Influence of Gender on Students' Academic Achievement in Biology When Taught Using Experiential Learning Approach in Secondary Schools in Maara Subcounty, Kenya

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ABSTRACT

The study aimed at determining the influence of gender on students' academic achievement in biology when taught using experiential learning approach. 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, Tharaka Nithi County. The accessible population consisted of 1,557 form two students in 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 in four schools. 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 (two-way ANOVA, Turkey post hoc analysis). The null hypothesis was tested at = 0.05 significant level. The findings revealed no statistically gender difference in academic achievement in biology when taught using experiential learning and conventional approaches. The study therefore recommended that experiential learning approach is an accommodative teaching approach that may be used with both male and female students. This means that, regardless of students gender, the experiential learning approach is appropriate in teaching and learning to promote academic achievement. Additionally, Experiential learning approach affords all students an equal access to the curriculum while maintaining their high expectations. The findings of the study may be help curriculum planners and learning institutions to incorporate innovative techniques in classroom teaching to improve learning of biology subject for both boys and girls in Kenya. The findings also form a ground upon which likely further research could be built for innovative teaching techniques in secondary schools.

Keywords: Experiential learning, Conventional teaching, Academic achievement.

BACKGROUND INFORMATION

Gender simply refers to the roles and characteristics that are socially and culturally developed to be identified with males and females in any given society (Nnamani & Oyibe, 2016). Due to the overemphasis on socialization throughout childhood, gender is the result of cultural learning and lifetime socialization. Some distinctive traits are assigned to males and others to females based on gender. Males are given attributes like dominance/assertiveness, tactfulness, intellect, self-confidence, bravery, aggression, and logical thinking, among others, while females are given traits like fearfulness, submissiveness, talkativeness, and tactlessness, among others (Nnamani & Oyibe, 2016). According to Ababneh and Samad (2018), there is a gender gap, with women experiencing disadvantages particularly when it comes to biology teaching and learning.

There are a number of positive findings from studies on the relationship between gender and academic achievement. Some found that gender is a relevant factor in academic achievement, while others discovered that there is no difference in academic achievement between males and females (Amedu, 2015). Regarding to the gender gap in science academic achievement, national trends in the United States of America showed conflicting reactions (Amelink, 2009). Amelink study revealed that in the coursework that was done, female peers perform equally to male peers, but assessments designed to gauge content mastery, like the National Assessment of Educational Progress, have shown that there are differences between males and females in K–12 educations that first became apparent in elementary school and persisted in high school. It is important for biology teachers to provide favorable learning atmosphere for both genders.

Almasri study in 2022 evaluated the attitudes and academic performance of male and female students in various learning environments based on e-learning and in-classroom learning modalities, collaborative learning, and conventional learning pedagogies. In a Kuwaiti undergraduate biology course, Almasri investigated the results of mixed- and single-gender grouping. One thousand three hundred and seventy-five biology students of the public university were allocated into 12 learning environments at random. Results showed that in single-gender classrooms as opposed to classes with mixed genders, females performed better in biology in conventional learning and collaborative sections; overall, there was a noticeable disparity in academic success between males and females. E-learning could therefore aid female students in overcoming the socio-cultural barrier that prevents them from feeling comfortable in settings with both men and women, thereby improving their academic performance in undergraduate biology courses. The effective teaching approach should be explored in order to enhance both boys' and girls' motivation for learning.

Prokop, Prokop, and Tunnicliffe (2007) investigated school students' interests and attitudes toward biology in Slovakia through their participation in extracurricular activities and their attitudes toward lessons as determined by interest, significance, and challenge. The majority of students learning zoology showed the highest preference for biology lessons, which were generally popular. Compared to boys, girls exhibited much more interest in biology. When studying botany in grade five (children aged 10 to 11), this difference was most pronounced. Compared to males, girls thought biology was more essential and simpler. Hobbies, movies, and books with a biological theme attracted more attention (10–20% more) and were strongly correlated. However, fifth graders' interest in biology dropped as time progressed and both boys and girls had difficulties learning botany. This implies that there is need for appropriate teaching approach to be inculcated in the classrooms for equal motivation to both males and females.

