Effects of Cooperative Learning Strategy on Academic Performance in Biology among Secondary Schools' Students in Gusau Metropolis, Zamfara State, Nigeria

[1]OLATUNBOSUN, Mujidat Lukman & [2]IBRAHIM, Aminu

[1 & 2]Department of Science Education, Faculty of Education, Federal University Gusau, Zamfara State
[1]olatunbosunmujidat@fugusau.edu.ng

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Abstract

This study examines the effects of cooperative learning strategies on academic performance of senior secondary school students in Biology in Gusau Metropolis, Zamfara State. The study is made up of two objectives with corresponding Research questions and hypotheses The research design wasa quasi-experimental design with a sample of 207 students. The instrument used for data collection was Ecology Performance Test (BPT), which was developed by the researchers. The instrument was validated by experts and was pilot tested on 30 students, the data from the pilot test was analyzed using PPMCC and a reliability index of 0.81 was discovered. The research questions were answered using descriptive statistics while the null hypotheses were tested using inferential statistics at 0.05 level of significance. Findings revealed a statistically significant difference in students' performance when taught with cooperative learning strategies. The study concludes that cooperative learning is an effective and efficient method for teaching ecology. The study recommended that the cooperative learning should be adopted and prioritized in teacher training.

Keywords: Instructional Strategy, Ecology, Academic Performance

Introduction

Cooperative learning strategy is an instructional approach that emphasizes collaboration, interdependence, and individual accountability among students. Scholars have provided various definitions of cooperative learning strategy, each highlighting its core components and principles. Cooperative learning strategy, as defined by Johnson et al (2018), involves structuring learning activities in a way that promotes positive interdependence among students. Positive interdependence means that students perceive that they are linked to one another and that their success is dependent on the success of their peers. In other words, students work together as a team, pooling their efforts and resources to achieve shared goals or complete specific tasks. This collaborative effort encourages students to actively engage with the content and rely on each other's knowledge and skills.

The ability of students to participate in group activities, share knowledge, skills and ideas

and work with one another to achieve a common goal is referred to as cooperative learning(Johnson & Johnson 2020). Cooperative learning is a collection of approaches in which students work together in small groups and assist one another in achieving learning objectives (Ochuenwike & Anugwo, 2020). Cooperative learning refers to teaching approaches in which students are divided into small groups by the teacher and then work together to help one another learn academic content (Gillies, 2016). Peers enhance one other's learning and effectively communicate in a cooperative learning technique. Students that use a cooperative learning technique are responsible for each other's learning as well as their own. As a result, one student's achievement aids the success of another student. To develop a common product, students are encouraged to rely on their particular experiences. Cooperative learning helps students to develop ideas, alter them by listening, and contribute as a group by asking questions, expressing uncertainty, and designing and implementing strategies together (Prince, 2020). Cooperative learning is highly effective teaching strategy, and this has been demonstrated through several empirical studies.

A study was conducted by Fariha & Shumaila (2015)to determine the effect of cooperative learning method on students' achievement in subject of Education. Quasi experimental design, with pre and posttest of control and experimental group was used to achieve target of the study. Sample of the study consisted of 63 female students enrolled in grade 12 of a public college. An achievement test was used as a pre-test, the students were then divided into experimental and control groups. Multiple cooperative learning activities were performed with experimental group by using three common methods of cooperative learning that is, STAD, TGT and Jigsaw II. The control group was taught by lecture method only. After 8 weeks a post test was administered on both experimental and control group in order to identify difference in achievement. The independent sample t-test was used to measure the mean scores difference between achievement scores of control and treatment groups on pretest. The results showed that there was no significant difference between the two groups (p=. 825) leading to assumption that both groups were on equal level of achievement before intervention. Same test was applied to find out difference between two groups before and after intervention. The results showed that there was a significant difference in scores of control and experimental group in post-test. In addition to this paired sample t-test was conducted to compare the effect of intervention on achievement scores of experimental group. The results showed that there was significant difference between scores of experimental group before and after intervention (p=. 000). It can be concluded from results that cooperative learning activities had a positive effect on academic achievement of students enrolled in the subject of Education. This study is a contribution to knowledge body of teaching methods for social sciences. This had

clarified that cooperative learning activities are equally helpful. The teachers can use this teaching method in their classes.

