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## EFFECTIVENESS OF EXPERIENTIAL LEARNING APPROACH ON STUDENTS' ACADEMIC ACHIEVEMENT AND ATTITUDE TOWARDS BIOLOGY IN SECONDARY SCHOOLS IN MAARA SUB-COUNTY, KENYA

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### ABSTRACT

The main purpose of this study was to investigate the effectiveness of experiential learning approach on students' academic achievement in biology in secondary schools in Maara sub-county, Kenya. Quasi experimental research design was employed and in particular Solomon four group design. The target population was 22,640 biology students in secondary schools in Maara sub-County, TharakaNithi County. The accessible population consisted of 1,557 form two students in the Sub-County mixed Secondary schools. The purposive sampling was used to draw four sub-County mixed secondary schools from a list of mixed secondary schools in Maara Sub-County. Simple random sampling was used to select and assign participating schools in experimental and control groups. The sample size comprised of 118 students. The research instruments used were Biology Pre-Test (BPT) and Biology Achievement Test (BAT). The instruments were piloted to determine their reliability in a Sub-County mixed secondary school in Meru-South Sub-County. Reliability coefficient for instruments was 0.741. The validity of the research instrument was ascertained by experts in the department of education of Chuka University. Experimental groups (E1 and E2) were taught using experiential learning approach while control groups (C1 and C2) were taught using conventional teaching approach. Statistical Package for Social Science (SPSS) version 26 aided in data analysis. The raw data obtained was analyzed using descriptive statistics (mean, standard deviation, percentages) and inferential statistics (one-way ANOVA, Turkey post hoc analysis, and t-test). The null hypothesis was tested at  $\alpha=0.05$  significant level. The findings of this study revealed that there was a significant difference in the academic performance between the students taught using experiential learning approach and those taught using the conventional approach. It was therefore recommended that the experiential learning approach should be applied to improve students' academic achievement in biology. The findings of the study may be helpful to the curriculum planners and learning institutions to incorporate innovative techniques in classroom teaching to improve learning of biology subject in Kenya. The findings also form a ground upon which likely further research could be built for innovative teaching techniques in secondary schools.

**Key words:** Experiential learning, Conventional teaching, Gender, Academic achievement.

## INTRODUCTION

In secondary schools, science subject comprises of Biology, Physics, and Chemistry. Biology contributes greatly to the advancement in biotechnology, medical engineering and microbiology globally (Joda, 2019). Professional health courses such as human and veterinary medicine, pharmacy, and dentistry require biology as a prerequisite (Daniel & Githui, 2011). Genetics, a branch of biology, has transformed the ability to resolve paternity issues and identify the perpetrators of serious crimes with certainty and precision through the use of Deoxyribonucleic Acid (DNA) sequencing and profiling (Tsevreni, 2021). To combat numerous human and animal diseases like malaria, measles and polio, biology has helped to develop new and improved drugs and vaccines (Daniel & Githui, 2011). Tsevreni (2021) claims that biological knowledge and skills also contribute to scientific literacy, which helps mankind to better understand the world, conserve the environment and endangered species in the ecosystem.

Despite the significance of biology, in most of the countries in the world, students' academic achievement has remained to be a major setback. In line with Rogayan research in 2019 in the Philippines, junior high school science students at a government-run secondary school in Central Luzon fared below average on the National Achievement Test (NAT) in terms of science achievement. According to Rogayan, the low academic performance is caused by a number of factors, including the teachers' ineffective teaching approaches, the size of the class, inadequate facilities, lack of opportunities for hands-on learning, and the students' attitudes toward science subjects.

In the recent years, Sub-Saharan African countries have generally had low students' academic achievement, and Kenya is no exception (Bizimana, Mutangana, & Mwesigye, 2022). Research study by Joda (2018) showed that there is a persistent low achievement in SSCE Biology examinations annually in Nigeria. The study examined how students' achievement in basic science was affected by explicit approach to learning and learning preference. Similarly, secondary school biology performance in Zambia has been poor for many years according to Kambaila, Kasali and Kayamba (2019). Compared to the other science subjects, Rwandan students' academic performance in biology continues to decline (Ntawiha, 2016). In Kenya, according to data from the KNEC report (2020) on students' academic achievement on the Kenya Certificates of Secondary Education, students often do unsatisfactorily in science subjects and in particular biology. The Maara Sub-County Education Office (2022) reported that for the Kenya Certificate of Secondary Education (KCSE), biology academic performance has been dismal over time in the Sub-County.