In an effort to equalize access to education to both male and female students, various remedies including the use of innovative and captivating instructional approaches in the teaching and learning have been proposed. Experiential learning was used in the current study to establish if the gender gaps could be addressed between boys and girls in schools to provide equal opportunities for learning. Experiential learning approach

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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.

In the Kenyan school curriculum, biology occupies a special position and is essential to many science-related courses, including those in nursing, biochemistry, microbiology, agriculture, medicine, and pharmacy. It is indisputable that a biological conceptual foundation is a basic requirement for every student who desires to pursue higher education in the fore-mentioned courses. Despite the importance of the subject and the government's interventional SMASSE and ICT integration programs, students' academic performance in biology at the secondary school level still show gender disparity. According to reports from the Kenya National Examination Council in 2019, male students record higher academic achievement than girls in the subject. In order to counter gender academic imbalance at school, scholars suggest that active learning instructional approaches be adopted to provide equal opportunities to both male and female students. Although research has shown how experiential learning approach can minimise the gender gap among students' learning achievement in physics, chemistry, and mathematics, there is limited information available on students' academic performance in biology by gender. Therefore, the current study will examine how well gender influences students' academic performance in biology when taught using experiential learning approach in the Maara Sub-County of Tharaka Nithi County, Kenya.

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 EI received a pretest (OI), a treatment (X), and a posttest (O2). The experimental group E2 did not receive a pretest but received treatment (X), followed by a posttest (05), while the control group (CI) 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 of 118 students 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 30 marks test consisted of six questions drawn from KCSE biology paper 1 and 2. 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,

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comprehension, application, and analysis.

The treatment ran for four weeks. Biology Students in the experimental group E1 and the control group C1 did a pre-test to determine their entry behavior. The BPT was administered before the treatment. The researcher met with Biology teachers in E1 and E2 on weekly basis to discuss content, problem encountered and teaching approach applied. Biology achievement test was administered to all the groups concurrently after the four weeks of teaching. The biology teachers in the respective schools assisted to administer the instruments so that students were not aware of experimentation. The pre-test and post-test were both scored by the researcher in order to get quantitative data for analysis.

The researcher used the Statistical Package for Social Sciences (SPSS) version 26.0 to arrange, code, enter the data, score the pretest and posttest, and do data analysis. For data analysis, descriptive and inferential statistics were used. Raw data were summarized using descriptive statistics, such as mean, standard deviation, and percentages. The purpose of inferential statistics was to analyze, interpret, and make decisions based on the findings. To examine the mean differences across groups that have been split based on two independent variables and to ascertain whether there was an interaction between two independent variables and the dependent variable, two-way ANOVA was employed. To determine precisely where the differences between the multiple groups exist, a post hoc test, more particularly Tukey Honest Significant difference, was performed. A significance level of $\alpha = 0.05$ was used to test the null hypothesis.

RESULTS

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 of Respondents

	Gender					
	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.

Effect of Experiential Learning Approach and Conventional Approach on Students' Academic Achievement Based on Gender

The objective of the study was to determine whether gender affected biology students' academic

advancement when they were taught using the experiential learning approach and the convention approach. The biology achievement test was used by the researcher to assess students' biology achievement based on gender. Before and after the trial, the gender-specific average scores of the learners' performances were compared. Table 2 presents the results of the analysis of the mean scores from the pretest.

Table 2: Pre-test Distribution of Means based on Gender

Gender	Group	Mean	Std. Deviation	N
Male	Experimental Group 1	5.4167	1.49722	6
	Control Group 1	4.3077	1.37747	13
	Total	4.6579	1.47246	19
Female	Experimental Group 1	3.2593	1.34715	27
	Control Group 1	3.9500	1.50350	20
	Total	3.5532	1.44175	47
Total	Experimental Group 1	3.6515	1.59337	33
	Control Group 1	4.0909	1.44403	33
	Total	3.8712	1.52495	66

The average score for male students in the experimental group one was 5.42 out of 30, with a standard deviation of 1.497, while the average score for male students in the control group one was 4.31 out of 30, with a standard deviation of 1.377. The average score for females in experimental group one was 3.26 out of 30, with a standard deviation of 1.347, while the average score for females in control group 1 was 3.95 out of 30, with a standard deviation of 1.503. To investigate the impact of gender and group on academic performance, a two-way ANOVA was carried out. Table 3 shows the results.