Meta-analysis of the impact of cooperative learning on academic performance by Tohid et al, (2023), analyzed and combined the results of the performed studies in order to reach a general conclusion, resolve the existing contradictions, and discover possible moderators. The study was conducted by meta-analysis method. Using purposive sampling method and extensive search based on the extracted data were analyzed with CMA software. Results from selected studies as a sample, in total, 258 effect sizes were extracted which 17 extreme effect sizes were eliminated in sensitivity analysis and the next analyzes were performed on 241 effect sizes. The value of the "fail-safe N" statistic was obtained at 12040, which indicated that after entering this number of non-significant studies, the combined effect size will be non-significant. The amount of combined effect size was calculated at 0.893 in the fixed model and 1.133 in the random model. Both models were statistically significant ($p<0.001$). As the effect sizes were heterogeneous, gender, type of sample, type of cooperative learning, type of course, and year of research were examined as the moderator variables. The results indicated that the effect size of cooperative learning on academic performance is in males more than females, in elementary students more than others, in student teams' achievement division (STAD) instruction more than other types, and in social science courses more than other courses. The results of the research showed that the year of studies has a very small contribution to explaining the heterogeneity. The results of the study showed that cooperative learning had a significant effect on academic performance. It has been assumed that cooperative learning is one of the most important factors or predictors for learners to achieve learning success.

In addition, Kaymak, (2021) investigated the effect of Cooperative Learning (CL) on 8th grade students' academic achievement while also considering the achievement outcomes by gender and to test the hypothesis that CL improves student achievement. The present study was carried out during the Covid-19 pandemic for six weeks during the academic year 2020-2021 in Nurorda high-school in Nursultan in Kazakhstan. The subjects of the study were 86 students (31 girls and 55 boys) aged 13-15 years old and were randomly divided into two groups, 45 students in the experimental group and 41 students in the control group. Final test was administered to students as measuring instrument. The t-test statistical technique was performed in order to answer to the research questions. The data obtained were analyzed with SPSS 21.00 statistical program. The significance level was taken as $p< 0.05$ in the analyzes. Results indicated that the CL has significant positive effects on students' mathematics achievement.

Furthermore, Mohammad & Robyn (2022) examined the effect of embedding cooperative learning (CL) into the Primary and Secondary Education Course (PSEC) on the academic

achievement of undergraduate university students. The study also sought to gauge the perceptions of these students application of CL. A mixed methods sequential explanatory design was used involving 136 undergraduate university students who participated in a 16 week semester intervention involving the implementation of CL into their PSEC. Achievement data were collected from all students pre- and post-intervention to determine if there were significant differences between the experimental and control conditions. Forty-four participants from the experimental condition were also interviewed post-intervention on their experiences of CL.

The results showed that there was a significant difference between the academic achievement of students in the experimental and control groups in favor of students in the experimental group ($p < 0.001$). The perceptions of participants in the experimental condition indicated that CL not only created an empathetic, safe and pleasant learning environment and strengthened students' individual and communicative skills, but it also helped to develop an understanding of quality learning.

A study by Ehsan et al (2019) concluded that cooperative learning increased the speaking skills of their students in an English class through raising their motivation and attitudes in class. They encouraged teachers to practice this method regularly and effectively by following through with its implementation procedure well, however, they also encouraged more research on this method on different academic levels to confirm its effectiveness in different levels.

In another study by Hasanah, & Surya (2017), they concluded that learning through cooperative method increased student achievement and improved student creative thinking in mathematics problem solving hence a suitable method for mathematics instruction. Casey & Fernandez-Rio (2019) noted that through the cooperative method, students learned to value both their own and others' views and solutions, become highly self-reliant on their own minds and ideas, adapt peer group work to suit their own and others' needs within the classroom, and think of academic success and achievement in terms of contribution than just performance in exams. They also noted an increase in positivity especially self-esteem and motivation in their work.

It goes beyond simple division of labor and encourages students to actively contribute, interact, and learn from one another. Another influential scholar in the field, Cohen (2018), conceptualizes cooperative learning as an approach that aims to promote academic achievement and equitable learning outcomes for all students. Cohen's approach, known as "complex instruction," focuses on providing challenging tasks and creating a supportive classroom climate that encourages cooperation and collaboration. In this context, cooperative learning is seen as a means to foster critical thinking, problem-solving, and communication skills among students (Cohen, 2018). It emphasizes the importance of providing students with intellectually stimulating tasks

that require higher-order thinking and active engagement. Through cooperative learning, students are able to construct their own understanding of the content, share their perspectives, and learn from the diverse experiences and ideas of their peers.

