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EFFECT OF COOPERATIVE LEARNING STRATEGY ON CHEMISTRY ACHIEVEMENT OF SENIOR SECONDARY STUDENTS IN ONUEKE EDUCATION ZONE, EBONYI STATE

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ABSTRACT

This study aimed to determine the impact of cooperative learning strategy on students' chemistry achievement and retention in senior secondary schools within the Onueke Education Zone of Ebonyi State. To address this objective, three research questions and hypotheses were formulated. A quasi-experimental, non-equivalent control group design was adopted, involving two groups of students. A multi-stage sampling technique was employed to select a representative sample of 228 SSII chemistry students from six coeducational government-owned senior secondary schools. Initially, the target population of SSII students across 68 schools was stratified. Subsequently, six public secondary schools were simple randomly drawn from these strata. Finally, 3 schools from these six schools were randomly drawn and used as experimental group while the remaining 3 schools used as the control group. This combined sampling approach ensured both representativeness and controlled experimentation. The experimental group was exposed to cooperative learning strategy, while the control group received traditional lecture-based instruction. Findings revealed that cooperative learning significantly enhanced students' chemistry achievements and retention compared to the traditional lecture method. A chemistry achievement and retention test with a reliability coefficient of 0.97 was used to measure students' achievement and retention before and after treatment (pre/post-treatment). The data were analyzed using mean, standard deviation, and analysis of covariance (ANCOVA). The results indicated that the cooperative learning strategy was significantly more effective in enhancing students' achievement and retention compared to the Lecture Teaching Method. This could be attributed to the student's active engagement due to shared responsibility, peer support, social and communication skills in CLS than in LTM leading to increased motivation, development of critical thinking skills, immediate feedback, and diverse learning styles. It was also observed that within the cooperative learning strategy group, male students had higher mean achievement and retention scores than female students. The findings have important implications for educational practice, presenting cooperative learning as an effective strategy for improving chemistry teaching and learning.

KEYWORDS: Students' achievement, Students' retention, Achievement test, Retention test, Analysis of covariance (ANCOVA)

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INTRODUCTION

The desire to improve chemistry achievement and retention through more effective learning strategy has focus on the importance of learner-centered approaches in chemistry education. It is essential for secondary school chemistry students to possess adequate science learning strategies to understand science concepts deeply. According to Tydings (2009), effective ways to improve performance in science subjects include the use of laboratory practicals and appropriate teaching methods. Igwe (2013) emphasizes that effective teaching in schools can be achieved through pedagogical strategies that link learners with scientific knowledge and practical applications, which enhance knowledge retention. Teachers have a great responsibility to identify the difficulties each student encounters by analyzing their achievement and retention. This process helps direct instruction to areas where students struggle and provides targeted remedies. Gallagher (2011) supports this by stating that identifying students' achievement levels helps understand whether behavioral changes have occurred, why they haven't, and what can be done to facilitate these changes. Therefore, reviewing students' achievement in chemistry is crucial to adopting appropriate methods for improvement.

Cooperative learning is an instructional approach where students work together to complete tasks. Nwafor (2014) describes cooperative learning as group learning where individual goals are interconnected, creating a positive correlation towards achieving set goals. Johnson and Johnson, cited in Igwe (2002), note that each student can achieve their learning goals only if other group members achieve theirs. Felder & Brent, (2007) adds that students work together in small groups, using cooperative behaviors to accomplish common tasks, and are individually accountable for their contributions. Activities are structured so that students need each other to succeed, promoting positive interdependence.

Enyi, cited in Omwirhiren (2015), defines achievement as the degree of success attained in a specific area of endeavor. Ngwoke (2010) identifies poor teaching methods as a key reason for students' forgetfulness in learning processes. Lee et al, (2018) research indicates that a learner's retention after instruction is influenced by their degree of involvement in the learning process. This suggests that student-centered teaching strategies can enhance retention. Given these insights, this research considers it worthwhile to investigate the impact of cooperative learning strategy on students' achievement and retention in chemistry within the senior secondary schools of the Onueke Education Zone, Ebonyi State.

