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Original Research

Pre-service Biology Teachers Academic Performance and Retention using Jigsaw Cooperative Presentation Learning Strategy

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ABSTRACT

There has been a paradigm shift in the instructional approaches of engaging the learner from teacher-centered approach to students-centered approach. Lecture method of teaching has not been so helpful in improving student performance and retention. Student-centered approach such as jigsaw cooperative learning strategy has been identified to be effective in advancing communication skills, interpersonal skills as well as academic performance and retention. This study investigated pre-service Biology teacher's academic performance and retention using jigsaw cooperative presentation learning strategy (JCPLS) in Kebbi and Sokoto States Universities, Nigeria. The study employed quasi-experimental research design; one hundred and twenty seven (127) pre-service Biology teachers were purposively selected as the sample for the study. Lower Invertebrate performance test (LIPT) with option A-D forms the instrument for the study. LIPT instrument was validated by 3 experts, the pilot testing result of LIPT shows the reliability index of .89 using PPMC. Two objectives, research questions and null hypotheses guided the study. The results revealed that experimental group to which JCPLS was used in teaching Lower Invertebrate Course performed better than the control group to which lecture method was used. Also the results showed that there was no significant difference between post test and follow-up test scores in experimental group. It was concluded that JCPLS is effective in improving academic performance and retention of Lower Invertebrate Course content among pre-service biology teachers. It was recommended among others that lecturers should utilize JCPLS in teaching Lower Invertebrate Course and other courses.

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1. INTRODUCTION

Science, Technology, Engineering, and Mathematics (STEM) education has a vital role in the socio-economic improvement of various nations. Cogent application of STEM knowledge and skills can provide speedy and viable developmental growth of a country. Amoo et al (2019) argued that STEM education has been popularly adjudged as an indispensable ingredient to sustainable development. It begets socio-economic development through opportunity for employment, income benefit, and welfare improvement. However, it is apparent that, as at today, these noble goals of STEM education cannot be said to have been satisfactorily

achieved in most developing countries, especially Nigeria, considering the level of development and massive unemployment, coupled with the current crisis across Nigeria, such as militancy, Banditry, kidnapping, oil bunkering, herdsmen/farmers clashes, murderous acts by Boko Haram religious extremists and armed robbery. Most of the key players in all these are youths who are either unemployed or uneducated (Adolphus & Oroworukwo, 2020).

Meanwhile, education, especially in the sciences, aims to instill appropriate values, knowledge, and abilities in the youth, facilitating their integration and responsible contribution to the advancement of their communities and nations. Proficiency in Biology is essential for the advancement of any society. This statement indicates that it can influence the professional trajectories of individuals across various fields, including education, medicine, engineering, chemistry, nursing, psychology, environmental science, scientific research, and other non-scientific professions (Collings & Smithers, 1983; Huffmyer et al., 2022; Anupama et al., 2018). Biology imparts science skills such as observation, identification, analysis, and evaluation of data. These abilities are necessary for day-to-day living.

Obigbor and Ajaja (2023) assert that the inadequate performance of pupils in Biology has emerged as an insurmountable issue inside the nation's educational framework. Tertiary education institutions can play a vital role in advancing the quality of Biology teachers, especially the Universities. Ojok et al, (2022) asserted that the demand for university education in Sub-Saharan Africa (SSA) is substantial, since the labor market necessitates qualified, knowledgeable, and adaptable graduates who can contribute to economic and social progress. Consequently, it is essential to investigate actions that could enhance Science education in Tertiary Institutions. Karisan et al, (2019) argued that equipping pre-service teachers (PTs) to interact with various student populations in STEM fields in substantial and impactful manners is a primary objective of STEM teacher education globally. While it is essential for teacher preparation programs to adhere to minimal criteria, additional measures are necessary to adequately equip candidates for effective teaching (Aleksieva, 2025; Douglass, 2023; Lang et al., 2018).