More so, Johnson & Johnson (2020) highlight the importance of individual accountability in cooperative learning. They argue that each student in a cooperative learning group must be responsible for their own learning and contribute actively to the group's success. Individual accountability ensures that students are actively engaged, as they know that their contributions and efforts will be evaluated by their peers. This accountability also helps to prevent social loafing and ensures that all members of the group are actively involved in the learning process. By holding each student accountable for their learning, cooperative learning fosters a sense of ownership and motivation, as students strive to fulfill their responsibilities and contribute meaningfully to the group.

The usual approach of relying solely on conventional methods and teachers as a source of knowledge is obsolete and no longer effective in today's technology driven world. There has been a shift towards innovative teaching methods that prioritize active learning and place students at the center of the learning process. This shift has been fueled by breakthroughs in education and recognition of the need to keep up with the rapidly changing world. The cooperative learning strategy is one of these innovative strategies (Ada, 2016). The ability of students to participate in group activities, share knowledge, skills and ideas and work with one another to achieve a common goal is referred to as cooperative learning (Johnson & Johnson 2020). Cooperative learning is a collection of approaches in which students work together in small groups and assist one another in achieving learning objectives (Ochuenwike & Anugwo, 2020). Cooperative learning refers to teaching approaches in which students are divided into small groups by the teacher and then work together to help one another learn academic content (Gillies, 2016). Peers enhance one other's learning and effectively communicate in a cooperative learning technique. Students that use a cooperative learning technique are responsible for each other's learning as well as their own. As a result, one student's achievement aids the success of another student. To develop a common product, students are encouraged to rely on their particular experiences. Cooperative learning assists come up with ideas, change their ideas in order to accommodate the better ideas of their colleagues.

Sani & Bello (2019) investigated the impact of cooperative learning strategy on the academic achievement of public and private senior secondary school students in Gusau, Zamfara State. The study included a sample of 120 students, representing both male and female students. The study revealed that students from both public and private schools exhibited significant improvements in their academic

achievement when taught using cooperative learning strategies. The implementation of cooperative learning techniques, such as group discussions, cooperative projects, and collaborative problem-solving tasks, positively influenced the academic performance of students in both school types.

Study by Muraya & Kinamo (2019) examined the influence of cooperative learning strategy on the academic performance of public and private senior secondary school students in Machakos District, Kenya, using a sample of 120 students, including both male and female students. The findings indicated that students from both public and private schools showed enhanced academic performance when exposed to cooperative learning strategies. The implementation of cooperative learning activities, such as the jigsaw technique, think-pair-share, 37 and group problem-solving, resulted in improved academic achievement for students in both school types.

Study by Musa & Garba (2018) investigated the effect of cooperative learning strategy on students' academic performance in economics. The study involved implementing cooperative learning techniques, including group discussions, cooperative projects, and peer tutoring, in selected secondary schools in Chikun local government of Kaduna State. The sample comprised 80 students, evenly distributed across different classes and genders. The instrument used to measure students' academic performance was a comprehensive economics examination. The results showed that students who experienced cooperative learning exhibited higher academic achievement in economics compared to those who received traditional instruction. The researchers attributed this improvement to the active engagement of students in cooperative learning activities, which fostered a deeper understanding of economics concepts, improved critical thinking skills, and promoted a sense of responsibility towards their own learning. Across the type of school, the results showed that students from both public and private schools exhibited improved academic performance when taught using cooperative learning strategies. The implementation of cooperative learning techniques, such as group discussions, 38 cooperative projects, and peer tutoring, led to higher academic achievement for students in both school types.

A study by Casey & Fernandez-Rio (2019) noted that through the cooperative method, students learned to value both their own and others' views and solutions, become highly self-reliant on their own minds and ideas, adapt peer group work to suit their own and others' needs within the classroom, and think of academic success and achievement in terms of contribution than just performance in exams. They also noted an increase in positivity especially self-esteem and motivation in their work.

Study conducted by Ehsan et al (2019) concluded that cooperative learning increased students' achievement in academics more than the traditional lecture-based system. The students had significantly improved their skills in the topic compared to their counterparts in

the traditional lecture-based class. They also realized that student motivation has significantly gone up compared to their counterparts. They also noted that intrinsic motivation came as a result of cooperative learning.

Study by Lestari et al. (2019) noted a significant difference in the learning outcomes of students who used cooperative learning in mathematics. Mathematics students who used cooperative learning had a higher learning outcome compared to the other students who used conventional learning media.

Study by Tran (2019) argued that cooperative learning increased the motivation of 72 Vietnamese students in their findings. Frequent collaboration and team-work among the students promoted effective learning hence a higher learning outcome was observed. The cooperative learning method has been proposed by many stakeholders as an alternative to the traditional methods but still requires more research and studies to confirm its effectiveness in pedagogy.

