

EFFECTS OF CONSTRUCTIVIST CLASSROOM APPROACH ON ACADEMIC ACHIEVEMENT IN BIOLOGY AMONG SECONDARY SCHOOL STUDENTS IN ILORIN METROPOLIS

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Abstract

The study investigated the effects of constructivist classroom approach on students' achievement among Secondary School Biology students in Ilorin metropolis of Kwara state. The study adopted a pre-test, post-test, non-randomized quasi experimental design. The target population comprised 11,465 Senior Secondary two (SSII) Biology students of 2017/2018 session in Ilorin metropolis. A total number of one hundred and seventy-nine (179) students from two co-educational schools was sampled for the study. Ninety four (94) students served as experimental group while 85 served as the control group. One research instrument was used for the study: Biology Achievement Test (BAT). The instrument was validated by two Biology education experts from the Department of science education Federal University of Technology Minna, Niger state. The BAT was pilot tested using the split half method with similar samples within the population of study and the reliability coefficient of 0.77 was obtained using Person Product Moment Correlation Coefficient (PPMC). Two research questions were answered and two null hypotheses were tested at 0.05 levels of significance. Analyses of data was carried out using Analysis of Variance (ANOVA). The result obtained showed that there was significant effect of the treatment on students' achievement between the experimental and control groups ($F_{cal}(1,177) = 153.22, p < 0.05$). Gender had no significant effect on students' achievement in the experimental group ($F_{cal}(1, 92) = 0.174, p > 0.05$). It was recommended that, Biology teachers should deploy the constructivist classroom approach in teaching Biology concepts in order to enhance students' achievement.

Keywords: Constructivist classroom approach, Achievement, Gender, Ecology

Introduction

Constructivism is a theory of learning based on the idea that knowledge is constructed by students based on mental activity. Constructivism is founded on the premise that, by reflecting on our prior experiences, we construct our own understanding of the world consciously live in. Each student has capacity to generate their own "rules" and "mental models," which students use to make sense of their experiences. Therefore, constructivism is simply the process of adjusting our mental models to accommodate new experiences (Jonassen & Land, 2012). Constructivists are of the opinion that learners interpret new experiences in the light of the already existing knowledge or experiences. The constructivist model therefore consists of teaching methods that foster learner's active participation during teaching and learning episode. Nwafor (2007) described constructivism as a theory that rests on the innate human drive to make sense of the world.

Offorma (2009) posited that the learner should not be spoon fed, instead, the learner should be left to discover solutions by him/herself. He further asserts that the message becomes effective when teaching rules and procedures involve active participation of learners which stimulates their imagination, provoke and guide learners' thinking. Constructivism approach is a reaction to didactic approaches such as behaviourism and programmed instruction,

constructivism states that learning is an active, contextualized process of constructing knowledge rather than acquiring it. Knowledge is constructed based on personal experiences and hypotheses of the environment (Audrey, 2014).

Constructivism approach is a student-centered approach and a total shift from the teacher lead conventional or traditional approach of teaching. The teacher is a facilitator in a constructivists' class where classroom activities are organized so that students can interact with and learn from each other as well as the teacher and the world around them. It is an arrangement in which students work in mixed ability groups and are rewarded on the basis of the success of the group as a whole (Stavin, 2000). The students therefore are able to learn more of what is taught and retain it longer than when the same content is presented in other instructional formats. Constructivists' learning has been found to improve students' performance (Hagen, 2000; Paulson, 1999), increase students' motivation (Paino, 2001), students' social skills and increase students' satisfaction (Lord, 2001). Constructivists' strategy enables students to interact among themselves exchange ideas compete and make use of all the five senses. Constructivism is purely students centered and a total departure from the teacher-centered conventional method. Therefore, it is very important to allow students to reflect their own ideas, prepare an environment giving them a chance to discuss their learning with other students and their teachers (Sagam & Millar, 2006). Teachers must do more than just to teach students, they must direct students to have the ability to become increasingly self-dependent, self-directed and depend less on others. The main focus of the strategy is that by participating in constructivists' style, students are able to learn concepts, processes and can present material while working directly under the supervision of the classroom teacher who is the facilitator.

