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Effects of Experiential and Generative Learning Strategies on Students' Academic Achievement in Environmental Concepts

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ABSTRACT This study was carried out to determine the relative effects of Experiential Learning Strategy (ELS) and Generative Learning Strategy (GLS) on students' academic achievement in environmental concepts in biology. The moderating effects of gender and mental ability were also examined. The study adopted pretest-posttest, control group, quasi-experimental design. A total of 439 sample involved in the study were randomised to ELS, GLS and Control groups. Instruments used include Biology Achievement Test (BAT) and Instructional guides on ELS, GLS and Conventional Strategy. Treatment had significant main effect on students' achievement score ($F_{(2,410)}$ =522.20, η^2= 0.718). Participants in ELS had highest achievement scores ($\bar{x}$=20.14) than those in GLS ($\bar{x}$=17.69) and control ($\bar{x}$=5.59). There was a significant main effect of mental ability on students' academic achievement in environmental concepts ($F_{(2,410)}$ =5.6, η^2=0.22). Students with high mental ability had higher adjusted score ($\bar{x}$=17.55) than those with low mental ability ($\bar{x}$=13.60). Both experiential and generative learning strategies enhanced students' achievement in environmental concepts.

INTRODUCTION

The dismal performance of secondary school students both in internal and external examinations in recent years has attracted a great deal of attention from scholars, researchers, experts and academics alike (Adeyemi 2006; Akiri et al. 2009; Ahmad et al. 2010; Fakude 2012; Josephat 2013; Okebukola 2014). The West African Schools Certificate Examination (WASCE) results over the years have not been impressive. Students have been consistently performing very poorly particularly in biology (Abimbola 2013; Agboghoroma and Oyovwi 2015; Lebata 2014; Ngesu et al. 2014). An analysis of WASCE results in biology shows a less than average credit pass performance between 2002 and 2012.

For example, in 2002, only 278,112 out of 882,119 students passed at credit level which is 31.5 percent. In 2003, it jumped up to 44.2 percent but descended to 24.7 percent in 2004. Year 2006 seems to make certain improvement with 559,854 students out of 1,152,045 which is 48.6 percent pass. Since then, the situation has remained the same.

Several factors have been identified to be responsible for students' poor academic performance in examinations, biology inclusive. These include teachers' negative attitude to work, use of inappropriate teaching methods, failure to accomplish teaching tasks, students' lackadaisical attitude to study, infrastructural decay and lack/inadequate instructional materials in schools amongst others (Ahmad et al. 2010; Akiri et al. 2009; Fakude 2012; Josephat 2013; Ofoegbu 2004; Oredein 2000). The findings of the works carried out by (Agboghoroma and Oyovwi 2015; Gbore and Daramola 2010; Lebata 2014; Ngesu et al. 2014) revealed that despite all the efforts made at improving students' performance in the subject, the level of achievement is still very low. It is therefore necessary to investigate how to improve the achievement of students in Senior Secondary Certificate Examination in biology. It is against this backdrop that the present study concerns itself with experimenting on other methods of teaching (Experiential and Generative learning strategies) to see if these would bring about improvement on students' academic achievement in biology.

Experiential learning activities have been developed to improve students' achievement. Researches carried out by Jegede and Okabwkala (1991) and Jolaoso (2012) revealed that students

benefit through experiential learning in their science classes by motivating students to contribute to their group, by learning cooperation skills and through enhanced self-esteem, more than using any other method that will not involve the learners in the teaching-learning activities. Kolb (2005) observed that: "The more open–ended and non-formulaic an assignment is, the more likely students will rely on their own experience and reflection and immerse themselves in the topic". This means that learning by self-experience gives unlimited achievement in any course of study and more particularly in science, of which Biology is one. House (as cited in Adeoye 2007) found out in his work that more frequent use of experiential learning strategy during science lessons was significantly correlated with higher student achievement in science. Scott (2006) emphasized that most environmental degradation programs are real-life in nature and should be experiential with students writing about what they learned, how they applied it and how they can become a better employee. Kolb and Kolb (2012) experiential learning theory also aligns with Scott's (2006) in that experiential learning and real life learning are mutually supportive. While the nature of environmental degradation program is similar throughout the country, the inclusion of experiential learning techniques all through the students' learning experience can provide significant benefit according to Kolb and Kolb (2012). Many environmental educators endorse the application of theoretical knowledge in a laboratory or environmental degradation setting as representing an experiential base that provides students with diverse learning opportunities and experiences. Duyilemi (2006) stated that experiential learning aligns with constructivism which posits that learners construct meanings from their experiences.