PROBLEM STATEMENT

There is a pressing need to address the decline in students' achievement in chemistry. Student-centered strategies have been identified as effective methods for enhancing performance in science subjects, particularly through the appropriate use of instructional materials. However, the impact of gender on students' learning and achievement has yielded inconclusive results. Against this backdrop, the study aims to empirically investigate how cooperative learning strategy can improve achievement and retention in chemistry among senior secondary school students in onueke Education Zone, Ebonyi central.

RESEARCH QUESTIONS

The study addressed the following questions:

1. What are the mean achievements and retention scores of students taught chemistry using the cooperative learning strategy compared to those taught using the lecture method?
2. How do the mean achievement and retention scores of male and female students taught chemistry using the cooperative learning strategy compare in senior secondary schools?
3. What is the interaction effect of teaching method and gender on the mean achievement and retention scores of SS2 students when taught chemistry using the cooperative learning strategy versus the lecture method?

RESEARCH HYPOTHESES

The following null hypotheses were tested at 0.05 level of significance;

1. **Hypothesis 1:** There is no significant difference in the mean achievement scores of students taught chemistry using the cooperative learning strategy compared to those taught using the lecture method.

2. **Hypothesis 2:** There is no significant difference in the mean achievement scores of male and female students taught chemistry using the cooperative learning strategy in senior secondary schools.
3. **Hypothesis 3:** There is no significant interaction effect of teaching method and gender on the mean achievement scores of students when taught chemistry using the cooperative learning strategy and the lecture method.

METHODOLOGY

This research employed a quasi-experimental design. The sample comprised 228 SSII Chemistry students selected from 6 public secondary schools, out of a total population of 2,380 SSII students across 68 senior secondary schools in the Onueke Education Zone. The sample was divided into two groups: an experimental group and a control group. The experimental group was taught topics such as balancing chemical equations, hydrocarbons, oxidation-reduction reactions, and electrolysis using the Cooperative Learning Strategy (CLS). In contrast, the control group received instruction on the same topics using the Lecture Teaching Method (LTM). A Chemistry Achievement and Retention Test, developed by the researcher and validated by three science education experts, served as the study's instrument. This instrument had a reliability coefficient of 0.97. Prior to the intervention, both groups were given a pretest, and their scores were recorded.

The researcher prepared two separate lesson plans, one for the experimental group and one for the control group. These lesson plans were handed over to the teachers, who served as research assistants, to deliver the instruction during regular school hours according to the school timetable. After six weeks of teaching, a post-test was administered to both groups, and the scores from the pretest and post-test were carefully recorded for subsequent analysis. Two weeks after the post-test, a retention test was conducted, and the results were recorded as retention scores for each group. The collected data were analyzed using mean and standard deviation to address the research questions. To test the hypotheses, Analysis of Covariance (ANCOVA) was employed to assess significant differences between the treatments based on the post-test scores, with the pretest scores serving as covariates.

RESULTS

Table 1: Mean Achievement Scores in Chemistry Based on Learning Methods

Methods	NO	$\overline{X}$	SD
Cooperative learning strategy	105	72.91	6.60
Lecture Teaching Method	123	44.07	3.65

The results of table 1 indicate that the cooperative learning strategy is more effective than the Lecture Teaching Method in enhancing students' achievement in chemistry.

Table 2: Mean Achievement Scores in Chemistry Based on Learning Methods and Gender

Gender	Learning strategy	NO	$\overline{X}$	SD
Male	Cooperative learning strategy	60	73.87	4.12
Female	Cooperative learning strategy	45	71.64	8.80

The results of table 2 show that male students have a slightly higher mean achievement score than female students. However, the strategy is beneficial for both male and female students in improving their achievement in chemistry.

Table 3: Mean achievement scores in chemistry based on interaction effect of learning Methods and Gender.

	Male		Female	
Methods	N	$\dot{x}$	N	$\dot{x}$
Cooperative learning strategy	60	73.87	45	71.64
Lecture Teaching Method	70	45.16	53	42.64

The results in table 3 indicated that male students had higher mean achievement scores in both the cooperative learning strategy group and the Lecture Teaching Method group. Therefore, there is no interaction effect between learning methods and genders on students' mean achievement scores in chemistry.

