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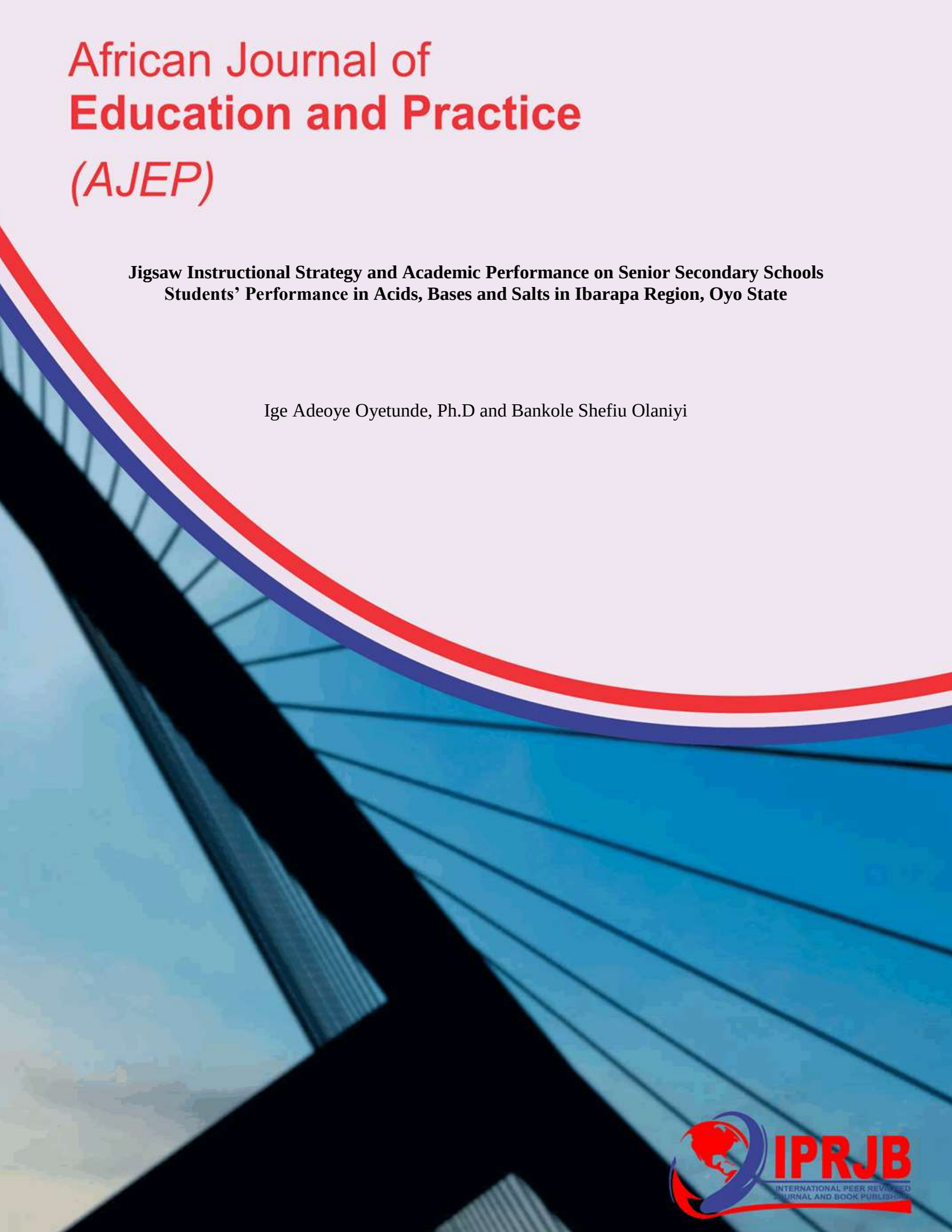

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Jigsaw Instructional Strategy and Academic Performance on Senior Secondary Schools Students' Performance in Acids, Bases and Salts in Ibarapa Region, Oyo State

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Abstract

Purpose: The research determines the effects of Jigsaw Instructional Strategy on students' performance in Acids, Bases and Salts as a topic in Chemistry in Senior Secondary Schools.