Table 3: Two Way ANOVA for Pretest

Source	Sum of Squares	Df	Mean Square	F	Sig.
Model	1016.137[a]	4	254.034	126.902	0.000
Gender	19.133	1	19.133	9.558	0.003
Group	0.529	1	0.529	0.264	0.609
gender * group	9.796	1	9.796	4.894	0.031
Error	124.113	62	2.002		
Total	1140.250	66			
Dependent Variable: Academic achievement					

The results in Table 3 indicated that there was a statistically significant interaction between the effects of gender and group on academic achievement, F (1, 62) = 4.894, p = 0.031. Hence there was need to check the simple main effects as described by Table 4.

Table 4: Pairwise Comparisons

Group	(I) Gender	(J) Gender	Mean Difference (I-J)	Std. Error	Sig.
Experimental Group 1	Male	Female	2.157*	0.639	0.001
	Female	Male	-2.157*	0.639	0.001
Control Group 1	Male	Female	0.358	0.504	0.481
	Female	Male	-0.358	0.504	0.481

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Simple main effects analysis revealed no gender differences for control group one (p = 0.481), however there was a significant difference between males and females for experimental group one (p = 0.001). Descriptive statistics and two-way ANOVA were used to test the null hypothesis, which states that there is no statistically significant difference in academic achievement in biology between students taught using an experiential learning approach and those taught using conventional approach based on gender. The findings of the descriptive statistics are shown in Table 5.

Table 5: Descriptive Statistics for Post-test

gender	Group	Mean	Std. Deviation	N
Male	Experimental Group 1	12.3333	2.33809	6
	Control Group 1	11.2308	2.89119	13
	Experimental Group 2	14.0769	2.56455	13
	Control Group 2	8.7778	2.53859	9
	Total	11.7561	3.21544	41
Female	Experimental Group 1	15.4444	3.94514	27
	Control Group 1	10.1500	3.32890	20
	Experimental Group 2	15.0625	4.10640	16
	Control Group 2	8.7857	3.23867	14
	Total	12.7792	4.64708	77
Total	Experimental Group 1	14.8788	3.87103	33
	Control Group 1	10.5758	3.16258	33
	Experimental Group 2	14.6207	3.47865	29
	Control Group 2	8.7826	2.92258	23
	Total	12.4237	4.21922	118

According to the descriptive Table, experimental group one had a mean score of 12.33, control group one had a mean score of 11.23, experimental group two had a mean score of 14.08, and control group two had a mean score of 8.78 out of 30 for male students. For females, the mean was 15.44 for Experimental Group one, 10.15 for Control Group one, 15.06 for Experimental Group two, and 8.79 for Control Group two. In the experimental and control groups, boys and girls had approximately the same means. The findings in Table 6 were obtained when a two-way ANOVA was used to investigate the effect of gender and group on academic attainment.

Table 6: Two Way ANOVA Results for Post-test

Source	Sum of Squares	Df	Mean Square	F	Sig.
Model	19033.369[a]	8	2379.171	207.273	0.000
Gender	14.011	1	14.011	1.221	0.272
Group	540.509	3	180.170	15.696	0.000
gender * group	56.123	3	18.708	1.630	0.187
Error	1262.631	110	11.478		
Total	20296.000	118			
Dependent Variable: Academic achievement					

According to two way ANOVA for post-test analysis, the findings revealed no statistically significant interaction between the effects of gender and group on academic achievement in biology, with F (3, 110) = 18.708, P = 0.187. The null hypothesis (H0), which states that there is no statistically significant difference in academic achievement in biology between students taught using an experiential learning approach and those taught using a conventional approach based on gender, was therefore accepted. There was no discernible difference in the performance of boys and girls when the experiential learning approach was used.