Table 4: ANCOVA Result of achievement scores in Learning methods and interaction effect of learning methods and gender in chemistry.

Source variation	Type III sum of squares	Df	Mean square	F	Sig. of f	Alpha level
Corrected model	41074.813	4	10268.703	849.639	.000	
Intercept	5554.315	1	5554.315	459.567	.000	
Pretest	182.698	1	182.698	15.117	.000	
Methods	2980.634	1	2980.634	246.619	.000	0.05
Gender	15.713	1	15.713	1.300	.255	
2-way interaction	45.823	1	45.823	3.791	.144	
Methods × Gender	45.823	1	45.823	3.791	.144	0.05
Error	2695.170	223	12.086			
Total	1046730.000	228				
Correction total	43769.982	227				

The results of table 4 show a significant difference in the mean retention scores of chemistry students taught using the cooperative learning strategy compared to those taught using the Lecture Teaching Method. Additionally, the results indicate a significant interaction effect between the learning method and gender on students' retention scores in chemistry.

Table 5: Mean achievement scores of Students in chemistry based on interaction effect of learning Methods and Gender.

Gender	Learning strategy	NO	$\overline{X}$	SD
Male	Cooperative learning strategy	60	80.82	3.36
Female	Cooperative learning strategy	45	80.78	3.64

The results of table 5 indicate that male students have slightly higher mean retention scores than female students within the cooperative learning strategy group. However, there is no significant difference in the mean retention scores between male and female chemistry students using the cooperative learning strategy.

DISCUSSION

The study's findings indicate that employing the cooperative learning strategy (CLS) in the teaching and learning process significantly enhances students' achievement and retention in chemistry compared to traditional lecture teaching methods (LTM).

This aligns with Igwe (2002), who emphasized that cooperative learning involves students working together to achieve shared academic goals, where each student's success is dependent on the success of the group. Swanson &Alloway (2012) similarly reported that CLS is more effective than LTM in improving students' achievement, particularly in science subjects. As noted by Laguador (2014), CLS encourages the development of students' natural intelligence, creativity, and collaborative tendencies. The superiority of CLS over LTM can be attributed to peer tutoring and active team involvement, which Awofala & Agbolade (2023) described as factors that promote student achievement. This collaborative approach fosters a deeper understanding of the subject matter, encouraging mutual support and engagement.

The study also reveals that male students slightly outperformed female students in both achievement and retention, consistent with Dode (2015), who observed a similar trend in science classes. However, as Oladejoet al, (2023) noted, the overall intelligence of males and females is relatively equal, suggesting that other factors might influence performance. While the males performed better, the difference was not statistically significant enough to suggest a meaningful interaction effect between gender and teaching methods. This finding is supported by Ojaleye and Awofala (2018), who argued that student achievement in chemistry can be influenced by various factors, including gender and the teaching method employed. Wang and Degol (2017) highlighted practical and pedagogical barriers that hinder girls' performance in science, such as teachers giving more attention to boys, the lack of female role models, and gender biases in textbooks. These challenges, combined with a lack of interest and commitment, can affect the academic outcomes of female students in science subjects.

CONCLUSION

Based on the findings of this study, it is concluded that the cooperative learning strategy (CLS) significantly enhances students' achievement and retention in chemistry among senior secondary students in the Onueke Education Zone, Ebonyi State. CLS proved to be more effective than the traditional lecture teaching method, demonstrating its potential to improve learning outcomes in chemistry. Unlike conventional teaching methods where the teacher is the sole source of knowledge, cooperative learning fosters student collaboration through active communication and cooperation. In this approach, the teacher assumes the role of a facilitator, guiding students while utilizing their administrative skills to manage the learning environment.

RECOMMENDATION

To improve students' performance in chemistry, it is recommended that teachers adopt the cooperative learning strategy in their instructional practices. Students should be given the opportunity to work in groups, as this approach not only promotes academic achievement but also reduces the pressure of individual performance, motivating students, especially those inclined towards science and technology to excel in these fields.

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