In an attempt to reverse the poor achievement in biology, various remedies have been proposed and implemented by the government of Kenya. These include in-service training of biology teachers through SMASSE and ICT integration programs. In spite of these programs, students' academic performance in biology and more especially in the gaseous exchange at the secondary school level is still not sufficient. According to reports from the Kenya National Examination Council (2020), students record low academic achievement in the subject, a tendency that is probably caused by students' lack of biological knowledge and skills as a result of ineffective instructional approaches and students' negative attitudes. The poor results in the subject has caused the agency to look into the innovative and captivating instructional approaches in the teaching of the topic gaseous exchange such as experiential learning approach.

Experiential learning approach emphasizes on learning by doing and reflecting on doing (Okuakaji & Sukolatambaya, 2020). Experiential learning approach is a form of experience-based learning where learners make meaning of the actual experience. The process of experiential learning encompasses a variety of processes that give students a hands-on, group-based, and reflective learning experience that aids in their full acquisition of new knowledge and skills (Morris, 2020). According to Kolb & Kolb (2017), one develops knowledge in ELA by transforming their own experiences. A learning experience is not simply something that happens; it is a planned activity with a purpose and the learners confirm the purpose. According to Kolb and Kolb, experience-based learning is inductive, learner-centered, and activity-focused. Experiential learning involves the process of making sense of self-concrete experience, which lessens reliance on teachers.

The teacher in experiential learning facilitates the process rather than directing it. According to Beard and Wilson (2018), to facilitate experiential learning, the teacher takes on the role of a facilitator, a less dominant position in the classroom, adopting a constructive and non-dominating mentality while approaching the learning process. Teachers that are experts in their fields aid students in organizing and connecting their reflections to the subject base of knowledge (Awolere, 2015). Teachers frequently promote and practice critical thinking when teaching. Teachers must constantly study in order to be capable of doing this. The teacher also serves as a mentor and a facilitator of learning, as the students are not fully left to pursue their own education. While the teacher gently helps, the learner must take the initiative to learn (Awolere, 2015). In order to ensure student empowerment, the teacher assumes the position of a participating observer. Experiential learning contributes to student engagement, deeper learning, better academic performance,

and improved career and life skills, according to Andresen, Boud, and Cohen (2020). Experiential learning helps students relate to their learning specifically by giving them an opportunity to connect new ideas with preexisting ones while building on their prior knowledge.

Although many lucrative courses require biology as a prerequisite, and despite government engagement through the SMASSE and ICT integration programs, students' academic performance in biology at the secondary school level is still not satisfactory. According to reports from the Kenya National Examination Council, students exhibit poor academic performance in the subject, a pattern that is probably brought on by their unfavorable attitudes toward it. The Kenya 2030 vision and the country educational goals are unlikely to be achieved if the subject dismal academic performance persists. Scholars propose the adoption of active learning instructional approaches to address this shortcoming. Although studies have demonstrated that using an experiential learning approach can enhance students' learning achievements in physics, chemistry, and mathematics, there is little information students' performance in biology. Therefore, the current study examined how experiential learning approach influenced students' academic performance in biology in the Maara Sub-County of Tharaka Nithi, Kenya in an effort to close the academic achievement gap.

## **METHODOLOGY**

The study was conducted in Maara Sub-County in Tharaka Nithi County which lies 186km due North of Nairobi City. In the Northern, Tharaka Nithi County borders Meru County; to the East the County is bordered by Kitui County and to the South it is bordered by Embu County. To the Western side, Tharaka Nithi is bordered by slopes of Mount Kenya.

The study employed the quasi-experiment, and more particularly the Solomon four group design. Four groups are involved in the Solomon four-group design (Ogunniyi, 1992). The Solomon four-group main feature is that participants are randomly assigned to either a treatment or a comparison group after being randomly assigned to either receive or not receive a pre-test. This design is preferred because it is based on groups of respondents rather than individuals. However, it is advised against dividing and reconstituting secondary school classes after they have been formed as whole groups for research. The design enables the researcher to conduct studies in natural and real-life settings while controlling and measuring the main effects of testing. The Solomon four group enables the researchers to conduct a detailed assessment of the cause for the change in the dependent variables and even determine whether changes are caused by interactions between the pretest and treatment. According to Shuttleworth (2009), the design enables the researchers to have total control over the variable and determine if the pre-test would have an impact on the outcomes. The Solomon four group design involves four groups. The experimental group E1 received a pretest (O1), a treatment (X), and a posttest (O2). The experimental group E2 did not receive a pretest but received treatment (X), followed by a posttest (O5), while the control group (C1) received a pretest (O3), posttest (O4), and no treatment. Those in the control group (C2) received the post-test (O6). The conventional approach was used to teach C1 and C2. Testing and treatment interactions were eliminated by post-test (O5) and (O6). Students took the pre-test to ascertain their entry behavior before the experiment began. The experimentation went unnoticed by learners since they were being taught by their teachers. To prevent subjects' interaction, the experimental and control groups were drawn from different schools.