Onwe and Uwaleke (2019) assert that teaching excellence has been adequately addressed in the Western world; Nevertheless, it continues to pose challenges in the Nigerian educational sector due to the predominant use of teacher-centered methods (Folashade, 2023). Ojok et al. (2022) indicated that higher education institutions in sub-Saharan Africa predominantly utilize teacher-centered approaches, which hinder student engagement and the cultivation of abilities such as critical thinking and problem-solving. Poor-quality teaching skills and an overreliance on lecture-based instruction remain key challenges in Nigerian science education (Ajeyalemi et al., 2021). Not only that, traditional lecturing has also shown limited effectiveness in improving students' academic performance (Timayi et al., 2019). The traditional lecture approach of teaching perceives students as passive recipients of knowledge, neglecting the necessity to actively include them in the learning process. This aligns with the perspective of Palanissamy et al. (2017) which asserts that students' interests were overlooked due to an inflexible teaching methodology, despite their essential significance in the educational process. The criticisms of traditional learning methods, alongside the development of various learning theories and the implementation of innovative instructional strategies in higher education, led to the emergence of the student-centered approach to teaching and learning (Ibrahim, 2014).

Meanwhile, the established provision for science teaching according to the National Policy on Education (FRN, 2013) states that, 'Science teaching shall be exploratory, experimental, participatory, and student-centered'. Supporting the (FRN, 2013) on student-centered teaching, Akpomi and Kayil (2020) indicated that there has been a paradigm shift in the instructional approaches of engaging the learner from a teacher-centered approach to a student-centered approach.

Researchers have identified the student-centered approach as beneficial and efficient in enhancing science learning outcomes (Etobro & Fabinu 2017; Ezeala Romanus & Ifenyinwa 2020; Quainoo et al., 2025). Cooperative learning is a student-centered strategy that involves various ways of group work, designed to enhance students' learning skills in small groups through shared objectives. Every team member is anticipated to not only acquire the knowledge imparted but also to assist fellow colleagues in their learning (Gambari & Yusuf 2017). Ekeanyanwu and Anene (2020) stated that the cooperative learning strategy yields benefits such as enhanced academic achievement and retention, development of critical and social skills, appreciation of individual differences among learners, increased participation, and heightened motivation for collaboration.

The jigsaw strategy was proposed by Elliot Aronson in 1971 and firstly applied by Aronson in 1978. It yielded much success in advancing students' outcomes such as social, conceptual and cooperative skills. It was letter improved by Slavin in 1980. Researchers have reported the potency of jigsaw cooperative learning strategy in enhancing students' performance and retention in science and related subjects (Khine et al, 2019; Azmin, 2019; Abed et al, 2020). In jigsaw cooperative learning strategy, students are assigned into 5-10 in a heterogeneous team/group to work on academic materials or solve a problem. Each student is given a

section/topic on which to become an expert. Students with the same section/topic meet in expert groups to discuss after which they return to their original team to teach what they have learnt to their team-mates (Aydin & Biyikli, 2017; Gambari & Yusuf, 2017). The statistical analysis of the study conducted by Karacop and Diken (2017) indicate that the effects of laboratory approach based on Jigsaw method were higher than those of the confirmatory laboratory practice on the development of student teachers' scientific process skills. Yapıcı (2016) indicated that an analysis of retention test scores in the study comparing the jigsaw technique and lecture method revealed a considerable disparity between the experimental and control groups regarding information retention. The findings indicate that the jigsaw technique of cooperative learning is more effective than standard teaching methods in promoting long-term retention of knowledge.

In this study the researcher adds some activities to jigsaw cooperative learning strategy and calls it Jigsaw Cooperative Presentation Learning Strategy (JCPLS). It is a strategy proposed and tested by the researcher for tertiary institutions. JCPLS follows the same procedure with other jigsaw strategies; it varies with the other jigsaw procedure in the contacts of home and expert groups which were carried out outside the formal class setting. In JCPLS the home and expert groups interactions are scheduled by the group members at convenience within a specified period before the general formal class session. This allows student to interact with each other and relate freely to learn the material or solve a problem without supervision of the teacher. In due course students will converge during the formal class setting and present the outcome of their expert and home group interactions individually with the supervision of the teacher. While in other jigsaw procedures all the interactions of the home and expert groups take place during the class session without individual presentation but under the supervision of the teacher.