Methodology: This study is a non-randomized, non-equivalent 2 x 2 quasi-experimental designs, which utilized a pre-test and post-test. The population for the study is all Senior Secondary School 1 (SS 1) chemistry students in Oyo State. The instrument for the study is Acids, Bases and Salts Performance Test (ABSPT). It consists of thirty multiple choice objective questions having four options A – D and seven theory questions of school certificate chemistry standard. The data obtained was subjected to Pearson Products Moments Correlation Formula for analysis.

Findings: The result reveals a significant difference in the performance of students taught using Jigsaw Instructional Strategy (JIS) to those taught using Lecture-Based Strategy

Unique Contribution to Theory, Practice and Policy: Students taught using Jigsaw instructional Strategy performed better than their counterpart using Lecture-based strategy, therefore, teachers are encourage to incorporate the principle of the strategy in teaching and learning processes.

Keywords: *Jigsaw Instructional Strategy (JIS), Lecture - Based Strategy (LBS), Academic Performance, Acids, Bases and Salts, Chemistry Senior Secondary School*

INTRODUCTION

Chemistry develops critical reasoning skills, knowledge to solving problem and analytical creativity. It helps to understand and mitigate the effects of climate change by developing sustainable technologies and reducing greenhouse gas emissions. The development of new materials such as plastics, ceramics and nanomaterial cannot be overemphasized, even to the knowledge and understanding of principles that could be applied to improving life. Hence, the topics of Acids, Bases and Salts are relevant to most food substances.

Chemistry remains an important subject and discipline with overwhelming influence on human life. (Ige, Oyelekan and Olorundare, 2018). It is the bedrock to all sciences and in fact, the pivotal, the cornerstone to all fields of science and technology. Chemistry as a concept in science is concerned with the substances of which matter as example is composed. The investigation of the properties, reactions and the use of such reactions to form new substance is Chemistry.

Statement of the Problem

Students' academic performance in recent times has been of concern not only to parents and students but the wider society. So many perceptions have been raised as to whether gender, environment, teachers, or instructional strategies, among others, determine the performance of students (Gabel, 1999). However, this study aims to intensify previous efforts on effects of instructional strategy on students' performance especially in Acids, Bases and Salts.

Ige et al. (2018) found positive performance outcomes in a study on Electrolysis using the Jigsaw instructional strategy. The researcher is using Acids, Bases and Salts as a test verification of the earlier research for confirmation and attestation majorly to highlight the limits of Jigsaw instructional strategy and propose directions for future research and practical guidelines for the implementation of the strategy.

Objectives of the study:

The study among others will find

1. The significant difference in the performance of students taught Acids, Bases and Salts using Jigsaw Instructional Strategy(JIS) and students exposed to Lecture-Based Strategy (LBS)
2. The significant difference in the performance of male and female students taught Acids, Bases and Salts using Jigsaw Instructional Strategy(JIS) and students exposed to Lecture-Based Strategy (LBS)
3. Suitability in Jigsaw Instructional Strategy (JIS) in the teaching of other related topics in Chemistry.

LITERATURE REVIEW

Jigsaw as a cooperative learning strategy enables individual student of a 'home' group to specialize in one aspect of a topic. For example, one group studies habitats of rain forest animals, another group and predators of rainforest animals. Students meet with members from other groups who are assigned the same aspect and after mastering the materials, return to the "home" group and teach the material to their group members. Individual student in the "home" group series has a piece of the topic's puzzle and when they interact together as a whole, then create the complete jigsaw puzzle (Akkus, and Doymus, 2022). In other word, Jigsaw, as a cooperative learning

strategy make groups of students 'experts' on different aspects of a topic and they have the opportunity to share what they learn with their classmates. (Stanczak, Darnon, Robert, Demolliens, Saren and Bressoux, 2022) analyze the fundamental of each model features of Jigsaw into four different steps.

i. First, Students belong to a jigsaw group. The groups display within group heterogeneity (i.e. sex, students' cognitive, social and motor levels) and between group homogeneity and it include 3-8 students each.
ii. Second is the student joining temporary "expert" groups of assigned same subset of material. The step provides less competent students with the opportunity to learn, understand and teach their material to more competent peers.
iii. Third, students return to their original jigsaw group, they teach and explain the skills they have learned to their groups' members with the aim of making them competent as well
iv. Finally, the home groups students work together to produce a final joint work through integration and evaluation.