The teaching approach in the Biology lessons in secondary school classrooms seems boring and uninteresting due to the abstract nature of the subject. This is particularly true when one considers that the conventional method are predominantly in vogue. Notwithstanding the call for the use of modern approach in the form of constructivist view, many teachers still use the conventional approach. The question is: Can constructivist teaching model make a significant difference in the achievement of secondary school Biology students? Moreover, as interest in a subject has been identified as correlating positively with achievement in such a subject, can constructivist teaching model produce a significance difference in academic achievement of secondary school Biology students?

Academic achievement is the degree of success attained by students after being exposed to one form of learning or the other. Jimoh (2014) corroborated that academic achievement is the level of success attained by student in school subjects. In other words, it is the degree of success reached in some general or specific area of study. Academic achievement is the success achieved by students in some general or specific area of study or field work (Ezenwosu & Nworgu, 2013; Enyi, 2014).

In the review of empirical studies on effectiveness of constructivist approach on students' academic achievement, Oludipe (2012) evaluated the effectiveness of constructivist-based teaching strategy on academic performance of students in integrated science and found that the approach enhance academic achievement. Duyilemi and Bolajoko (2014) found that constructivists' learning strategies enhance students' achievement in biology in the area of arthropods with male students performing better than the female students. Uwalaka and Offorma (2015) reported that constructivist teaching method had no influence on students' achievement in French listening comprehension. Helen (2017) in another study investigated the effects of engaging learners with Constructivist-Based Instructional Model (CBIM) for achievement and self-concept in Biology in a learner-centered Science classroom. Findings

from the study showed that learners taught with Constructivist-Based Instructional Model (CBIM) had higher achievement in the researcher-made Biology Test than those taught using traditional method. The findings further revealed that constructivist model is not gender selective. Esther and Nkoyo (2015) indicated that there is no significant interaction between gender difference and treatment in terms of students' understanding when taught with constructivist approach.

Gender as a moderating variable will also be investigated in this research. Gender is the range of physical, biological, mental and behavioural characteristics pertaining to masculinity and femininity and which also differentiate between, masculinity and femininity (Martel 2013). Researchers have different view on the influence of gender on academic performance, while some are of the opinion that gender has no influence on academic performance, others believe that gender influences academic performance. There is need for comparison of gender issues in order to support or against propositions and assumptions on educational matters.

Parents, teachers and stakeholders are increasingly uncomfortable with persistent underachievement of students in biology and the need to cope with the demands of the industrial 21st century information society. Nigeria needs citizens who are well informed scientifically to meet up the challenge of nation building. However, the approach used in instruction (teaching methodology) by teachers has not been encouraging. This can be seen from students' examination performances in both internal and external examinations

Although, several studies have been carried out in order to find ways of improving the teaching and learning of Biology, yet, the inadequacy of laboratories facilitates, - teaching materials, inadequately trained teachers and poor instructional delivery approach have impacted on the educational enterprises resulting in persistent unsatisfactory performance in Senior Secondary Certificate Examination (SSCE). In addition, the chief examiner in 2011 addressed the use of actively student centered method of instruction such as collaborative constructivism teaching method advocated by Nwachukwu and Nwosu (2010) in order to improve students' academic performance in Biology. The Chief examiner of WAEC also reported in 2015 that performances of Biology students were unsatisfactory and recommended that activity-based method of instruction be used in teaching Biology. Therefore, this study was carried out to investigate the effect of constructive classroom approach (collaborative constructivism) on the academic achievement of students in Biology.

Research Questions

The following research questions were formulated to guide the study:

- (i) What is the difference in achievement of students taught Biology with constructivist classroom approach and those taught with lecture method?
- (ii) Is there any difference in academic achievement of male and female students taught Biology with constructivist classroom approach?