Types of Jigsaw Cooperative Learning Strategy

Table 1. Presented Comparisons of Six Different Types of Jigsaw Cooperative Learning Strategy

Statement of Comparison	**Jigsaw I by Aronson et al (1978)**	**Jigsaw II by Slavin (1980)**	**Jigsaw III by Gonzalez and Guerrero (1983)**	**Jigsaw IV by Holiday (2002)**	**Reverse Jigsaw by Hedeen (2003)**	**Jigsaw Cooperative Presentation by Musa (2025)**
Brief Introduction of topic.	NO	NO	NO	YES	NO	NO
Expert sheets assigned to each member of expert group.	YES	YES	YES	YES	YES	YES (Different topic to each member)
Group members answer expert questions prior to returning to home teams.	YES (Inside the class scheduled by the teacher).	YES (Inside the class scheduled by the teacher).	YES (Inside the class scheduled by the teacher).	YES (Inside the class scheduled by the teacher).	YES (Inside the class scheduled by the teacher).	YES (Outside the class scheduled by the students).
Quiz to check accuracy of content in expert group: based on the expert sheet.	NO	NO	NO	YES (Inside the class scheduled by the teacher).	NO	YES (Outside the class scheduled by the students).
Students return to home teams sharing their information with team mates.	YES (Inside the class scheduled by the teacher).	YES (Inside the class scheduled by the teacher),	YES (Inside the class scheduled by the teacher).	YES (Inside the class scheduled by the teacher).	NO	YES (Outside the class scheduled by the students).
Quiz to check accuracy of content in home group: based on all material.	NO	NO	NO	NO	YES (Inside the class scheduled by the teacher)	YES (Outside the class scheduled by the students).

Review process by whole group.	NO	NO	YES	YES	NO	Individual Present to the whole Class.
Individual assessment and grade	NO	YES	YES	YES	YES	YES (after whole presented)
Re-teach any material which teacher think misunderstood after individual assessment.	NO	NO	NO	YES (Inside the class scheduled by the teacher).	NO	YES (Inside the class by the teacher after whole class presented).

Source: Adapted with some modifications from Jansoon, Somsook, and Coll (2008)

Jigsaw Cooperative Presentation Learning Strategy (JCPLS) is superior to other jigsaw strategies in application at Tertiary Institutions because, looking at the statements of comparison as adapted from Jonsoon et.al (2008) only jigsaw IV and JCPLS had all YES and one NO to all the statements. In jigsaw IV all learning activities take place inside the class under the supervision of the course tutor, while in JCPLS learning activities are solely vested on the students' interactions with one another in the expert and home groups taking place outside the class without the supervision of the course tutor. These provide an avenue for the students to feel free to explain and criticize each other for better comprehension of the topic and sub-topics. Despite that, Moin et al. (2024) reported some negative aspects of jigsaw technique as identified by students that, jigsaw activity took a lot of time for its completion, numerous groups in one lecture hall made it difficult for them to discuss as there was a lot of background noise, switching from expert teams to home group teams created a lot of disturbance and confusion in the limited class space and there were inadequate preparation by teammates. In Nigeria context these problems may be apparent. Meanwhile, the issue of enough time, space, distraction and inadequate preparations from other members of the class were eliminated in JCPLS. Because the students at Tertiary Institutions were more mature to control and handle one another with mutual respect for better performance of all involved in the various group settings. In JCPLS the home and expert group interactions were scheduled by the students at convenient time and place, also the students will have time to study his/her sub-topic individually before meeting with expert group members, in the expert group they corroborate their expert knowledge, re-examine the sub-topic for proper comprehension at the same time ask each other questions for proper monitoring of individual ability on the sub-topic. The same procedure will take place in the home groups. Learning activities were fully student-centered with minimal supervision from the course tutor. Note that the JCPLS was first proposed and implemented in this study.