The main thrust of the motivational perspective is the motivation brought about by the reward system under which the jigsaw strategy operates (Johnson and Johnson, 1999, Slavin, 2011). The arrangement makes individual success dependent on group success; hence, members of a group are to assist others in achieving a common goal. The overall success of the group is a combination of the efforts of individual members of the group. The social cohesiveness, theoretical perspective holds that the cohesiveness of the group impacts significantly on the ability of the group to improving their achievement with cooperative learning strategy. This theoretical perspective is hinged on the belief that students can help one another to learn when engaging in group work since members of a group often comprise of students with various degree of learning abilities (Ige et al., 2018). Task specialization is used in Jigsaw, group investigation, and finding out to facilitate interdependence among members of a group with a view to enhancing social cohesion among learners. Task specialization here refers to a strategy where each group member becomes an expert in a specific part, or 'task,' of the topic being studied. By using task specialization in Jigsaw, students develop deeper understanding of specific aspects of the topic. Learn from peers and develop teamwork skills along with sharing knowledge and expertise promoting collaborative learning. Therefore, this study finds the suitability of the instructional strategy with relevance to practical related topics like acids, bases and salts

METHODOLOGY

Research Design

This study is a non-randomized, non-equivalent 2x2 quasi-experimental research design, which utilized a pretest and post-test. The design has two levels independent variables and gender at two levels. (i.e. the Jigsaw Instructional Strategy, JIG, the Lecture-Based Strategy, LBS and males and females).

Population

The population for the study will be all Senior Secondary School I (SS I) chemistry students in Oyo State. The choice of SS1 is based on their pre-requisite knowledge in basic chemistry concepts and majorly because Acids, Bases and Salts are taught in SS I.

Sampling Technique

Two schools from Ibarapa East Local Government were purposively selected having a minimum of 10 years of experience in fielding candidates for the West African Examinations Council (WAEC) and National Examinations Council's School Certificate Chemistry. Added advantage is the school with chemistry teachers with teaching qualifications and WAEC/NECO examiners.

Sample Size

The two schools were randomly assigned to the experimental and control groups.

Data Collection

The instrument for the study is Acids, Bases and Salts Performance Test (ABSPT). It consists of thirty multiple choice objective questions with four options A-D and seven theory questions of school certificate chemistry standard.

Statistical Analysis

The data obtained was subjected to Pearson Products Moments Correlation formula for analysis.

RESULTS

The analysis of the data collected from the study is presented in tables according to research questions and the hypotheses.

Research Question 1:

What is the mean difference in the performance scores of students in Acids, Bases and Salts when taught using Jigsaw Instructional Strategy (JIS) and those that were taught using Lecture-Based Strategy (LBS)?

The answer to question 1 was provided by the data analyses shown in Table 1.

Table 1: Mean Difference in the Performance Scores of Students in Acids, Bases and Salts When Taught Using Jigsaw Instructional (JIS) Strategy and those that were taught using Lecture-Based Strategy (LBS).

Group	N	Pre-test		Post-test		Mean gain
		($\underline{X}$)	SD	($\underline{X}$)	SD	($\underline{X}$)
Experimental group (JIS)	58	30.50	5.729	75.78	7.375	44.97
Control group (LBS)	101	30.81	8.176	47.46	13.000	16.65

N= Number of subjects,-X = Mean, SD = Standard Deviation

From the above , the findings revealed that prior to the use of Jigsaw instructional (JIS) strategy (Experimental method) in solving problems in Acids, Bases and Salts, the pre-test mean scores of the students in the experimental group was 30.50 and standard deviation of 5.729, the control group has pre-test mean score of 30.81 and standard deviation of 8.176 This shows that both groups have relatively equal pre-test mean scores. But after the treatment the post-test mean scores for the experimental group (JIS) improved appreciably from 30.50 to 75.78 with a mean gain of 44.97. But for the control group, it was an improvement from a mean score of 30.81 to 47.46 with a mean gain of 16.65 lower than that of experimental group. This implies that subjects taught with JIS outperform those taught using Lecture-Based Strategy (LBS).

Research question 2: *What is the mean difference in the performance scores of male and female students in Acids, Bases and Salts when taught using Jigsaw Instructional Strategy (JIS) and those that were taught using Lecture-Based Strategy (LBS) ?*

The answer to question 1 was provided by the data analyses shown in Table 1.

Table 2: Mean Difference in the Performance Scores of Male and Female Students in Acids, Bases and Salts When Taught Using Jigsaw Instructional (JIS) Strategy and those that were taught using Lecture-Based Strategy (LBS).

