
Pretest	18.43	3.68	15.85	6.77

From Table II above, the result shows that the students in the urban school achieved higher than their counterparts in the rural school with a mean score difference of 7.67. In terms of variability of the mean scores, the posttest scores in either group were more stable in posttest than in the pretest. Higher stability in mean was achieved by the urban relative to the rural sub-sample.

The result for hypothesis I is shown in table 3 below.

Table III: ANCOVA Results for Students Mean Achievement Scores in Physics Achievement Test.

Source	Sum of squares	Df	Mean square	F	Sig
Gender	3.092	1	3.092	.303	.583
Location	1157.026	1	1157.026	113.473	.000
Method	491.826	1	491.826	48.235	.000
Gender * Location	3.055	1	3.055	.300	.585
Gender * Method	9.714	1	9.714	.953	.331
Location * Method	565.721	1	565.721	55.482	.000
*Method * Location*	3.409	1	3.409	.334	.564
Error	1111.413	109	10.794		
Total	52774.000	118			
Corrected total	5173.153	117			

From the results presented in table III, the probability associated with F-value of 48.235 for single main effect due to method on students' achievement in Physics was 0.000. Since this probability value was less than 0.05 level of significance set for this study, the null hypothesis was rejected. The researcher concluded that there was a significant main effect due to method on students' achievement in Physics in favour of the experimental group.

For hypothesis 2, the probability associated with F-value of 113.473 for single main effect due to location on students' achievement in Physics was 0.000. Since this value was less than 0.05 level of significance set for this study, the null hypothesis was rejected. Hence, there was a significant main effect due to location on students' achievement in Physics in favour of urban schools.

On the interaction effect of method and location, the probability associated with F-value of 55.482 was 0.000. Since this value was less than 0.05 level of significance, set for this study, the null hypothesis was rejected. Thus there was a significant ($p < 0.05$) interaction effect due to method and location on students' achievement in

Physics. This implies that method was consistent in being efficacious in enhancing students' achievement in Physics in urban and rural areas.

VI. DISCUSSION OF FINDINGS

The findings of this study indicated that the students in the experimental group that were taught using constructivist instructional method had a mean score difference of 4.69 while students in the control group that were taught with lecture method obtained a mean score of 1.31. This suggests that the students that were taught using constructivist instructional method achieved higher than those that were taught using lecture method.

On investigation using ANCOVA, the result confirms that there is a significant difference in the mean achievement scores of Physics students based on method of instruction. The finding of this study is in agreement with Samaresh (2017), who noted that students exposed to constructivist model achieved higher in Sciences than those taught with lecture method. Also, Akinyemi & Folashade, (2010) in their studies on effect of constructivist instructional approach on

academic achievement established that this method of teaching is the most effective in facilitating student's achievement in physics.

The findings of this study showed that the Physics students in the urban schools who were taught concept of electricity achieved higher than their counterparts in the rural schools that were taught the same topic. This study is in line with the findings of Opara, (2011) who reported that school location has a significant influence on academic achievement in Biology in favour of urban students. Therefore, the assertion of Zephania, Mark and Daniel (2013) that location has no significant influence on academic achievement is not accepted with respect to the findings of this study. From the result obtained, the researcher concluded that location has a positive influence on the Physics achievement of students in favour of urban school.

On the interaction effect of method and location, the findings of this study established that there is a significant interaction effect between location and method on Physics achievement. The findings of this study is in perfect agreement with Achor & Ogbeba (2012) who reported from their study that urban students obtained a significant higher scores in Biology than their rural counterparts. The findings also indicated that interaction effect between method and location was statistically significant. The result of this present study is also in line with (Agboghroma, 2015) whose findings indicated a significant interaction effect of school setting and Instructional mode. The study also conforms with Jacob & Linus (2017) who reported that a significant interaction effect existed between gender and academic achievement.

On the other hand, the findings of this present study is partly in agreement with Nworgu, Ugwuanyi and Nworgo, (2013) who investigated the influence of gender and school location on students' conceptual understanding of force and motion. The results indicated that there was a significant interaction effect due to gender and location in the students' conceptual understanding of force and motion. The result further showed that this interaction effect was not consistent across the levels of location.

The results from the studies reviewed showed inconsistencies on interaction effect of method and location. This implies that there is need to carry out more researches on the interaction effect of method and location.

VII. CONCLUSION

From the results of this study, the researcher made the following observations and conclusions: That the use of constructivist Instructional method enhanced students' achievement in physics and that location had a significant influence on academic achievement of Physics students in favour of urban schools. There is a significant interaction between instructional method and location on students' achievement in Physics.

VIII. RECOMMENDATIONS

In view of the findings of this study, the following recommendations have been made:

1. Constructivist instructional method is

recommended to science teachers and in particular Physics teachers for use in teaching students.

2. Government and school authorities should provide adequate facilities to rural schools for effective teaching and learning.
3. From the existing literature, it was observed that studies on interaction effect of location and method has not received adequate attention. It is therefore recommended that more studies be carried out on this area.

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