Statement of the Problem

Nigeria is left behind in terms of Human Capital Development and Infrastructural Development which led to current youth restiveness, security crisis and unemployment. Kebbi and Sokoto States security crises and unemployment are apparent. Effective Biology education can provide young generation with increasing intellectual capacity and coping skills for dealing with challenges of life. The problem is that majority of lecturers in the University teach students using teacher-centered approach especially Lecture Method. This may affect the quality of pre-service Biology teachers. The underperformance of pre-service Biology teachers in Lower Invertebrates Course (LIC) in Kebbi and Sokoto States Universities Nigeria has become a worrisome situation that calls for attention.

The poor performance of UG II pre-service biology teachers may leads to problems to the students such as; not learning the content of the course, which may lead to the course to become a carry-over, it may result to dropping of the course or being additional workload, in some cases social and emotional problems may occur due to attending the course with junior course mate, it may also affects science teaching self-efficacy of pre-service Biology teachers due to inadequate mastery of subject matter knowledge. Therefore, this study investigates the effects of jigsaw cooperative presentation learning strategy on performance and retention of pre-service biology teachers in Kebbi and Sokoto States Universities, Nigeria.

Research Questions

The following research questions were raised for the study:

1. What is the difference between academic performance of experimental group taught Lower Invertebrate Course (LIC) using jigsaw cooperative presentation learning strategy and control group taught LIC using lecture method?

2. What is the difference between post test and post-post test score of experimental group taught LIC using jigsaw cooperative presentation learning strategy?

Null Hypotheses

The following hypotheses were formulated based on research questions which were tested at $p \leq 0.05$ level of significance.

1. **Ho1**: There is no significant difference between academic performance of experimental group taught Lower Invertebrate Course (LIC) using jigsaw cooperative presentation learning strategy and control group taught LIC using lecture method.
2. **Ho2**: There is no significant difference between post test and post-post test score of experimental group taught LIC using jigsaw cooperative presentation learning strategy.

2. THEORETICAL FRAMEWORK

This study is grounded in the theoretical framework of social cognitive theory, developed by Canadian psychologist Albert Bandura in 1962. It is a learning theory predicated on the notion that individuals acquire knowledge through the observation of others' actions (Riaz & Mushtaq, 2019; Saka, 2025). The theory posits that learning transpires through observation, with environment, behavior, and cognition as primary elements influencing growth. The primary tenets of social cognition theory assert that individuals can acquire knowledge through observation, namely that learning transpires when one witnesses others doing the task (Ott, 2024). The jigsaw cooperative learning approach facilitates observational learning through the joint efforts of group members to uncover facts and articulate them to others. In jigsaw learning, a sequence of observation and engagement takes place, whereby both instructors and observers acquire knowledge from the demonstrated activities during interactive phases. Consequently, the use of the jigsaw cooperative learning technique may result in enhanced learning and retention from a social cognitive theoretical standpoint (Jimoh, Idris & Olatunji, 2016).

3. METHODS

The design adopted for this study is quasi-experimental, which comprises two groups, namely the experimental and control groups, involving pre-test, post-test and post-post-test research design. The study population consisted of four hundred and ninety-six (494) UG I - IV Students of Departments of Sciences Education KSUSTA and SSU for 2023/2024 Academic Session. 127 UG II pre-service biology teachers were purposively selected due to the requirements of the study. Intact classes of seventy-five (75) UG II Pre-service biology teachers in KSUSTA served as the experimental group and fifty two (52) UG II pre-service biology teachers in SSU served as control group, this was arrived at by simple random sampling technique.

The Lower Invertebrate Performance Test (LIPT) was used as the instrument for the study. LIPT was a researcher's constructed instrument from the content of Lower Invertebrate Course. The instrument was validated by three (3) experts from Department of Zoology Faculty of Life Science Usmanu Danfodiyo University Sokoto. All comments and observations were used to improve the test items and were reflected in the final version of the instrument. The data obtained from the pilot testing was subjected to statistical analysis using Pearson Product Moment Correlation Coefficient (PPMC) The result of the analysis shows the reliability index of .89 which indicate that the instrument is highly reliable.