Group	Gender	N	Pre-test		Post-test		Mean gain $\underline{X}$
			$\underline{X}$	SD	$\underline{X}$	SD	
Experimental group (JIS)	Male	19	31.79	6.303	73.47	10.173	41.68
	Female	39	29.87	5.401	78.90	5.350	49.03
Control group (LBS)	Male	35	29.49	7.298	46.80	13.308	17.31
	Female	66	31.52	8.576	47.80	12.924	16.28

N= Number of subjects,-X = Mean, SD = Standard Deviation

From the above Table 2 , the results reveal that the pre-test gender means scores of students taught with JIS (Experimental method), and LBS (Control) were found to be 31.79 and 29.49 with the relative standard deviation of 6.303 and 7.298 for male, and means scores of 29.87 and 31.52 with the standard deviation of 5.401 and 8.576 for female respectively; while the post-test results show 73.47 and 46.80 with the standard deviation of 10.173 and 13.308 for male and post-test mean scores of 78.90 and 47.80 with the relative standard deviation of 5.350 and 12.924 for female respectively. The mean gain scores of the male students are 41.68 for JIS, and 17.31 for the LBS; for the female students the mean gain scores are 49.03 for JIS and 16.28 for LBS. The results indicated that the difference in post-test mean scores is higher among female students taught with Jigsaw instructional strategy (JIS) and also for male students it was higher with JIS. The results indicated a gender difference in pre-test and post-test scores.

Hypothesis 1: *There is no statistically significant main effect in performance (pre-test and post-test scores) of students in Acids, Bases and Salts when taught using Jigsaw Instructional Strategy (JIS) and those that were taught using Lecture-Based Strategy (LBS).*

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Table 3: Summary of Analysis of Covariance (ANCOVA) of the significant Main and Interaction Effects of Treatment (JIS) and Gender of Students in Acids, Bases and Salts.

Tests of Between-Subjects Effects

Source of Variance	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	36115.259[a]	4	9028.815	103.490	.000	.729
Intercept	9978.975	1	9978.975	114.381	.000	.426
Pretest	6392.895	1	6392.895	73.277	.000	.322
Main Effect:	153.639	1	153.639	1.761	.000	.650
Groups						
Gender	24959.230	1	24959.230	286.088	.186	.011
2-way Interactions:	277.380	1	277.380	3.179	.077	.020
Groups * Gender						
Error	13435.471	154	87.243			
Total	580490.000	159				
Corrected Total	49550.730	158				

a. R Squared = .729 (Adjusted R Squared = .722)

The data were analyzed using ANCOVA with pretest value as covariates. Thus, result according to Table 3 above indicates a summary result of the significant main effect of treatment (JIS) and gender on students' performance in Acids, Bases and Salts. The table reveals that, after adjustment for the covariate, Acids, Bases and Salts performance scores, there is a statistically significant main effect of JIS on students' performance in Acids, Bases and Salts, [$F_{(1, 154)} = 1.761$, $P < .05$, $\eta^2 = .650$]. Since the associated exact probability value (.000) was less than .05 alpha level, the null hypothesis which stated that there is no significant main effect in the performance (pre-test and post-test scores) of students taught using Jigsaw instructional Strategy and students taught using LBS in Solving Problems in Acids, Bases and Salts was therefore rejected. The partial eta-squared estimate was .650. The result implies that the treatment accounted for 65.0% of the variance experienced in students' performance in Acids, Bases and Salts.

Hypothesis 2*: There is no statistically significant main effect in the performance (pre-test and post-test scores) of male and female students in Acids, Bases and Salts when taught using Jigsaw Instructional Strategy (JIS) and those that were taught using Lecture-Based Strategy (LBS).*

ANCOVA Results in Table 3 further shows that after adjustment for covariate, the main effect of gender on students' performance in Acids, Bases and Salts is not significant [$F_{(1, 154)} = 286.088$, $P > .05$, $\eta^2 = .011$]. Since P-value (.186) is greater than .05 alpha level; therefore, the null hypothesis which stated that there is no significant main effect in the performance (pre-test and post-test scores) of male and female students taught using Jigsaw Instructional Strategy in solving problems in Acids, Bases and Salts was not rejected. The result also indicated that the estimated partial eta-squared was .011. This indicated that gender contributed 1.1% of the variance observed on the students' performance in Acids, Bases and Salts.