Research Hypotheses

The following null hypotheses were tested at 0.05 alpha level:

HO₁: There is no significant difference in the academic achievement of students taught Biology using constructivist classroom approach and those taught using lecture method

HO₂: There is no significant difference in the academic achievement of male and female students taught Biology using constructivist classroom approach.

Methodology

The research design used is the quasi-experimental design; pre-test post-test non-equivalent experimental and control groups design. Fraenkel and Wallen (2003) defined quasi-experiment designs as designs that do not include the use of random assignment. It is an empirical study used to estimate the causal impact of an intervention on its target population without random assignment. This study used the constructivist classroom approach as an independent variable which effect were observed on two dependent variables; Academic achievement on ecology concept in Biology.

The total population of study comprised 11,465 Senior Secondary two (SS II) Biology students of 2017/2018 academic session from all 73 senior secondary schools in Ilorin metropolis in Nigeria. (Source: Kwara State MOE and Human Cultural Development December 2017). A total sample of 171 students offering Biology in 2017/2018 academic session were selected from two senior secondary schools within the population of study. A three-stage sampling technique was used for the selection; Purposive sampling techniques was used in selecting the schools. Firstly, the schools were purposively sampled based on research requirement (co-educational schools). In the second stage, simple random sampling technique (hat-draw method) was used to assign the selected schools into the two groups (experimental group & control group) lastly, two intact classes each were randomly selected from all arms of senior secondary school two offering Biology in already selected schools to enable researcher have a representative sample.

The research instruments used for the study is Biology Achievement Test (BAT). The BAT has 25 questions and the scores were converted to 100%. That is, 4 marks for each question with options A-D and students are expected to select one options (correct option). The instrument was designed (prepared) by the researcher and was guided by Essential Biology text book for Senior Secondary by Michael (2017). The instruments were administered to the Experimental and Control groups as pre-test. The test instruments were shuffled and administered as post-test for the purpose of collecting achievement data.

The face, construct and content validity of the research instruments were established by two specialists in the field of Biology education from the science education department of Federal University of Technology, Minna, Niger State. Based on the feedback, required corrections were effected on the organization of the activity plans, lesson plans and achievement tests. To determine the reliability of the BAT, a pilot study was carried out with a similar group within the population of the study. Split-half method was used. The instruments were shared into groups. That is odd and even based on their numbering before administration. The two groups were then compared for reliability using Pearson Moment Correlation Coefficient (PMCC). Based on this analysis, the reliability coefficient of 0.77 was obtained which was considered highly reliable.

The study lasted for a period of six (6) weeks, within this period, treatment was carried out and data were collected. Experimental group (Constructivist Classroom Approach) and control group were pre-tested on ecology which is the content scope for the study in order to ascertain the level of equivalence of both groups before the commencement of the experiment, treatment was administered in the second and third week followed by post-test in the sixth week. For Control group (convectional teaching method), teaching also commenced in the second week, by the end of third week, the teaching was concluded and post-test was given at the beginning of the sixth week. The pre-test and post-test scripts were collected and marked, the scores obtained from the students were subjected to data analysis.

The Constructivist Classroom Activity Plan (CCAP) was used for purpose of instruction of ecology concepts for the experimental group as intervention (treatment). The class was student-cantered and activity-based. After the introduction, students were divided into three groups with the topics divided as well as assigned to each group. Students were required to conduct a library research on topics given to their groups and come up with presentations, formulate questions/problems, and procedures to test the questions/problems. In other words, the students were the scientists in the classroom.

Each group made presentations on the topics given to them while the researcher's role was to ensure students are guided, hence, correct wrong information and complete incomplete information on the topics presented. Questions were asked after each presentation. Biology teacher of the class assisted in monitoring students during the process while conventional teaching method was used to teaching the control group ecological concepts which were selected from the senior secondary school two (SSII) Biology syllabus and scheme of work. Descriptive statistics were used to answer the research questions raised, furthermore, the null hypotheses raised were subjected to inferential statistics which is Analysis of Variance (ANOVA). Statistical Package for the Social Sciences (SPSS) was used to analyse the data and decisions to reject or accept the P-value computation was set at 0.05.