Generative learning strategy is one major strategy that helps the learners improve their cold attitude towards biology in particular, and science in general. Introductory science courses such as biology, chemistry and earth science are usually required in our learning institutions so as to improve the general attitudes of learners toward science (Faralhnaz 2012). In order to make these science courses meaningfully taught, there is a need for the learners to be allowed to generate meanings from events. Generative learning strategy posits that learners also have facts to give, expressions to make and should therefore be given opportunity and freedom to express their minds and give their personal opinion about the subject matter being discussed. The instructor here just has to accept the feeling of his students, appreciate the contributions of the learners, acknowledge and guide the ideas of the students. He also guides factual information by asking the students stimulating questions that can enhance their participation.

Conventional Strategy is the oldest method of teaching used in most Nigerian schools. It is a traditional 'talk-chalk strategy. The teacher "gives out" the facts to the students and the students in turn listen and digest the knowledge (Osborne et al. 2003). Adesoji (2004) and Olagunju (2006) have identified lack of infrastructural facilities, over-loaded curriculum, lack of training programmes/workshops and lack of skills in handling difficult concepts as reasons why teachers refuse to embrace new learning strategies.

Gender influence on academic achievement and skills acquisition has generated much concern among researchers. There have been different results for gender performance on students' achievements and practical skills acquisition, with boys demonstrating higher ability skills in some tasks (Okeke 2002); and girls performing better than boys in practical skills (Awoderu 2012). However, Oduwaiye (2009) and Lock (2007) found no gender related difference in students' achievement in acquisition of practical skills. Therefore, this lack of consensus on the influence of gender on learning outcomes makes further investigation imperative.

Mental ability has been found to influence performance of students in several subjects, Biology inclusive (Olagunju and Chukwuka 2008). The global objective guiding the consideration of mental ability test is that the test has the capacity to discriminate between high and low ability participants. Adekunle (2005) found that the relationship between certain capabilities of mental ability measured by academic performance of learners and intelligence test is significant. Furthermore, he found that the performance needed on a number of mental ability tests such as, ability to apply knowledge to solving problems, ability to manipulate abstract concepts and relationships and test of language competence are linked to performance in school learning. Besides, measurement of cognitive skills is a

measure of mental ability of students. Similarly, as cited by Jolaoso (2011) and Adekunle (2005), it was asserted that knowing the intelligence level of learners will to a greater extent, determine how much the learner will achieve from a learning process or acquisition of skills.

Theoretical Framework

This study is underpinned by Kolb's (1984) experiential learning style theory. Kolb (Mcleod 2013) described learning as the process whereby knowledge is created through the transformation of experience, and that learning involves the acquisition of abstract concepts that can be applied in a range of situations. He believed that the urge for the development of new concepts is provided by new experiences. Kolb identified four stages in his learning cycle as:

Concrete experience (a new experience of situation is encountered, or a reinterpretation of existing experience); ***reflective observation*** (of the new experience, of particular importance are any inconsistencies between experience and understanding); ***abstract conceptualisation*** (reflection gives rise to a new idea, or a modification of an existing abstract concept); ***active experimentation*** (the learners apply them to the world around them to see what results).