Hypothesis 3: *There is no statistically significant interaction effect of treatment (JIS and LBS) and gender on students' performance (pre-test and post-test scores) in Acids, Bases and Salts.*

The interaction effect of treatment (JIS and LBS) and gender on students' performance in Acids, Bases and Salts, was further indicated in Table 3 with [$F_{(1,154)} = 3.179$; P= .077, η^2=.020]. Since P (.077) is greater than alpha (α) levels, the inference drawn therefore is that the interaction effect of treatment and gender on students' performance in Acids, Bases and Salts is not significant. This implies that applying the JIS and LBS crossed with male and female gender has no effect on their levels of solving problems in Acids, Bases and Salts. As a result of this finding, the null hypothesis was not rejected.

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary

From the analysis and interpretations of the data collected, the followings are the major findings:

1. Student taught Acids, Bases and Salts using Jigsaw Instructional Strategy performed significantly better than those taught with Lecture-Based Strategy with mean gain difference of 28.32.
2. The mean gain scores of male students are 41.68 for Jigsaw Instructional Strategy and 17.31 for lecture Based Strategy while the female students are 49.03 for Jigsaw Instructional Strategy and 16.28 for Lecture Based Strategy.
3. The mean gain scores were higher among female students and male students taught with Jigsaw Instructional Strategy. The result indicated a gender difference in both the pre-test and post-test scores.

Conclusion

The findings from table 1 revealed that the mean performance scores of students in the experimental group were higher than that of students in the control group. Thus, from the table, the results shows that the students taught with Jigsaw Instructional Strategy had mean score of 75.78 and standard deviation of 7.375, those taught with LBS had mean score of 47.46 and standard deviation of 13.0. This is an indication that the students taught using JIS perform better than those taught with LBS. This finding is in agreement with some earlier findings of Ige et al (2018).

Furthermore, the result in table 2 revealed that both the male and female students taught using Jigsaw Instructional Strategy and those taught using Lecture-Based strategy have slightly similar mean scores, this mean that there is no significant difference in the response of male and female students. They performed almost equally. This finding supports the finding of Mbacho and Githua (2013).

The ANCOVA results of hypothesis 1 in table 3 revealed that the mean achievement scores of the different groups of students taught with JIS and LBS differed significantly. The result clearly showed the potency of Jigsaw Instructional Strategy over the Lecture-Based strategy. This might be a result of the effectiveness of the teaching method that was introduced. This was confirmed by the studies on teaching strategies in Basic Science for production of quality teachers and facilitators for sustainable Education. The study also supports the findings of Ige (2024). Also, Adewale (2024) where he affirmed that developing quality teaching skills and effective classroom instruction is essential for improving learning outcomes among students

Results on hypothesis 2 revealed no statistically significant difference in the response of male and female students taught with JIS and LBS. Thus, this is further confirmed by the ANCOVA result in table 3 which revealed that gender response was not significant factor on student's performance in Acids, Bases and Salts. This result indicates that gender accounted for 1.1% of the variance observed in the post-performance test scores in Acids, Bases and Salts. This means that 1.1% of the variance observed in the post-performance test scores is attributable to gender difference. The finding of this study conforms with the results of some researchers on the gender difference in science.(Ibrahim,2024) and Nwosu, Ehud and John (2017)

Finally, ANCOVA result in table 3 further revealed that the interaction effect between the groups (JIS and LBS) and gender has no significant effect on the students' performance in Acids, Bases and Salts. It thus, implies that the effect of the JIS on students' performance in Acids, Bases and Salts is not gender sensitive. This implies that the effect of the treatment on participants' performance does not vary from male to female. The results of this study affirm similar findings in recent research by Ajala (2024) that gender did not have any significant influence on student's performance in Basic Technology.

Recommendations

On the basis of the result findings, the following recommendations are made:

1. Acids, Bases and Salts as a topic in school certificate chemistry should be taught using Jigsaw instructional strategy and chemistry teachers should incorporate the principle of Jigsaw Instructional Strategy to its full advantage.
2. The school administrators should organize seminars and workshops on the instructional strategy for proper dissemination to teachers as a means of improving students' overall achievement in Chemistry.
3. The policy maker should also encourage the use of strategy in teaching students in Secondary Schools with no discrimination for male and female students
4. Future researcher should consider other topics to ascertain the suitability of the instructional strategy.

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