In the control group, students learned the content of Lower Invertebrate Course through conventional lecture-based teaching. The instructor's role was information transmitter. The main interaction was between the teacher and the students. This whole process was repeated six times, once in week for each unit of work that was covered in a week as in the experimental groups. The experimental groups were taught based on the experimental procedure; both groups were taught by the research assistants (Lower Invertebrate Course Tutors).

Experimental Procedure

The following specific steps were followed in implementing jigsaw cooperative presentation learning strategy in teaching of Lower Invertebrate Course:

1. In the experimental group, the students were divided into four heterogeneous groups called jigsaw cooperative presentation learning (JCPL) groups of twelve (12) members in each group. Each week one JCPL group will make presentation. Each group of JCPL were also divided into three (3) small heterogeneous groups called home groups with four (4) members in each group, thereafter three (3) members with the same responsibility from different home group formed four (4) expert groups. The groups were diverse in terms of gender i.e male and female.

2. All students were given academic tasks different sub-topics in their jigsaw home groups. The three home groups contain the same content to be covered.
3. Each sub-group member in the home group took the part of the sub-topic allocated to him/her researched on and studied on his/her own outside the class.
4. Two (2) days after, each member from home group moved into expert group consisting of members from other home groups who have been assigned similar sub-topic, they discuss and share their findings meeting outside the class.
5. Two (2) days later from expert group, participants returned to their home groups where they took turn and teach what they have learned from expert groups to the members of their home groups, meeting outside the class.
6. Three (3) days later jigsaw cooperative presentation learning group containing three (3) home groups presented the outcome of their home and expert groups interactions, whereby each home group presented the outcome of their group work individually with each member presenting his/her own section of the sub-topic to the general class members for the duration of seven (7) minutes per individual making twenty eight minutes, while twelve (12) minutes were used for entertaining questions, contributions or observation from the class members to the presenters.
7. The research assistant Lower Invertebrate Course Tutor guides the conduct of the class activities and also makes clarification on the presentation where necessary. The same procedure continued each week with one jigsaw cooperative presentation learning group of twelve students, three home groups making their presentation for the period of six weeks until the whole topics were covered.

Two hours duration for the class session was divided as; forty minutes for each home group of four students, each student made presentation for the duration of seven minutes making twenty eight minutes, while twelve minutes was used for questions, observations and Course Tutors remarks. Three groups covered the two hours. Figure 1 presented steps in implementing jigsaw cooperative presentation learning strategy in teaching Lower Invertebrate Course in experimental group.