According to Kolb (1984) effective learning results when a person passes through the four stages of having a concrete experience, followed by observation of and reflection on that experience, which leads to the formation of abstract concepts (analysis) and generalizations (conclusions), which are then finally used to test hypothesis in future situations, resulting in new experiences. Based on his four stages of learning, Kolb and Fry (1974) identified four learning styles. These learning styles according to Mcleod (2013) include:

Diverging (feeling and watching - CE/RO)

Here, people are able to look at things from different perspectives. They are sensitive. They prefer to watch rather than do, tending to gather information and use imagination to solve problems. They are best at viewing concrete situations at several different viewpoints. Kolb called this style 'diverging' because these people perform better in situations that require ideas-generation, for example, brainstorming.

Assimilating (watching and thinking - AC/RO)

The Assimilating learning preference is for a concise, logical approach. Ideas and concepts are more important than people. These people require good clear explanation rather than practical opportunity. They excel at understanding wide-ranging information and organizing it in a clear logical format.

Converging (doing and thinking - AC/AE)

People with a converging learning style can solve problems and will use their learning to find solutions to practical issues. They prefer technical tasks, and are less concerned with people and interpersonal aspects. People with a converging learning style are best at finding practical uses for ideas and theories. They can solve problems and make decisions by finding solutions to questions and problems.

Accommodating (doing and feeling - CE/AE)

The Accommodating learning style is 'hands-on', and relies on intuition rather than logic. These people use other people's analysis, and prefer to take a practical, experiential approach. They are attracted to new challenges and experiences, and to carrying out plans.

However, knowing one's learning style enables learning to be organised according to the preferred method. But everyone needs the stimulus of all types of learning styles to one extent or another. It is a matter of using emphasis that fits best with the given situation and a person's learning style preferences. Consequently, teachers are encouraged to ensure that activities are designed and carried out in ways that offer each learner the chance to engage in the manner that suits them best. Also, individuals can be helped to learn more effectively by the identification of their preferred learning styles and the strengthening of these through the application of the experiential learning cycle (Mcleod 2013).

Statement of the Problem

This research work was carried out to determine the effects of experiential and generative learning strategies on students' academic achievement in environmental concepts in Biology, in Oyo State. The study also investigated

the moderating effects of gender and mental ability of the students.

Purpose of Study

The study is part of continuous search for effective learning strategies capable of improving students' academic achievement in general and in biology in particular.

Objectives

The specific objectives of the study include:

- To determine the relative effects of experiential and generative learning strategies on students' achievement in environmental concepts in biology.
- To investigate the effects of gender on students' academic achievement.
- To examine the effects of mental ability on students' academic achievement.

Hypotheses

The following null hypotheses were formulated and tested in this study:

Ho1: There will be no statistically significant main effects of treatments on students' academic achievement in environmental concepts.

Ho2: There will be no statistically significant main effects of gender on students' academic achievement in environmental concepts.

Ho3: There will be no statistically significant main effects of mental ability on students' academic achievement in environmental concepts.

All hypotheses were tested at 0.05 level of significance.

METHODOLOGY

The study adopted pre-test-post-test control group, quasi-experimental design with a 3x2x3 factorial matrix. The study population consisted of all the Senior Secondary School Students in three Local Government Areas (LGAs) in Oke-Ogun area of Oyo State. Random sampling was used in selecting the three Local Government areas. Purposive sampling was used to select nine Senior Secondary School (SSS) across the LGAs, while the intact class of Senior Secondary Students One (SS I) was used to select sample for each of the schools involved in the study. The experimental schools were randomly assigned to treatment conditions of Experiential and Generative Learning Strategies and the Control group. The experiential learning strategy group consisted of 146 participants, the generative learning group had 141 participants, while the control group was made up of 152 participants. In all, a total of 439 participants took part in the study that lasted 12 weeks.

Instruments

The instruments used for the study include both testing instruments (i and ii) and stimulus instruments (iii –vi):

i. Students Biology Achievement Test (SBAT)
ii. Mental Ability Test (MAT)
iii. Instructional Guide on Experiential Learning Strategy (IGELS)
iv. Instructional Guide on Generative Learning Strategy (IGGLS)
v. Instructional Guide on Modified Conventional Strategy (IGMCS)
vi. Evaluation Sheet for Assessing Teachers (ESAT)

Students Biology Achievement Test (SBAT)

SBAT was designed to measure the students' performance in specific environmental concepts in Biology. The instrument is in two sections - A and B. Section A has to do with the personal data of the respondents while section B elicits responses from the students on selected topics for the study. The test was initially made up of forty-five items, which were later reduced to thirty-six by experts in measurement and evaluation and science education, while validation after the pilot study reduced the number of items to twenty-five.