The target population was 22,640 biology students in secondary schools in Maara Sub-County, Kenya. The accessible population was composed of 1,557 form two students in the Sub-County mixed secondary schools where the study sample was drawn. The researcher purposively sampled Maara Sub-County out of the 4 sub-counties in Tharaka Nithi County based on the low academic performance in biology. The researcher used purposive sampling to draw a total of four Sub-counties mixed secondary schools from a list of 58 secondary schools in the Sub-county. The selection of schools was guided by low academic achievement and mixed sub-county secondary schools. Simple random sampling technique was used to assign selected schools to experimental groups (E1 & E2) and control groups (C1 & C2). In case a school had more than one stream taking biology, all the streams were subjected to the study using similar method of teaching but only one stream was considered for analysis. The sample size of the study was 118 students. A list of all sub-county secondary schools from the county was obtained from county education office before sampling to establish whether they were suitable for the study. During the visit the researcher obtained information on the extent of syllabus coverage in form three chemistry classes.

The units for sampling in this study were schools and not individual students. The researcher purposively sampled Maara Sub-County out of the 4 sub-counties in Tharaka Nithi County based on the low academic performance in biology. The researcher used purposive sampling to draw a total of four Sub-counties mixed secondary schools from a list of 58 secondary schools in the Sub-county. The selection of schools was guided by low academic achievement and mixed sub-county secondary schools. Simple random sampling technique was used to assign selected schools to experimental groups (E1 & E2) and control groups (C1 & C2). In case a school had more than one stream taking biology, all the streams were subjected to the study using similar method of teaching but only one stream

was considered for analysis.

The instruments that were used are: Biology Pre-Test (BPT) and Biology Achievement Test (BAT). The Biology Pre-Test (BPT) instrument was prepared on the topic of gaseous exchange in plants and animals. The main aim of the pre-test instrument was to measure the students' academic entry behavior in biology. The test consisted of six questions from biology paper 1 and 2 of the biology totaling to 30 marks. All of the questions were taken from previous KCSE biology paper 1 and paper 2 examinations to ensure content validity. Levels of knowledge, comprehension, application, and analysis were examined on the exam items. Students' biology achievement was measured using a Biology Achievement Test. Based on a post-test exam administered at the end of the treatment phase, the effect of the intervention on students' academic achievement in biology was tested. The researcher designed the BAT instrument based on the several subtopics of gaseous exchange in plants and animals. There were 6 total items in the test, totaling to 30 marks. The questions came from KNEC biology sample exams. The test items tested levels of knowledge, comprehension, application, and analysis.

Statistical Package for Social Science (SPSS) version 26 aided in data analysis. The raw data obtained was analyzed using descriptive statistics (mean, standard deviation, percentages) and inferential statistics (one-way ANOVA, Turkey post hoc analysis, and t-test).

## RESULTS AND DISCUSSION

The BAT scores were coded and analyzed to determine whether there was a difference in biology achievement between students taught using the experiential learning approach and those taught using the conventional approach.

### Gender

The number of males and females that took part in the

study is as shown in Table 1. Table 1: Gender Distribution

	Male	%	Female	%	Total	%
Experimental Group 1	6	18.18	27	81.82	33	100.0
Control Group 1	13	39.39	20	60.61	33	100.0
Experimental Group 2	13	44.83	16	55.17	29	100.0
Control Group 2	9	39.13	14	60.87	23	100.0
Total	41	34.75	77	65.25	118	100.0

Information in Table 1 shows that there were 33 students for experimental group 1 of which 81.82% were females while 18.18% were males. Out of 33 students for control group 1, 39.39% were males while 60.61% were females. For experimental group 2, 44.83% were male while 55.17% were females. For control group 2, 39.13% were males while 60.87% were females. The total sample was 118 students of which 41 (34.75%) were males while 77 (65.25%) were females.

