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PROF. PATRICK C. IGBOJINWAEKWU

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EDITORIAL

Journal of Science Education and Research (JSER) is a peer-reviewed published Bimonthly. It aimed at advancing knowledge and professionalism in all aspects of educational research, including but not limited to innovations in science education, educational technology, guidance and counselling psychology, childhood studies and early years, curriculum studies, evaluation, vocational training, planning, policy, pedagogy, human kinetics, health education and so on. JSER publish different types of research outputs including monographs, field articles, brief notes, comments on published articles and book reviews.

We are grateful to the contributors and hope that our readers will enjoy reading these contributions.

Prof. Patrick C. Igbojinwaekwu
Editor-in-Chief

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EFFECT OF INTERACTIVE INSTRUCTIONAL STRATEGY ON ACADEMIC ACHIEVEMENT OF SECONDARY SCHOOL STUDENTS IN CHEMISTRY IN AWKA EDUCATION ZONE

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Abstract

This study investigated the effect of interactive instructional strategy on academic achievement of students in chemistry in secondary schools in Awka Education Zone of Anambra State, Nigeria. Two research questions were formulated to guide the study and two hypotheses tested at 0.05 significant levels was used. Quasi -experimental research design was adopted for the study involving experimental and control groups. The experimental group was taught using interactive instructional strategies, while the control group was taught using the Conventional lecture method. The population of the study was 1,609 senior secondary year two students who offered Chemistry in Awka education zone in 2024/2025 session.The study sample comprised 120 Senior Secondary II (SS II) Chemistry students selected from two co-educational secondary schools in Awka education zone using multi-stage sampling procedure. The instrument for data collection was Chemistry Achievement Test (CAT) validated by three experts, two from the department of science education and one from Measurement and Evaluation Unit, Department of Educational Foundations, both from Nnamdi Azikiwe University Awka. The reliability coefficient of the instrument was 0.81 and this was found using Kuder-Richardson 20 (K-R20) formula. Data collected were analyzed using mean and standard deviation to answer the research questions and Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 significance level. *Findings revealed that students exposed to interactive instructional strategies performed significantly better than those taught using conventional lecture method. The study also found that both male and female students benefited similarly from the interactive instructional strategy with no statistically significant gender difference. It was recommended among others that chemistry teachers in Awka education zone should adopt interactive instructional strategy to enhance student's achievement in chemistry.*

Keywords: Interactive Instructional Strategy, Chemistry Students, Academic Achievement

Introduction

All the nations around the world accord priority to education in their development efforts. The reason for according such priority attention to education is that it is a road map to great economic improvement and technological advancement. Education equally serves as an efficient means to national growth and development (United Nations Educational, Scientific and Cultural Organization, 2015, World Bank, 2018). It is in view of this that the primary purpose of education in Nigeria is to equip her citizens with knowledge, skills, attitudes and values for character formation so as to enable them live fully and contribute to the development of the nation (Federal Republic of Nigeria, 2022). Education is an act of teaching which aim to provide useful knowledge, skills and understanding to the learner. The education system can contribute to scientific and technological advancement of a nation through viable science education (Egolum & Onuigwe, 2023).

Science education is the application of methodologies and principles of education in the development and acquisition of processes and procedures required to help others acquire scientific and technological knowledge from today's application to everyday living. Science education, according to Konyefa and Okigbo (2021) is an integral field of study which considers both the subject matter of science disciplines such as Biology, Chemistry, Physics, Agriculture, as well as the process involved in the learning and teaching of science. It includes all education processes aimed at providing unlimited opportunities for learners to learn and utilize necessary knowledge, skills, and attitudes required to operate effectively in a scientific and technological society. According to Gabriel (2012) Science education can be

achieved by the inculcation in the learners, the necessary skills and attitudes through proper teaching of science subjects such as Chemistry, Physics, Biology, Mathematics, Computer science, Basic science and so on.

Chemistry is one of the fundamental science subjects taught at the secondary school level in Nigeria. It is the branch of science that studies the composition, structure, properties, and changes of matter. According to Kofoed and Miller (2020), Chemistry is defined as the study of matter and the chemical reactions. Mastery of chemistry helps students to develop analytical skills, problem-solving abilities and scientific literacy necessary for technology advancement. Chemistry is often called the central science because it connects and supports other sciences like biology, physics, environmental science, and medicine. Its importance is seen in many areas of life.

Despite the subject's importance, students' performance in chemistry across Nigerian secondary schools is not impressive. Reports from the West African Examinations Council (WAEC 2018-2023) consistently reveal low achievement in Chemistry especially in public schools. Many factors have been associated with students' poor academic achievement in Chemistry. These include lack of qualified teachers, lack of instructional materials, students' interest, self -concept, students attitude towards Chemistry, the abstract nature of most chemistry concepts learnt (Moriliat, 2019).Study by Njoku (2016) attribute this recurring underperformance to several factors including the abstract nature of the subject, limited access to laboratory facilities and most notably ineffective teaching methods. A lot has been done to improve students' academic achievement in chemistry in senior secondary schools in

Nigeria. For instance, Ihejiamezu, Obi and Neji (2020) suggested provision of laboratories and adoption of appropriate teaching methods.

The general consensus is that the conventional methods mostly used in teaching chemistry have not been very successful but only encourage rote learning of facts and making the subject uninteresting, difficult for students and disconnected from real life applications.