The table of specification for SBAT is shown in Table 1.

Validation of Students Biology Achievement Test (SBAT)

SBAT was given to experts in the department of teacher education (Biology), measurement and evaluation and environmental education to assure both the face and content validity. Only the 25 items out of 45 that survived the various stages of validation were retained in the

Table 1: Table of specification for SBAT

Concepts	*Knowledge*	*Comprehension*	*Application*	*Analysis*	*Synthesis*	*Evaluation*	*Total*
Pollution	2 (1.9)	2 (2,4)	2 (3,5)	2 (11,13)	1 (8)	2 (6.7)	11
Ecology	-	1 (16)	1 (10)	-	-	1 (12)	3
Conservation of natural resources	2 (17.21)	1 (18)	1 (19)	-	1 (15)	1 (14)	6
Population	1 (25)	2 (20.23)	1 (24)	1 (22)	-	-	5
Total	5	6	5	3	2	4	25

Source: Adeyemi and Aworele (2015)

questionnaire. The reliability index was calculated to be 0.74, using Kuder Richardson formula 20 (KR_{20}).

Mental Ability Test (MAT)

This test was administered to discriminate between high and low ability participants. The obtainable mark is 100 percent. Students who scored 60 percent and above were grouped into high mental group; 40 percent to 59 percent were assigned to medium ability group while students who obtained less than 40 percent were placed in low mental ability group

Validation of Mental Ability Test (MAT)

The instrument was validated using Alternate/Parallel forms of reliability. The test was validated to ascertain its suitability for the study. The alternate/parallel forms of reliability gave the reliability value of 0.86, which was considered high enough to be used for the study.

Instructional Guides

Instructional guides were developed and validated for each treatment conditions. These were meant to guide the experimental teachers (research assistants) in the implementation of the experiment. Evaluation Sheet for Assessing Teachers (ESAT) was also developed to assess the experimental teachers (research assistants) during training and in the course of the experiment in order to ensure they are doing the right thing.

Treatment

The study involved two experimental and one control groups. Each of the groups consisted of male and female students of varying mental abilities, (high, medium and low). Each group was exposed to the instructional strategy designed for its treatment. The first week was used for the administration of the Student Biology Achievement Test (SBAT) as pre-test and the Mental Ability Test (MAT) to classify the students into different mental ability groups across the groups, while the last week was devoted to the administration of the SBAT as posttest, leaving the remaining ten weeks for the experiment proper. Following are the treatment guide for each of treatment conditions

Experiential Learning Strategy (Experimental Group 1)

Step I: **Introduction and grouping of students:** The teacher introduces the lesson and divides the students into specific groups for activities

Step II: **Concrete experience:** Presentation of materials: Students follow instructions as the teacher presents materials to work with.

Step III: **Reflective observation:** Students relay their previous experience on each concept/topic.

Step IV: **Abstract conceptualization:** Students are exposed to new learning or experience through measurements, observation, manipulation of apparatus etc.

Step V: **Active experience:** Students ask questions based on the differences and similarities between their previous and new experiences

Step VI: **Conclusion and application:** The students are guided to provide correct answers to the questions raised.

Step VII: **Summary:** Students put down notes and the teacher goes through to mark.

Generative Learning Strategy (Experimental Group 2)

Step I: **Introductory phase (Introduction and grouping of students):** The teacher puts the students into small groups for activities.

Step II: **Focusing phase:** Students follow instructions as the teacher presents materials to work with.

Step III: **Activity phase:** Students manipulate apparatus as each group was given different materials on each topic each week.

Step IV: **Discussion period:** Students ask questions based on their observations and record.