Results

Research Question One: What is the difference in achievement of students taught Biology with constructivist classroom approach and those taught with lecture method?

Table 1: Pre-test and post-test mean (\bar{X}) and standard deviation (SD) of experimental and control groups

Group	N	Pre-test		Post-test		\bar{X} Gain	\bar{X} Diff
		\bar{X}	SD	\bar{X}	SD		
Experimental	94	42.38	13.57	80.68	8.87	38.30	11.52
Control	85	43.01	13.74	69.79	11.49	26.78	

Table 1 reveals that both experimental and control groups recorded low scores at the pre-test level, Experimental group had Mean (\bar{X}) achievement score of 42.38 with Standard Deviation (SD) of 13.57 while the control group had Mean (\bar{X}) achievement score of 43.01 with Standard Deviation (SD) of 13.74. The table further revealed that students taught Biology using constructivist classroom approach had Mean (\bar{X}) achievement score of 80.68 with Standard Deviation (SD) of 8.87 while the students taught Biology using lecture method recorded a Mean (\bar{X}) achievement score of 69.79 with Standard Deviation (SD) of 11.49 at the post test level. The table further shows that the experimental group recorded higher Mean (\bar{X}) gain score of 38.30 while the control group had 26.78. Students taught Biology using constructivist classroom approach therefore performed better than their counterparts taught Biology using lecture method with the Mean difference of 11.52.

Research Question Two: Is there any difference in academic achievement of male and female students taught Biology with constructivist classroom approach?

Table 2: Mean (\bar{X}) and Standard deviation (SD) of male and female students at pre-test and post-test in the experimental group only

Group	N	Pre-test		Post-test		(\bar{X}) Gain	(\bar{X}) Diff
		\bar{X}	SD	\bar{X}	SD		
Male	49	43.59	13.47	81.06	9.76	37.47	1.73
Female	45	41.07	13.71	80.27	8.56	39.20	

Table 2 shows the Mean (\bar{X}) achievement score of male and female students at pre-test and post-test levels. The table shows that Male students had Mean (\bar{X}) gain of 37.47 while the female students recorded Mean (\bar{X}) gain of 39.20 after post-test. There is a Mean (\bar{x}) difference of 1.73 between the achievement scores of male and female students taught Biology using constructivist classroom approach. This implies that there is no much difference in the Mean achievement scores of Male and female students exposed to constructivist classroom approach.

Pre-test Analysis

Pre-test Analysis of scores obtained before treatment of the experimental and control groups with constructivist classroom approach and traditional method (lecture method) of instruction on the concepts of ecology in Biology. Analysis of variance (ANOVA) was used to establish whether there is homogeneity or not between the comparison groups of the study.

Table 3: Analysis of variance (ANOVA) results of the pre-test scores

Source of Variation	Sum of square	df	Mean Square	f-value	p-value
Between groups	17.65	1	17.65	0.95 ^{ns}	0.759
Within Groups	32999.20	177	186.44		
Total	33016.85	178			

NS: Not significant at 0.05 level.

The result of table 3 on pre-test scores of experimental and control groups showed that $F_{cal}(1,177) = 0.95$, $P > 0.05$. There is no significant difference between the two groups. Therefore, both the experimental and control groups are equal (homogenous) before they were exposed to the teaching methods.

Testing of Hypotheses

Ho₁: There is no significant difference in achievement of students taught Biology using constructivist classroom approach and those taught using lecture method.

Table 4: Analysis of variance (ANOVA) result of post-test achievement scores on experimental and control groups

Source of Variation	Sum of square	df	Mean Square	f-value	p-value
Between groups	15932.28	1	15932.28	153.22 *	0.000
Within Groups	18404.61	177	103.98		
Total	34336.89	178			

*Significant at 0.05 level.