### Mean Scores and t-test of Pretest for Experimental and Controlgroups

Both the experimental group (E1) and the control group (C1) were subjected to a pretest before the start of the treatment. To determine whether the students chosen to participate in the study had similar characteristics before to the study, a pretest was conducted. The independent sample t-test was run to determine whether there were any statistically significant differences between the mean scores of the experimental groups (E1) and control group (C1). The t-test outcomes for the pretest mean scores in BAT for E1 and C1 are presented in Table 2.

Table 2: BAT Mean Scores and t-test of Pretest for Experimental Group 1 and Control Group 1

Group	N	Mean (%)	Std. Deviation	t	df	Sig.
Experimental Group 1	33	3.65(12.17%)	1.593	1.174	64	0.245
Control Group 1	33	4.09(13.64%)	1.444			

According to the findings in Table 2, experimental group one had a mean score of 3.65 (12.17%) out of 30, while control group one had a mean score of 4.09 (13.65%) out of 30. To compare the means of Experimental Group one with Control Group one, a t-test was used. The t-test showed that, at alpha ( $\alpha$ ) = 0.05 significant level, there was no significant difference between the two groups,  $t(64) = 1.174$ ,  $p = 0.245$ . The results showed that the difference in the pretest mean score was not significant suggesting that the experimental group (E1)

and the control group (C1) were similar. This implies that the two groups' biology academic achievement levels prior to exposure to the experiential learning approach and the conventional approach were equivalent. At the end of the treatment, a post-test examination was administered to assess the effect of the intervention on students' academic performance in biology. The results are presented in Table 3.

Table 3: BAT Mean Scores and t-test of Post-test for Experimental Group 1 and Control group 1

Group	N	Mean (%)	Std. Deviation	t	df	Sig.
Experimental Group 1	33	14.88(49.60%)	3.871	4.945	64	0.000
Control Group 1	33	10.58(35.25%)	3.163			

The mean score for the experimental group one was 49.60%, against 35.25 for the control group one. After the intervention, the means of experimental Group one and Control Group one were compared using a t -test. According to the results of the t-test  $t(64) = 4.945$ ,  $p = 0.000$ , there was a significant difference between the groups. Thus a statistically significant difference was found in academic achievement between groups exposed to the experiential learning approach and the conventional approach.

#### Mean Gain for Experimental and Control groups

The means for the experimental group one and control group one pretest and posttest were calculated and compared, as shown in Table 4.

Table 4: Mean Gain for Experimental group 1 and Control group 1

Group	N	Mean for Pretest	Means for Posttest	Mean Gain
E	33	12.17	49.60	37.43
1	33	13.64	35.25	21.61
C				
1				

The mean gain of students in experimental group one (37.43) is higher as compared to the mean gain for students in control group one (21.61) as shown in Table 4. These results imply that students taught using Experiential learning approach performed better than those that were exposed to conventional approach. The results of this study agree with those of Chesimet (2016) who reported that ELA significantly impacted student's mathematical academic achievement and creativity. The study investigated how the experiential learning approach (ELA) affected student's mathematical creativity and academic achievement in Kericho East Sub-County. Form Two students were taught statistics because the Kenya National Examinations Council asserts that it is one of the topics with the lowest performance on the KCSE. The quasi-experimental research employed Solomon four non-equivalent control group design.

Similarly, the findings are also consistent with those of Agsalog (2019), who documented the impact of an experiential learning approach on the academic achievement and motivation to learn physics of grade 10 students at Kinawe National High School (KNHS) in Libona City, Philippines, during the academic year 2016–2017. The results of Agsalog study showed a substantial difference in academic achievement between students who were taught using an experiential learning approach and those who were taught using the conventional approach. Students who learn through experiential learning developed fundamental qualities and values including the confidence to express their minds and empathy for others.

Correspondingly, the findings concur with those Okuakaji and Sukolatambaya (2020), who claimed that in experiential classrooms, students take the initiative to learn on their own, complete an activity, and then gather around a table to discuss and reflect on the results of the activity completed. Therefore, experiential learning carries with it the requirement that the students complete an action, reflect on their observations, comprehend, and then apply what they have learned. The study's findings are in line with those of Morris (2020), who said that experiential learning frees students from having to adhere to the narrow and straight road of a particular teacher's

the truth. The teacher facilitates rather than directing the learning process when pupils are really interested in what they are studying. Morris (2020) asserted that experiential learning frees students from having to adhere to the narrow and straight road of a particular truth of the teacher. The teacher facilitates rather than directing the learning process when students are really interested in what they are studying.