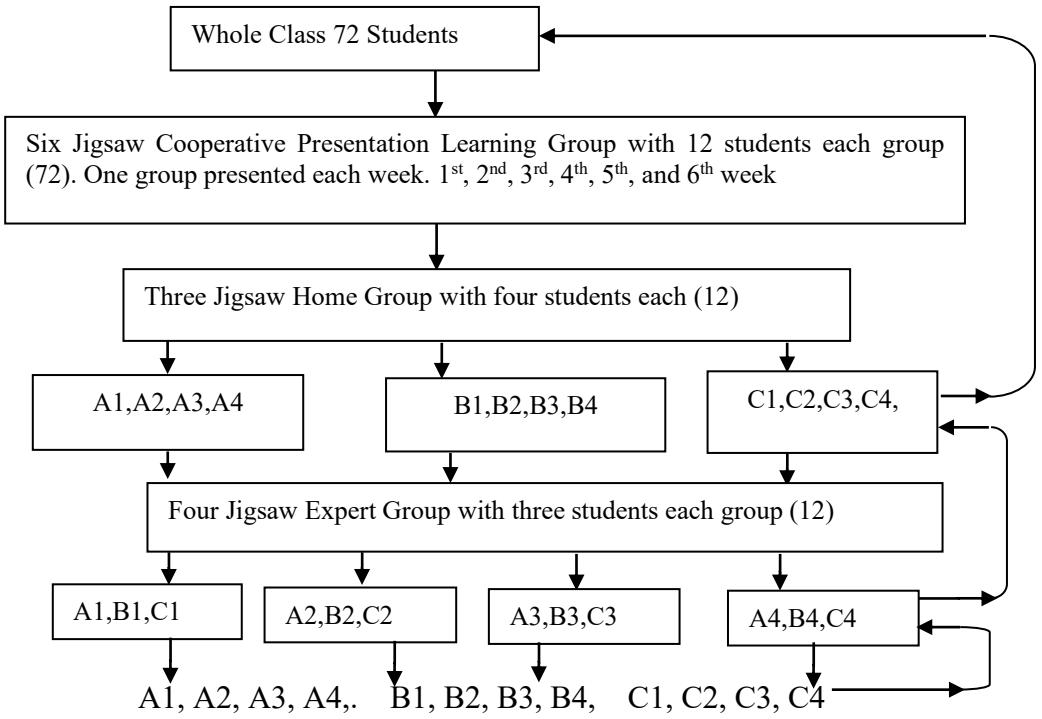

Figure 1. Steps in Implementing Jigsaw Cooperative Presentation Learning Strategy (JCPLS) in Teaching Lower Invertebrate Course to experimental group.
Source: *Researchers Designed Steps for Implementing Jigsaw Cooperative Presentation, 2024*

Key:
The first box indicate the whole class of experimental group of 72 students
The second box had six (6) jigsaw cooperative presentation learning groups of 12 students each
The third box had three (3) jigsaw home groups with each home group having 4 students each possessing different sub-topics, but all four home groups has the same sub-topics.
The fourth box had four (4) jigsaw expert groups with 3 students all having the same sub-topics in an expert group, but different sub-topic with other jigsaw expert groups.
The alphabet A1-A4, B1-B4, C1-C4, indicates the phase where individuals will study their sub-topic on their own.


Indicate how the whole class was grouped to the level of individual study
Indicate how learning interaction takes place from individual study to expert group, to the home group and then to the whole class.

Method of Data Analysis

The collected data for the study were presented and analyzed using descriptive statistics, with mean, standard deviation and mean difference to answer the questions. First, the two groups in the Universities studied (KSUSTA and SSU) were homogenous. Consequently, the researcher sought this homogeneity in terms of pre-service biology teachers' responses to the pre-test of Lower Invertebrate Performance test (LIPT). An independent samples t-test conducted shows the mean 15.44 and standard deviation 2.75 of experimental group, and the mean 15.58 standard deviation 2.43 of control group with t(119)= .327, p= .744 on the pre-test scores of experimental and control groups respectively. Hence, the groups in KSUSTA and SSU were said to be equivalent at the beginning of the study. Out of the total sample of one hundred and twenty seven 127 students' one hundred and twenty one 121 students remained 95.27% and six 6 students (3 from both groups) drop out from the study making 4.73%. Note that this did not in principle become a significant threat to internal validity.

4. RESULTS AND DISCUSSIONS

Research Question One: What is the difference in academic performance of experimental group taught Lower Invertebrate Course (LIC) using jigsaw cooperative presentation learning strategy and control group taught LIC using lecture method?

Table 2. Descriptive Statistics of Post Test Score of Experimental and Control Groups

Groups	N	Mean	SD	MD
Experimental Group	72	31.55	3.945	3.96
Control Group	49	27.59	3.048	
Total	121			

Source: Field Work (2024)

Table 2 presents the mean, Standard deviation and mean difference of the Lower Invertebrate performance test score of experimental and control groups. The results shows that the experimental group had a mean score of 31.55, SD 3.945 and the control group had a mean score of 27.59; SD 3.048. These indicate mean difference of 3.96, the difference in favor of experimental group. This answered the research question that there is difference in the academic performance of experimental group and control group, with experimental group taught LIC using jigsaw cooperative presentation learning strategy performed better than the control group taught LIC using lecture method.