Step V: **Application phase:** Students generate knowledge from observation. This is to be done on group basis.

Step VI: **Conclusion:** A representative from each group presents new knowledge to the entire class.

Step VII: **Summary:** Group differences among the students' opinion are reconciled.

Modified Conventional Teaching Method (Control Group)

Step I: **Introduction of the new concept:** The teacher introduces the new concept by asking questions on relevant previous knowledge. The teacher does all the talking and /or all the activities while the learners passively listen and watch the teacher.

Step II: **Presentation of lesson:** The teacher teaches the new concept as the learners listen to the teacher.

Step III: **Formative evaluation stage:** The teacher asks questions on the concepts discussed.

Step IV: **Conclusion:** The teacher concludes the lesson by marking learner's notes.

Step V: **Summary:** The teacher gives the summary of the whole lesson on the chalkboard and allows the students to copy the summary.

Step VI: **Application phase:** The students are guided to make necessary applications from the lesson taught.

Step VII: **Assignment:** The teacher gives the students assignment.

Data Analysis

Data were analyzed using Analysis of Covariance (ANCOVA). This was to determine group differences, using the pre-test scores as covariates. Estimated Marginal Mean (EMM) was used to find out the magnitude of the differences in the various groups where there is significant effect. To determine the actual source of the significant differences, Scheffe Post hoc test was performed on the mean scores of the groups. All the hypotheses were tested at $P< 0.05$ level of significance.

RESULTS

$H_0$1: There will be no statistically significant main effect of treatment on students' academic achievement in environmental concepts

From Table 2, the result shows that there was significant main effect of treatment on students' posttest academic achievement in environmental concepts. ($F_{(2,410)} = \mathbf{522.200}$, $p < .05$, $\eta^2 = 0.718$). Therefore, on the basis of this result, hypothesis 1 was rejected. Beta square of 0.718 implies that treatment contributes 71.8 percent of the variation in posttest mean scores in SBAT. To determine the magnitude of achievement mean scores across the treatment groups, the estimated marginal means of the treatment groups were calculated and are shown in Table 3.

Table 3 reveals that students exposed to Experiential Learning Strategy had the highest adjusted post mean score ($\bar{x}$=20.141); followed by those exposed to Generative Learning strategy of mean score ($\bar{x}$= 17.687), while those exposed to modified conventional strategy had the least adjusted mean score ($\bar{x}$= 9.592).

To determine the direction of the significant difference among the different groups, Scheffe Post hoc analysis was carried out and the results are shown in Table 4.

Table 4 shows that experiential learning strategy was significantly different ($\bar{x}$= 20.141) from both the generative learning strategy ($\bar{x}$= 17.687) and modified conventional strategy ($\bar{x}$= 9.592) groups; while generative learning was significantly different from MCS. Therefore, students in the experiential learning strategy group performed better than their counterparts in both

Table 2: Summary of ANCOVA of posttest scores of treatment, gender and mental ability on students' achievement in environmental concepts

Source	*Sum of squares*	*DF*	*Mean square*	*F*	*Sig.*	*Eta squared*
Corrected model	9825.038	18	547.335	106.737	.000	0.824
Pre-achievement	18.063	1	18.063	3.522	.061	0.009
Main Effect						
Treatment group	5355.58	2	2677.790	522.200	.000*	0.718
Gender	1.423	1	1.423	0.278	0.599	0.001
Mental ability	578.696	2	289.348	56.426	.000*	0.216
2-Way Interactions						
Treatment X gender	7.755	2	3.878	0.756	.470	0.114
Treatment X mental ability	37.675	4	9.419	1.837	0.121	0.018
Gender X mental ability	22.163	2	11.082	2.161	0.117	0.010
3-way Interactions	11.023					
Treatment x Gender x						
Mental Ability	2102.438					
Error	11954.476					
		4	2.756	0.537	0.708	0.005
		410	5.128			
Total		428				

* Significant at p <0 .05
Source: Adeyemi and Aworele (2015)

the generative learning and the control groups, while the generative learning group participants out-performed their mates in the control group.