**Effects of Experiential Learning Approach on Students’ Academic Achievements in Biology**

All the four groups took posttest BAT. Achievement was measured by use of BAT posttest scores. Experimental groups (E1) and (E2) were taught using Experiential learning approach while control groups (C1) and (C2) were taught using conventional approach. The means for posttest E1, E2, C1 and C2 are presented in Table 5.

Table 5: BAT Post-test Mean Scores by the Four Groups

	N	Mean	Std. Deviation	Minimum	Maximum
Experimental Group 1	33	14.88(49.60%)	3.871	7	24
Control Group 1	33	10.58(35.25%)	3.163	3	17
Experimental Group 2	29	14.62(48.74%)	3.479	10	25
Control Group 2	23	8.78(29.28%)	2.923	4	16
Total	118	12.42(41.40%)	4.219	3	25

The results presented in Table 5 show that the experimental group one and control group one students obtained mean scores of 49.60% and 35.25 respectively. Compared to control group one, experimental group one mean score is higher. Students in the control group two and experimental group two had average scores of 48.74% and 29.28%, respectively. Similarly, experimental group two mean score is greater than control group two. E1 and E2 both had a standard deviation of 3.871 and 3.479, respectively. The control groups C1 and C2 had standard deviations of 3.163 and 2.923, respectively. Experimental group 1 had the highest mean score (49.60%), followed by experimental group 2 (48.74%), Control group 1 (35.25%), and Control group 2 (29.28%). This suggests that the experiential learning approach was more successful than the conventional approach because the experimental groups had higher mean scores than the control groups. Figure 1 provides additional information of the BAT mean scores for the four groups.

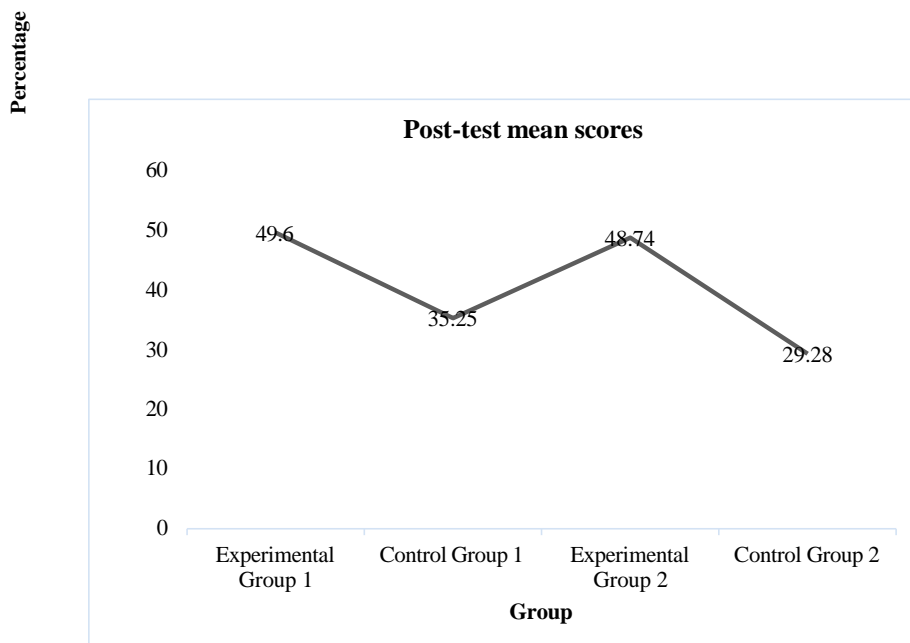


Figure 5: Relationship between Post-test Mean score in BAT in the Four Groups.

From figure 1, the graph shows that students who were taught using an experiential learning approach performed better on the BAT than those who were taught using a conventional approach. One-way ANOVA was used to determine whether there were any significant differences in the posttest mean scores for the four groups. The ANOVA of posttest mean scores on BAT are displayed in Table 6.

Table 6: Analysis of Variance (ANOVA) for the Post-test BAT Mean Scores of the Four Groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	756.497	3	252.166	21.674	0.000
Within Groups	1326.316	114	11.634		
Total	2082.814	117			

According to the one way ANOVA results ,  $F(3,114) = 21.674, p = 0.000$ , there was a statistically significant difference between the four groups and hence the null hypothesis ( $H_0$ ) was rejected. This suggests that students taught using the experiential learning approach and students taught using the conventional approach have statistically different levels of academic achievement in biology. The findings imply that the experiential learning approach had an improvement on students' academic performance. As indicated in Table 7, a Tukey post hoc test was used to determine which group differed from the other.