Research Question Two: Is there any difference in retention of experimental group taught Lower Invertebrate Course (LIC) using jigsaw cooperative presentation learning strategy?

Table 3. Descriptive Statistics of Post-test and Post-post Test of Experimental Group

Group	Scores	N	Mean	SD	MD
Experimental Group	Post Test	72	31.55	3.945	0.57
	Post-post Test	72	30.98	3.529	
Total	-	144			

Source: Field Work (2024)

Table 3 presents the mean score, standard deviation and mean difference of Lower Invertebrate Post Test and Post-post test scores of the experimental group taught Lower Invertebrate Course (LIC) using the

jigsaw cooperative presentation learning strategy (JCPLS). The results show that Post test had mean of 31.55, SD 3.945 and Post-post test had mean of 30.98, SD 3.529. These indicate a difference of 0.57 in favor of the post-test. This answered the research question that there is a slight difference between the mean of the Post Test and the Post-post test of the experimental group taught LIC using JCPLS.

Hypotheses Testing

The data collected were further subjected to hypothesis testing at a 0.05 level of significance; the hypothesis testing was done to confirm the results of the analysis.

Table 4. Summary of Independent Sample t-test of Experimental and Control Groups

Group	N	Mean	SD	Df	t-cal.	p-value	Decision
Experimental	72	31.55	3.945	119	6.397	.000	Rejected
Control	49	27.59	3.048				

Source: Field Work (2024)

Table 4 revealed that there is significant difference between experimental group and control group on academic performance, $t(119)=6.397$, $p< .001$. Hence, the null hypothesis is hereby rejected. This indicates a statistically significant difference in academic performance between experimental and control Group. This indicates that jigsaw cooperative presentation learning strategy is an effective strategy for teaching LIC to pre-service Biology teachers.

Table 5. Summary of Paired Sample t-test of Post Test and Post-post Test of Experimental G

Test	N	Mean	SD	Df	t-value	p – Value	Decision
Post Test	72	31.55	3.945	73	1.325	.186	Retained
Post-post Expt	72	30.98	3.529				

Source: Field Work (2024)

Table 5 revealed that there is no significant difference between post test and post-post test performance, $t(73)=1.325$, $p=.186$ in experimental group taught Lower Invertebrate Course (LIC) using jigsaw cooperative presentation learning strategy (JCPLS). Hence, the null hypothesis is hereby retained. This indicates retention in the experimental group taught LIC using JCPLS.

Discussion

The result of the null hypothesis one showed that there was a significant difference in the mean performance of pre-service Biology teachers taught the Lower Invertebrate Course (LIC), with the jigsaw cooperative presentation learning strategy group performing better than the lecture method group. This finding is in agreement with studies conducted by Yaayin, Emmanuel and Oppong (2021) their findings indicated that the jigsaw model significantly enhanced performance in selected functional group organic compounds among pre-service teachers in the experimental group compared to their counterparts in the control group, who were instructed using the traditional lecture method. Similarly, Aydin and Biyikli (2017) reported a study at the State University in Turkey, indicating that the laboratory skills of the experimental group to which jigsaw was applied developed more than those of the control group to which the traditional lecture method was used. Likewise, Khine et. al (2019) performed a study at the University of Computer Studies, Yangon (UCSY) and found that the average score of the students taught using the jigsaw strategy has improved more than that of the students taught using the traditional lecture teaching method. The use of jigsaw cooperative presentation learning strategy (JCPLS) in this study has evidence that JCPLS is effective in improving learning outcomes. The positive impact of JCPLS on advancing academic performance of pre-service biology students may be as a result of experiences involved during the learning processes of the strategy, such experiences include individual study, during individual study, each individual search for knowledge about the sub-topic assigned to him/her, comprehend the sub-topic before meeting in an expert group. In the expert group each member explain to the group what he/she comprehend about the sub-topic, thereafter brain storming follows which will lead to coming up with a unanimous decision on the sub-topic or how to solve the assigned problem, members of the group ask themselves to justify before moving to jigsaw home group. In the jigsaw home group, each student having different sub-topic take turn to explain the aspect of his/her sub-topic, students scrutinize each other for proper comprehension of all sub-topics and also to justify each other mastery of his/her sub-topic before final presentation in the general class session. In the general class session, each jigsaw home group makes their presentation whereby each student presents the aspect of his/her sub-topic to the whole class, while class members listen and ask question after presentations. This experience could be stimulating and demanding, perhaps motivating students to aspire for excellence