H_o2: There will be no statistically significant main effect of gender on students' academic achievement in environmental concepts.

Results in table 2 reveal that there was no statistically significant main effect of gender on students' academic achievement in environmental concepts. ($F_{(1,410) = 0.278,}$ $\eta^2 = 0.001$). The contribution size of 0.1 percent was negligible. Therefore, hypothesis 2 was not rejected. The esti-

Table 3: Estimated marginal means of posttest of achievement scores by treatment

Treatment groups	*Mean*	*Std. error*	*95% confidence interval*	
			Lower bound	*Upper bound*
Experiential learning's strategy (ELS)	20.141	.249	19.651	20.631
Generative Learning Strategy (GLS)	17.687	.275	17.146	18.228
Modified Conventional strategy (MCS)	9.592	.235	9.131	10.053

Source: Adeyemi and Aworele (2015)

Table 4: Summary of Scheffe post hoc test of treatment by achievement

			Treatment		
	N	$\bar{x}$	*Experiential learning strategy*	*Generative learning strategy*	*Modified conventional strategy*
Experiential learning strategy	146	20.141		*	*
Generative learning strategy	141	17.687			*
Modified conventional strategy	152	9.592			

* Pairs of groups significantly different
Source: Adeyemi and Aworele (2015)

Table 5: Estimated marginal means of posttest of achievement scores by gender

Gender	*Mean*	*Std. error*	*95% confidence interval*	
			Lower bound	*Upper bound*
Male	15.884	.212	15.466	16.302
Female	15.729	.202	15.332	16.127

Source: Adeyemi and Aworele (2015)

mated marginal means of gender are shown in Table 5.

Table 5 reveals that the male had 15.884, and the female had 15.729 as their mean scores respectively. Although the male mean score is slightly higher than the females', the difference is not statistically significant.

$H_0$3: There will be no statistically significant main effect of mental ability on students' academic achievement in environmental concepts.

Table 2 reveals that there was statistically significant main effect of mental ability on the students' academic achievement in environmental concepts. ($F_{(2,410)} = 56.426, p < .05, \eta^2 = .216$). The beta square value (.216) which is 21.6 percent implies that mental ability contributes 21.6 percent to the variation in posttest mean scores of the participants. Therefore hypothesis 3 was rejected. To determine the magnitude of posttest achievement mean scores of students according to mental ability, the estimated marginal means were calculated and are presented in Table 6.

Table 6 reveals that students with high mental ability had the highest adjusted mean score ($\bar{x}$=17.584) followed by students with medium mental ability ($\bar{x}$=16.253); while students with low mental ability had the least adjusted mean score ($\bar{x}$=13.583).

To determine the direction of the significance among the different levels of mental ability, Scheffe post-hoc analysis was carried out and the result is presented in Table 7.

Table 7 reveals that students with high mental ability group was significantly different ($\bar{x}$= 17.553) from Low Mental Ability group; and Medium Mental Ability group ($\bar{x}$= 16.289) also differs significantly from low mental ability group ($\bar{x}$= 13.598). Although there is a difference in the mean scores of high and medium ability groups, it is not statistically significant

DISCUSSION

The results obtained in this study revealed that there was significant main effect of treatment on variation in students' academic achievement mean scores in environmental concepts in

Table 6: Estimated marginal means of posttest achievement scores of students by mental ability

Mental ability	*Mean*	*Std. error*	*95% confidence interval*	
			Lower bound	*Upper bound*
High	17.584	.327	16.942	18.227
Medium	16.253	.136	15.986	16.519
Low	13.583	.260	13.072	14.093

Source: Adeyemi and Aworele (2015)

Table 7: Summary of Scheffe post-hoc analysis of mental ability according to achievement

			Mental ability		
Mental ability group	*N*	$\bar{x}$	*High*	*Medium*	*Low*
High	63	17.553			*
Medium	289	16.296			*
Low	87	13.598	*	*	