Table 7: Post Hoc Comparisons of Posttest BAT Mean Scores for the Four Groups

(I) group	(J) group	Mean Difference (I-J)	Std. Error	Sig.
Experimental Group 1	Control Group 1	4.30303 <sup>~</sup>	0.83971	0.000
	Experimental Group 2	0.25810	0.86818	0.991
	Control Group 2	6.09618 <sup>~</sup>	0.92650	0.000
Control Group 1	Experimental Group 1	-4.30303 <sup>~</sup>	0.83971	0.000
	Experimental Group 2	-4.04493 <sup>~</sup>	0.86818	0.000
	Control Group 2	1.79315	0.92650	0.219
Experimental Group 2	Experimental Group 1	-0.25810	0.86818	0.991
	Control Group 1	4.04493 <sup>~</sup>	0.86818	0.000
	Control Group 2	5.83808 <sup>~</sup>	0.95238	0.000
Control Group 2	Experimental Group 1	-6.09618 <sup>~</sup>	0.92650	0.000
	Control Group 1	-1.79315	0.92650	0.219
	Experimental Group 2	-5.83808 <sup>*</sup>	0.95238	0.000

According to the post-hoc results in Table 7, the mean difference between groups E1 and C1 and C2, and E2 and C1 and C2 was significant at 0.05 level with  $p < 0.05$ . At the 0.05 level with  $p > 0.05$ , the mean scores for the groups E1 and E2, C1 and C2 were not statistically significant. The difference may have resulted from the treatment suggesting that the approach to experiential learning is superior for both teaching and learning. Our study findings are consistent with those of Ayeni (2022) on the effects of problem-solving and experiential learning approaches on senior biology students' academic performance in different senior secondary schools in south-west Nigeria who reported that students who were exposed to the experiential learning approach performed better on a biology test than their peers who were taught using the conventional approach.

This study results are also in line with those of Chabari (2018), whose findings confirmed the value of using graphic organizers as part of an experiential instructional approach to raise students' academic achievement levels in chemistry.

Equivalently, the findings of this study concur with those of Andresen, Boud, and Cohen (2020), who found that experiential learning helps students learn more deeply, get better academic results, and develop their professional and life skills. According to Kuakaji and Sukolatambaya (2020), experiential learning enables students to collaborate, fights rote learning and monologic transference of knowledge, and provides them the deeper understanding and ownership that come from self-discovery. Experiential learning specifically helps students relate to what they are learning because it allows them to build on prior knowledge and create connections between new and old ideas.

Also, these study findings correspond with those of Chesimet (2016), whose findings reported that mathematics achievement varied among students exposed to experiential learning approach and those subjected to the conventional approach. The students who were exposed to the experiential learning approach had higher mean scores because they performed better, which is evidence that this approach raises students' achievement levels. The results of this study support those of Rukhsana, Naeemullah, and Rehman (2022), who agreed that experiential learning has been effective in Pakistan's primary schools for teaching science. The use of experiential learning lessons has improved student performance in science. Our study findings are in line with those of Adeyemi and Awolere (2016), who reported that greater student participation improved learning outcomes and motivated students to think critically and creatively, including interpreting, analyzing, and synthesizing information. She based her findings on a review of the literature on participation in senior secondary classrooms.

### **Summary of Research Findings**

The study sought to establish whether students who were taught biology using an experiential learning approach and those who were taught using the conventional approach achieved different levels of performance in the subject. In terms of biology achievement, there was a statistically significant difference between students taught using experiential learning approach and those taught using the conventional teaching approach. There were substantial differences in mean scores between students in the experiential learning approach treatment groups (E1 and E2) and those in the control groups (C1 and C2). The mean score for students in Experiential learning groups had a higher score in BAT (E1 and E2) than to those in the conventional teaching groups (C1 and C2). The study ascertained that experiential learning approach is more effective and can lead better results in academic achievement.

### **CONCLUSION**

According to the study findings, students who were taught using an experiential learning approach made reasonable learning gains in comparison to students who were taught using the conventional teaching approach. It was clear from the data that was collected and analyzed that employing the experiential learning approach in teaching and learning improves learners' academic achievement in biology. It was concluded that implementing experiential learning approach would therefore enhance academic performance. This is due to the fact that the students who were taught experientially had a higher mean score than those who were taught utilizing the conventional teaching approach. Experiential learning approach is an effective method of teaching a science subject; it entails hands-on engagement of learners in the learning process. Biology teachers should employ teaching approaches that engage students in experiential learning, as this will motivate them to pursue science.

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