Despite the importance of biology for the overall development of individuals and society, students' academic performance in the subject has been observed to be unsatisfactory in Gusau, Zamfara State, WAEC Chief Examiners' Reports for 2022 and 2023 recommended early preparation, using pasts reports and improving practical knowledge to improve students' outcome. This poor performance may be attributed to the traditional teaching methods commonly used by teachers, which are primarily teacher-centered and failed to promote students' engagement and participation. While cooperative learning is an effective strategy that emphasizes student-centered learning and active participation, which can help make abstract biology concepts more concrete. However, little research has been conducted to assess the effectiveness of these teaching strategies on academic performance in demand and supply among secondary school students in Gusau, Zamfara State. Therefore, this study was necessitated to investigate the effects of both cooperative learning and demonstration methods on academic performance in Demand and Supply in Economics in some secondary schools in Gusau, Zamfara State.

Objectives of the Study

The main objective of the study is to find out the effects of cooperative learning strategy on academic performance of students in ecology when compared to discussion method of teaching; specifically, the study sought to find out;

1. To determine the difference in the pre-test and post-test scores of students taught ecology using cooperative learning strategy in senior secondary schools in Gusau metropolis, Zamfara state
2. To determine the difference between cooperative learning strategy and discussion method on the academic performance of students taught ecology in senior secondary schools in Gusau metropolis, Zamfara State.

Research Questions

The following research questions guided the study;

1. What is the difference between the pre-test and post-test scores of students taught ecology using cooperative learning strategy in senior secondary schools in Gusau metropolis, Zamfara state?
2. What is the difference between cooperative learning strategy and discussion method on the academic performance of students taught ecology in senior secondary schools in Gusau metropolis, Zamfara State?

Research Hypotheses

The following null hypotheses are formulated to be tested at a 0.05 level of significance:

1. H01: There is no significant difference in the pre-test and post-test scores of students taught ecology using comparative learning strategy in senior secondary schools in Gusau metropolis, Zamfara state.

2. H02: There is no significant difference between cooperative learning strategy and discussion method on the academic performance of students taught ecology in senior secondary schools in Gusau metropolis, Zamfara State.

Methodology

Aquasi-experimental research design was adopted for this study. The research design involved the implementation of pre-test and post-test to evaluate the effect of cooperative learning strategy and demonstration method on the academic performance of SS2 students taught ecology. The study employed intact classes, two groups were formed, an Experimental Group (EG) that received instruction using cooperative learning strategy and a Control Group (CG)that received instruction using demonstration method. Pre-test was administered to both groups prior to teaching and learning, while post-test was administered to both groups after treatment (teaching using cooperative and discussion method). Population of the Study The population of the study consisted of SS2 biology students in all secondary schools in metropolis, Zamfara State, Nigeria. A purposive sampling technique was used to select the sample of 207for the study. The research instrument used for data collection was Ecology Performance Test (EPT). The items in the test were specifically designed to assess students' academic performance in ecology, it consisted of multiple-choice questions. The test was developed based on the syllabus and learning objectives of the biology scheme of work for SS2 students. The research instrument was validated by experts. Test re-test reliability of the instrument was determined by PPMCC to 0.81.

Results

Answering Research Question 1: What is the difference in the pre-test and post-test scores of students taught ecology using cooperative learning strategy in senior secondary schools in Gusau metropolis, Zamfara state?

Table 1: Summary of the descriptive analysis of the difference in the pre-test and post-test scores of students taught ecology using the cooperative learning strategy.

Groups	N	X	SD	Mean Difference
Pre-Test	103	10.11	1.80	1.24
Post-Test	104	11.35	1.79	

Source: Fieldwork, 2025

Table 1 presents a descriptive analysis of the difference in pre-test and post test scores for students taught ecology using a cooperative learning strategy. The pre-test scores, with a mean of 10.11 and a standard deviation of 1.80, indicate a relatively similar starting knowledge base among the students. Following the intervention, the post-test scores for the students showed an increased mean of 11.35 and a slightly reduced standard deviation of 1.79, suggesting a general improvement in scores with a slightly tighter distribution. The mean difference of 1.24 between the pre-test and post-test scores further highlights this positive change, indicating that, on average, students scored over one point higher after being taught with the cooperative learning strategy.

Answering Research Question 2: What is the difference between cooperative learning strategy and discussion method on the academic performance of students taught ecology in senior secondary schools in Gusau metropolis, Zamfara State?

Table 2: Summary of the descriptive analysis of the difference between cooperative learning strategy and discussion method on the academic performance of students taught ecology in senior secondary schools in Gusau metropolis, Zamfara State.