*Pairs that differ significantly
Source: Adeyemi and Aworele (2015)

biology ($F_{(2,410) = \mathbf{522.200}, p < .05, \eta^2 = 0.718}$). The EMM clearly showed that the experiential learning strategy had a higher posttest mean score over and above the generative learning group and the control group. This means that the experiential learning strategy is more effective in improving the students' academic performance in environmental concepts in Biology. This was followed by generative learning strategy group which had a higher posttest mean score than the control group which had the least mean score. The result also indicated that learning strategies accounted for 71.8 percent of the variation in the posttest mean scores. It is therefore implied in these results that both the experiential and the generative learning strategies are found to be effective in the teaching of environmental concepts and hence biology as a subject in the school curriculum. The effectiveness of experiential learning strategy and the generative learning strategy over the modified conventional strategy may be ascribed to the fact that both experiential and generative learning strategies are learner-centered, a process that allows for collaborative work amongst the students, making them to be more involved in the learning process. Through these two strategies, students in groups create knowledge through the transformation of experience, generate knowledge, identify and solve problems together, reflect on doing, interact and communicate among themselves, focusing on the active learning process for the individuals, enjoying the dividends of peer-tutoring. These results are in agreement with the findings of (Daramola 2008; Faralhnaz 2002; Jegede 2012; Jolaoso 2012) The findings also lend credence to (Moore et al. 2010; Mukunthan 2011; Okoli and Okechukwu 2014) viewpoint that educators should look for ways to improve students' academic achievement. Curiously, there has not been any known study doubting the efficacy of experiential learning strategy in improving students' academic performance

The poor performance exhibited by students exposed to the modified conventional strategy as shown by the posttest achievement mean scores may not be unconnected with the fact that the conventional strategy is teacher-centered. Here, the students become passive recipients of knowledge. There is no opportunity for the students to be actively involved in the learning process. The teacher carries out all the activities involved in the teaching-learning process all alone by himself, hence the name "teacher-centered" (Agboghoroma and Oyovwi 2015; Lebata 2014; Ngesu et al. 2014). This practice is contrary to that popular Chinese saying: "what I hear, I forget; what I see, I remember; what I do, I understand". This implies that emphasis in the teaching-learning process should be on "doing", active involvement and engagement of learners in the process, rather than just listening. This is what is conspicuously missing in the conventional mode of teaching. Unfortunately, this is what most practicing teachers are using today in schools because it does not waste time like other learning strategies ostensibly to cover the volume of content in the school curriculum. Therefore, in order to assure quality academic performance, there should be more of students' active engagement in the teaching-learning process (Taylor and Parsons 2011; James 2014).

The results of the analysis of covariance (ANCOVA) in Table 2 also showed that there was no significant main effect of gender on students' academic achievement. The results further indicated that gender contributed 0.01 percent to the variation in students' posttest achievement mean scores. This result gave empirical support to the findings of (Agboghoroma and Oyovwi 2015; Lock 2007; Oduwaye 2009; Okoli and Okechukwu 2014). The result is however contrary to the findings of (Awoderu 2012; Okeke 2002) who found that boys demonstrated higher ability skills in some tasks than girls and girls performing better than boys in practical skills.

The mental ability of the participants is another factor that was considered could have influence on students' academic achievement in SBAT. The results in Table 2 showed that there was significant main effect of mental ability on the variations observed in students' posttest mean scores in SBAT. The EMM (Table 6) revealed that the high mental ability had the highest posttest mean score, while the low mental ability had the least posttest mean score. It is also noteworthy that the high mental ability group did not only have the overall highest posttest mean, but scored the highest in each treatment goup. The Scheffe post-hoc analysis (Table 7) showed that both the high and medium mental ability groups differed significantly from the low mental ability group, while there was no statistically significance difference between the

high and medium ability groups. This result lend credence to the findings of (Kiboss 2003; Olagunju and Chukwuka 2008; Raimi 2003). From the findings of this study and many others, it seems there is agreement among researchers about the important role mental ability plays in the teaching-learning process and hence students' academic achievement. This consensus is reflected in the fact that there is little or no controversy over this issue in literature.