DISCUSSION

The findings of our study showed that gender had no effect on biology achievement. The findings of this study agree with those of Ababneh and Samad (2018) who discovered that collaborative, cooperative, and laboratory-based learning activities with fairness among learners are promoted by experiential classrooms. The findings of this study are consistent with those of Nwuba and Osuafor (2021) who investigated the effects of experiential learning approach on secondary school students' academic achievement in biology in the Awka Education Zone. According to the study findings, there was no appreciable gender influence on students' academic achievement in biology.

Agreeably, the findings of this study are in line with those of a study published in 2022 by Bizimana, Mutangana, and Mwesigye on the effects of concept mapping on boosting retention in photosynthesis throughout secondary schools in the Nyamagabe region of Rwanda. The results demonstrated that when concept mapping was used to teach students about photosynthesis, both male and female students equally retained the content. However, there was a gender difference in the mean retention scores when students were exposed to cooperative mastery learning, with female students remembering the information substantially more than male students.

The findings of this study are consistent with those of Chabari (2018), who investigated the effect of a hands-on, experiential teaching approach using graphic organizers on students' academic success and self-concept in chemistry. The results demonstrated that student gender had no appreciable influence on either achievement or chemistry self-concept. This suggests that if the new approach is implemented in biology instruction, the performance gap between boys and girls would be reduced, thereby raising students' overall achievement. The findings of the study are in agreement with those of Chesimet (2016) who explored how students' mathematical creativity and academic achievement were impacted by experiential learning approaches in Kericho East Sub-County. The results indicated that the effects of the treatment on gender and mathematical achievement were not significantly different.

Correspondingly, the results of our study are in line with those of Kabunga, Habiba, and Mnjokava (2018). Their findings showed that there was no appreciable variation in gender interest in the natural sciences. The study examined the relationship between academic success and interest in natural science topics among secondary school students in western Uganda using a correlational research design. The 1350 senior four students were scheduled to attend 350 schools. For the study sample, 450 participants were randomly selected. At the secondary school level, career counseling should be offered professionally to improve students' interest in natural scientific courses. The government should keep up its initiatives and policies to advance gender parity in sciences for better academic performance.

Contrarily, the current study contradicts the findings of Okuakaji and Sukolatambaya (2020), who investigated the effects of experiential learning on academic performance among biology students in Nigeria. The results of the study showed that males demonstrated higher performance than females. In the United States, public polls on the gender imbalance in science achievement provided conflicting results (Amelink, 2009). According to this study, females and males performed equally in the completed classwork;

nevertheless, in evaluations aimed to measure content knowledge, such as the nationwide study of department of education, differences between males and females in education programs emerged in primary and proceeded through high school. Moreover, our study findings are in contradiction with those of Arop, Umanah, and Effiong (2015) who examined the effect of instructional materials on students' learning of science in Cross River State, Nigeria. The findings revealed a considerable disparity in learners' average achievement scores, with females scoring higher than males.

Similarly, our findings contradicted those of Weinberg, Basile, and Albright (2011) who reported that there were some gender disparities, with males exhibiting greater improvements in interest in mathematics than females. The study examined the effects of experiential learning on middle school students' motivation and interest in mathematics and science in Nigeria using a mixed methods design. The Expectancy-Value model served as the theoretical foundation for the investigation of the 336 middle school participants. More effective teaching approaches should be explored in order to enhance both boys' and girls' motivation for learning.

SUMMARY OF RESEARCH FINDINGS

In order to obtain results based on gender, the study compared students' performance in biology subject when taught both conventionally and experientially by gender. The results showed that there were no statistically significant differences between males and females in terms of achievement in biology subject when taught using experiential learning approach. The study established that, when experiential learning approach is used, gender has no influence on students' academic achievement.

CONCLUSION

Our study findings confirmed that when students are taught biology using ELA, gender has no influence on biology achievement. This implies that, experiential learning approach is an appropriate teaching approach for male and female students; it is gender sensitive and non-discriminative. Additionally, ELA affords all students an equal access to the curriculum while maintaining their high expectations.