Group	N	X	SD	Mean Difference
Experimental Group	103	10.23	1.77	1.51
Control Group	100	8.77	2.21	

Source: fieldwork, 2025

Table 2 presents a descriptive analysis of the differences between the experimental group (cooperative learning strategy) and the control group (discussion method) among students. The experimental group, with 103 students, showed a mean performance score of 10.23 with a standard deviation (SD) of 1.77, indicating a relatively consistent performance within this group. In contrast, the control group, comprising 100 students, had a lower mean performance score of 8.77 and a higher standard deviation of 2.21, suggesting greater

variability in performance among students taught using the discussion method. The mean difference of 1.51, favouring the experimental group, suggests that students exposed to the cooperative learning strategy demonstrated a higher average performance of ecology compared to those taught with the discussion method.

Testing Null Hypotheses

Testing Null hypothesis 1: There is no significance difference in the pre-test and post-test scores of students taught ecology using cooperative learning strategy in senior secondary schools in Gusau metropolis, Zamfara state.

Table 3: Summary of the t-test analysis on the significance difference between the pre-test and post-test scores of students taught ecology using the cooperative learning strategy.

Groups	N	X	SD	Df	t-Cal	P-value	Decision
Pre-Test	103	10.11	1.81	205	4.36	.000	Rejected
Post-Test	104	11.35	1.89				

Source: Fieldwork, 2025 $\alpha \leq .05$ level of significance

Table 3 presents the results of a paired-samples t-test comparing the pre-test and post-test scores of students taught ecology using cooperative learning strategy. With a sample size of N=103 for the pre-test and N=104 for the post-test, the mean pre-test score was 10.11 (SD = 1.81), while the mean post-test score significantly increased to 11.35 (SD = 1.89). The calculated t value of 4.36 with 205 degrees of freedom (df) and a p-value of 0.000 (which is less than the chosen significance level of $\alpha \leq 0.05$), this led to the rejection of the null hypothesis. This indicates a statistically significant difference between the pre-test and post-test scores, suggesting that cooperative learning strategy had a positive and significant effect on students' performance.

Testing Null hypothesis 2: There is no significance difference between cooperative learning strategy and discussion method on the academic performance of students taught ecology in senior secondary schools in Gusau metropolis, Zamfara State.

Table 4: Summary of the t-test analysis on the significance difference between cooperative learning strategy and discussion method on the academic performance of students taught ecology

Groups	N	X	SD	Df	t-Cal	P-value	Decision
Experimental Group	101	11.23	1.77	199	4.43	.000	Rejected
Control Group	100	8.92	2.21				

Source: Fieldwork, 2025 $\alpha \leq .05$ level of significance

Table 4 presents the results of independent samples t-test comparing the academic performance of students taught ecology using cooperative learning strategy (Experimental Group) versus those taught ecology using discussion method (Control Group). The experimental group (N=101) had a mean performance of 11.23 with a standard deviation of 1.99, while the control group (N=100) had a mean performance of 8.92 with a standard deviation of 2.21, with 199 degrees of freedom, the calculated t-value (t-Cal) is 4.43. The p-value of 0.000 is less than the significance level (α) of 0.05, leading to rejection of the null hypothesis. This indicates a statistically significant difference in academic performance between the two groups, suggesting that the cooperative learning strategy had a more positive effect on students' academic performance compared to the discussion method.

Discussion of Findings

The significant improvement observed in students' post-test scores compared to their pre-test scores, is a superior performance of the cooperative learning group over the demonstration method group, this aligns with a substantial body of existing literature. This outcome supports the notion that engaging students in collaborative learning environments fosters a deeper understanding of biology concepts. This is in agreement with Fariha and Shumaila (2015), Tohid et'al (2023), Kaymak (2021), Musa and Garba (2018), Sani and Bello (2019), Muraya and Kinamo (2019), Mohammad and Robyn (2022), all of whom reported similar positive effects of cooperative learning on students' academic achievement or performance across various contexts.

Conclusion

The study concludes that cooperative learning strategies are significantly more effective and efficient in enhancing students' understanding and academic performance in biology. The findings clearly demonstrated a marked an improvement in students' learning outcomes.

Recommendations

Based on the findings of this study, the following recommendations are made: That curriculum planner should;

1. Promote the widespread adoption of cooperative learning strategies in biology teaching at secondary school levels.
2. Prioritize cooperative learning techniques in teacher training and professional development programs.
3. Reduce the content and lay emphasis on core concepts.
4. Teachers should serve as facilitators, guiding students.

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