Table 4 shows the ANOVA comparison of post-test scores of experimental and control groups. The table showed a significant difference in academic achievement of students taught Biology using constructivist classroom approach and those taught with lecture

method $F_{cal}(1,177) = 153.22$, $p < 0.05$. The difference was in favour of experimental group. Therefore, the null hypothesis was rejected which meant that there is significant difference between students that received instruction with constructivist approach and those that were taught with traditional method. This implies that constructivist classroom approach improves students' achievement in Biology.

Ho₂: There is no significant difference in academic achievement of male and female students taught Biology using constructivist classroom approach.

Table 5: Analysis of variance (ANOVA) of post-test achievement scores of male and female students exposed to the constructivist classroom approach

Source of Variation	Sum of square	df	Mean Square	f-value	p-value
Between groups	14.809	1	14.809	0.174 ^{ns}	0.677
Within Groups	7813.616	92	84.931		
Total	7828.426	93			

NS: Not significant at 0.05 level.

Table 5 shows the ANOVA comparison of post test scores of male and female students exposed to the constructivist classroom approach. The table revealed that there is no significant difference between the male and female students of the experimental group only $F_{cal}(1, 92) = 0.174$, $p > 0.05$). The null hypothesis was therefore not rejected which meant that there was no significant difference in their Biology achievement after been exposed to constructivist classroom approach. This implies that constructivist classroom approach is gender friendly.

Discussion

The result from this finding showed that students taught Biology using constructivist classroom approach achieved significantly better than the students taught using lecture method ($F_{cal}(1,177) = 153.22$, $p < 0.05$). By implication, constructivist classroom approach had a positive effect on students taught ecology concepts in biology. This finding agrees with the findings of Oludipo (2010), Duyilemi and Bolajoko (2014) and Helen (2017) who in their individual studies discovered that students taught with constructivist approach performed better than those taught with conventional approach. However, the finding of this study negates the findings of Uwalaka and Offorma (2015) whose study showed that there is no significant difference in the mean achievement scores of students taught listening comprehension using constructivist method and those taught with the traditional method.

The analysis on influence of gender shows that there is no significant difference ($F_{cal}(1, 92) = 0.174$, $p > 0.05$) on students' academic achievement in Biology of male and female students exposed to constructivist classroom approach. This finding is in consonance with Helen (2017) and Esther and Nkoyo (2015) who indicated that there is no significant difference attributed to gender in terms of students' understanding when taught with constructivist approach. However, the findings of this research negates the findings of Duyilemi and Bolajoko (2014) who indicated that Male students had higher Biology achievement score than their female counterparts when exposed to constructivist learning approach.

Conclusion

The results of this study confirmed the effectiveness of the Constructivist Classroom Activities on academic achievement of students in Biology. It helps students in development

of scientific thinking, because the learner is given the opportunity to practice thinking skills such as: observation, description, classification, and the conclusion, in addition to developing hypotheses and testing them. It also gives students opportunity to debate and discuss with colleagues and mentors; which helps them receive training on these skills and master them. Constructivist Classroom Activities are of different stages: Exploring stage where learners perform a variety of activities such as collecting data and information, explanation stage which includes proposing solutions and testing the validity of these solutions and decision-making where learners reach the appropriate solution to the problem and implement it which leads to the formation of new cognitive constructivist and applying what they have learned in new situations. The results also showed that there are no differences regarding students' academic achievement attributed to the gender which indicated that the use of constructivist classroom approach does not discriminate between genders.

Recommendations

The following recommendations were made based on the findings of this study:

- (i) Biology teachers should be encouraged to use constructivist method of instruction, since the method is more effective and gender friendly in learning Biology compared to lecture method that most teachers are currently using in order to improve students' achievement in Biology and enhance gender equality in Biology achievement.
- (ii) School administrators should be encouraged to improve on management of academic programmes by providing necessary facilities required for instructional purposes specifically variety of text-books, apparatus and equipment for practical lessons to promote constructivist methods of learning.

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