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REFERENCES

1. Ababneh, E., & Samad, M., (2018). Gender gap in Science Achievement for Jordanian Students in PISA2015. *European Journal of Educational Research*, *7*(4), 963-972.
2. Almasri, F. (2022). The impact of E-Learning, Gender-Groupings and Learning Pedagogies in Biology Undergraduate Female and Male Students' Attitudes and Achievement. *Education and Information Technologies*, 1-52.
3. Amedu, O. (2015). The Effect of Gender on the Achievement of Students in Biology Using the *Jigsaw Method. Journal of Education and Practice*, 6(17), 176-179.
4. Amelink, C. (2009). *Literature Overview: Gender Differences in math Performance*. SWEAWE CASEE Overviews. Retrieved from: https://www. engr. psu. edu/AWE/misc/ARPs/ARP Math Gender Differ Overview 063009. pdf.
5. Andresen, L., Boud, D., & Cohen, R. (2020). Experience-based Learning. In *Understanding Adult*

Education and Training, (225-239).

6. Arop, B., Umanah, I., & Effiong, E. (2015). Effect of instructional materials on the teaching and learning of basic science in junior secondary schools in Cross River State, Nigeria. *Global Journal of Educational Research*, *14*(1), 67-73.
7. Awolere, M. (2015). *Effects of Experiential and Generative Learning Strategies on Students' Academic Achievement, Attitude to and Practical Skills in Biology in Oyo state,* Nigeria.
8. Bizimana, E., Mutangana, D., & Mwesigye, A. (2022). Fostering Students' Retention in Photosynthesis Using Concept Mapping and Cooperative Mastery Learning Instructional Strategies. *European Journal of Educational Research*, *11*(1), 103-116.
9. Beard, C., & Wilson, J. (2018). *Experiential Learning: A Practical Guide for Training, Coaching and Education*. Kogan Page Publishers.
10. Chabari, K. (2018). *Effects of Graphic Organizers Experiential Teaching Approach on Secondary School Students' Achievement and Self-Concept in Chemistry in Nakuru north Sub County, Kenya* (Doctoral Dissertation, Egerton University).
11. Chesimet, M. (2016). *Effects of Experiential Learning Approach on Mathematical Creativity and Achievement among Secondary School Students of Kericho East Sub-County, Kenya* (Doctoral Dissertation, Egerton University).
12. Kabunga, A., Habiba, C., & Mnjokava, C. (2018). Learners' Attitudes and Performance in Science Subjects in A-Level in Secondary Schools, in Mbarara, Uganda.
13. Kenya National Examinations Council, (K.N.E.C). (2019). *K.C.S.E Examination Report. Nairobi Kenya National Examinations Council*. Government Printers.
14. Kolb, A., & Kolb, D. (2017). Experiential Learning Theory as a Guide for Experiential Educators in Higher Education. *Experiential Learning & Teaching in Higher Education*, *1*(1), 7-44.
15. Morris, T. (2020). Experiential Learning–a Systematic Review and Revision of Kolb's Model. *Interactive Learning Environments*, *28*(8), 1064-1077.
16. Nnamani, S., & Oyibe, O. (2016). Gender and Academic Achievement of Secondary School Students in Social Studies in Abakaliki Urban of Ebonyi State. *British Journal of Education*, *4*(8), 72-83.
17. Nwuba, I., & Osuafor, A. (2021). Effect of Experiential Learning Approach on Secondary School Students' Academic Achievement in Biology in Awka Education Zone. *South Eastern Journal of Research and Sustainable Development (SEJRSD)*, *4*(2), 1-15.
18. Ogunniyi, B. (1992). *Understanding Research in Social Science*. Nigeria: Ibadan University Press.
19. Okuakaji, M., & Sukolatambaya, (2020) Effect of Experiential Learning Strategy on Biology Students' Academic Achievement in Dutsin-MA Local Government Area of Katsina State in Nigeria. *AL-hikmah Journal of Education, 7*(10) 20-25.
20. Prokop, P., Prokop, M., & Tunnicliffe, S. (2007). Is biology Boring? Student Attitudes toward Biology. *Journal of Biological Education*, *42*(1), 36-39.
21. Shuttleworth, M. (2009). *Solomon Four-Group Design*. From http://www.experiment resources.com/solomon-Four group-design.htm
22. Weinberg, A., Basile, C., & Albright, L. (2011). The Effect of an Experiential Learning Program on Middle School Students' Motivation toward Mathematics and Science. *RMLE Online*, *35*(3), 1-12.