and superior performance rather than merely attending class and passively listening to the instructor's teachings. However, the accord with many authors on this finding echoes the theoretical concept of 'convergent validity, this convergence underscores the strength of JCPLS in enhancing academic performance. Furthermore, this finding align with the philosophical idea of social cognitive learning theory, which posits that learning occurs through observation, and that environment, behavior and cognition are all chief factors that influence development (Bandura, 1962).

The findings of null hypothesis two indicate that there was no significant difference between post-test and post-post-test scores of the experimental group taught the Lower Invertebrate Course (LIC) using the jigsaw cooperative presentation learning strategy (JCPLS). This suggests that the study found retention in the experimental group. The findings in this study are consistent with previous research that has shown the jigsaw strategy to be more effective in promoting learning retention, for instance, Yapıcı (2016) found that students in the jigsaw group performed significantly better in learning retention. Similarly, a study by Dirlikli and Akgun (2017) showed that the jigsaw learning strategy has been more effective on the development of pre-service teachers' academic achievement and learning retention in analytical examination of the circle in mathematics. This may be as a result of JCPLS, with its emphasis on cooperative learning experiences, student's centered approach and active social interaction among students, may have created a multifaceted learning environment that fosters retention. By recognizing the convergent substantiation, we can agree with the effectiveness of the jigsaw strategy in enhancing learning retention within the experimental group to which JCPLS was utilized.

Despite the effectiveness of jigsaw cooperative presentation learning strategy in improving academic performance of pre-service biology students in Lower Invertebrate Course in the present study, it was observed that the absence of randomization may have introduced selection bias, as the students in the groups could differ in characteristics such as prior knowledge, motivation, or learning ability, which might have influenced the outcomes independent of the treatment. Likewise, because the classes were taught by different instructors, the teacher effect could not be fully controlled. This may be addressed by other researchers by adopting a randomization design and utilizing one-sample pre-test, post-test and follow-up test to determine the effectiveness of JCPLS. Similarly, the study fails to seek students perceptions on motivation factors for learning, communication skill development, interpersonal skill improvement and possible implementation challenges of JCPLS. Therefore, researchers can explore these aspects so as to strengthen JCPLS.

5. CONCLUSION AND RECOMMENDATIONS

This study has an emphasis on the importance of the jigsaw cooperative presentation learning strategy on pre-service biology teachers' academic performance and retention. At this juncture, it can be concluded that pre-service biology teachers perform better, retain concepts learnt better when taught the Lower Invertebrate Course (LIC) using the jigsaw cooperative presentation learning strategy (JCPLS) than their counterparts who were taught LIC using the lecture method. Therefore, the jigsaw cooperative presentation learning strategy is an effective strategy worth utilizing in teaching pre-service biology teachers. Similar studies can be replicated at different locations, as well as using different topics or subject areas at tertiary institutions, to confirm the effectiveness of the jigsaw cooperative presentation learning strategy. An effort should be made to monitor students' interactions in the home and expert group learning. Similarly, other researchers can compare JCPLS with different types of jigsaw strategies and other student-centered approaches to justify its effectiveness.

Recommendations

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

1. Lecturers at Universities should adopt JCPLS in teaching the Lower Invertebrate course in order to enhance performance and retention of pre-service biology teachers.
2. Learners should be given equal opportunity to actively participate with their class members in their own learning so as to improve the academic performance of students.

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