General mental ability is a term used to describe the level at which an individual learns, understands instructions and solves problems. General mental ability has been found to be the single best predictor to determine the extent of academic performance/achievement of students. Studies showed that students with higher general mental ability acquire more academic knowledge and acquire it faster than others. Higher levels of academic knowledge lead to better performance, (Sethi 2010; Ayoola 2009).

The global principle guiding the consideration of mental ability is to ensure that the test has the capacity to discriminate between high and low ability participants. Adekunle (2005) found that the relationship between certain capabilities of mental ability measured by academic performance of learners and intelligence test is significant. Furthermore, he found that the performance needed on a number of mental ability tests such as, ability to apply knowledge to solve problems, ability to manipulate abstract concepts and relationships and test of language competence are linked to performance in school learning. Besides, measurement of cognitive skills is a measure of mental ability of students.

CONCLUSION

Consequent upon the results and the discussion, it may be concluded as follows:

The experiential learning strategy and the generative learning strategy were both found effective in improving students' academic achievement, and that the conventional method of teaching is less fashionable in improving students' academic achievement.

Gender was not found to have any influence on students' academic achievement in environmental concepts in biology. This implies that students' performance in biology as demonstrated in this study is independent of gender. Mental ability interacts positively with the learning strategies that were found effective to improve students' academic performance. The high mental ability group performed better than the medium and the low ability groups in all treatment conditions. This is followed by the medium ability group.

Implications of Findings

The results of this study seem to have implications for the teaching and learning of environmental concepts in particular and biology in general in Nigeria's secondary schools. It was found that both the experiential and generative Learning Strategies had high posttest mean scores. It means that the two strategies are capable of improving students' learning in significant way. The success recorded by these methods may be attributed to team or collaborative work amongst the learners inherent in them, and therefore they are recommended for use in schools. The two strategies however necessitate tremendous role-change for the teachers. Therefore, special short courses, seminars and workshops should be organized for teachers towards the successful implementation of the strategies in the classrooms. This also has implication for the school time table. Because the strategies take time to implement in the classroom, enough time should be allocated in the school-time table for their use.

It was also found that treatment did not interact with gender in determining students' scores in the dependent measure. This implies that the use of the experiential and the generative learning strategies is not associated with gender characteristics. Therefore, efforts should be made to popularize captivating instructional strategies such as experiential and generative strategies among the two gender groups.

The results further showed that mental ability had significant main effect on participants' achievement in favor of the high mental ability group over the medium and low ability groups. The low mental ability group had the lowest posttest mean score. In any learning situation, students cannot be of equal academic ability, hence the different levels of performance. The implication of this for teachers is to provide opportunities by which students' mental ability can be aroused and stimulated. This they can do through close interaction with the students and provision of adequate exercises amongst others.

RECOMMENDATIONS

Base on the findings of the study, the following recommendations are made:

- Experiential learning strategy and the generative learning strategy should be adopted as effective and viable strategies for studying ecology, pollution, and conservation of natural resources as well as the population studies.
- Teachers of biology should develop activities that will give room for the learners to be actively involved in the teaching - learning process. The activities may be in form of provision of concrete experiences, reflective observation, abstract conceptualization and active experimentation.
- Enough time should be allocated on the school time-table such that will accommodate and encourage the use of the strategies in classroom.
- There is need to include in the secondary school biology curriculum various activities that students can engage in, in the teaching of ecology-related concepts in biology. Teachers should make their classroom teaching participatory where learners are made to create their own experience through the materials involved and available in the environment.
- Seminars, short courses and workshops should be organised for biology teachers where they will be trained in the use of experiential and generative learning strategies, this becomes imperative as the roles of the teachers using these strategies will change. Therefore, head of schools, curriculum planners and ministry of education officials should assist in this regard.
- Teachers are encouraged to have positive close interaction with the students in order to make a success of the strategies. It is hereby recommended that biology teachers should make use of experiential learning strategy and generative learning strategy as they are activity-based and students-cantered in order to improve the quality of students' learning in the subject.

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