A conventional lecture method is one of the most as traditional teaching approaches used in classroom. In this type of classroom, students are seated in rows facing the teacher who stands at the front of the classroom to deliver his/her lesson (Briggs, 2023). Conventional lecture methods typically involve textbook learning, standardized assessments, teacher-centered approach, rote memorization, lecture-based instruction etc.

Statement of the Problem

Chemistry is a fundamental science subject that contributes significantly to technological advancement and national development. The effective teaching of chemistry in secondary schools remains a significant challenge, particularly in the Awka Education Zone, where students' academic achievement in the subject has often been unsatisfactory. A major contributing factor is the reliance on teacher-centered instructional strategies, such as the conventional lecture method, which tend to promote passive learning, limit student's engagement, and fail to address diverse learning needs. This approach often results in poor conceptual understanding, low retention of knowledge, and substandard performance in both internal and external

examinations. This research tried to solve this problem by wading into Interactive Instructional Strategy where the students are engaged in active participation during teaching.

Research Questions

The following research questions guided this study:

1. What is the difference in the mean achievement scores of secondary school students taught Chemistry using Interactive Instructional Strategy (IIS) and that of those taught using Conventional Lecture Method (CLM)?
2. What is the difference in the mean achievement scores of male and female secondary school students taught chemistry using Interactive Instructional Strategy (IIS)?

Hypotheses

The following research hypotheses were formulated and tested at 0.05 level of significance.

$H0_1$: There is no significant difference in the mean achievement scores of secondary school chemistry students taught Chemistry using Interactive Instructional Strategy (IIS) and that of those taught using Conventional Lecture Method (CLM)

$H0_2$: There is no significant difference in the mean achievement scores of male and female secondary school students taught Chemistry using Interactive Instructional Strategy (IIS)

Methods

The study adopted a pretest- posttest non-equivalent control group quasi-experimental research design, specifically the pretest- posttest non-equivalent control group design. According to Nworgu (2018), the design is where a random assignment of research subjects into experimental control groups is not possible. Therefore, in this study, the already existing classroom arrangements in the schools that were sampled as experimental and control groups were not disrupted by the researcher but rather intact classes were used. The area of the study was Awka Education Zone. The population of the study comprised 1,609 students. The sample consisted of 120(50 males and 70 females) SS11 Chemistry students. The sample were selected from two schools out of the 47 co-educational schools in Awka Education zone using simple random sampling (balloting without replacement). The sample was drawn from from two schools out of the 47 co-educational schools in Awka education zone. The sample was selected using multi- stage sampling procedure. The sampling procedure is applied as follows: firstly, sample random sampling (balloting without replacement) was used to select one local government area out of 5 in the zone. This was to ensure that all that local government area has a chance of being selected. Secondly, purposive sampling technique was employed to select all co-education schools from the selected local government area. This is because gender is one of the variables in the study. Thirdly, simple random sampling was again used to select two schools from the co-education schools selected. Fourthly, lucky dip sampling was also used to pick one of the sciences SS2 classes (intact class) from the two schools to be used for the study. This is because each sample schools have more than one arm of SS2. Lastly, a toss of the coin was used to assign the class to the experimental group

and control group. After the sampling, the experimental class consisted of 64 students (28 males and 36 females) while control group consisted 56 students (22 males and 34 females). The instrument for data collection was Chemistry Achievement Test (CAT). The instrument was structured into two parts namely A and B (Part A was to elicit information on students' demographic data while part B contained the main questions). The instrument's validation was done by three experts and was subjected to reliability testing. The reliability coefficient of the instrument was found to be 0.81 using Kuder-Richardson 20(K-R20) formula. The experiment lasted for a total of seven weeks, including one week of pretest administration. Prior to the administration of treatment, a pre-test was administered to determine student's prior knowledge related to acids, bases and salt. During the post-test, questions were reshuffled to assess how well students understood the topic after treatment. The data collected were subjected to data analysis using mean and standard deviation. Mean and standard deviation was used to answer the research questions while Analysis of Covariance was used to test the hypotheses at an alpha level of 0.05.

Results

Results of the study were presented according to research questions and hypotheses

Research Question 1: What is the difference in the mean achievement scores of secondary school students taught Chemistry using Interactive Instructional Strategy (IIS) and that of those taught using Conventional Lecture Method (CLM)?

Table 4.1: Mean Achievement Scores of Students Taught Using IIS and CLM

Group	N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	Mean Gain
Experimental (IIS)	64	28.42	6.73	41.87	7.24	13.45
Control (CLM)	56	27.85	6.91	35.23	6.89	7.38
Mean Difference		0.57		6.64		6.07

The results in Table 4.1 shows that students taught using Interactive Instructional Strategy (IIS) had a higher posttest mean score of 41.87 compared to those taught using Conventional Lecture Method (CLM) who scored 35.23. The mean gain for the experimental group (13.45) was higher than that of the control group (7.38), indicating a difference of 6.07 points in favor of students that with Interactive Instructional Strategy.

Research Question 2: What is the difference in the mean achievement scores of male and female secondary school students taught chemistry using Interactive Instructional Strategy (IIS)?

Table 4.2: Mean Achievement Scores of Male and Female Students Taught Using IIS

Gender	N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	Mean Gain
Male	28	29.15	6.42	42.35	7.18	13.20
Female	36	27.84	6.97	41.48	7.31	13.64
Mean Difference		1.31		0.87		-0.44

Table 4.2 reveals that among students taught using Interactive Instructional Strategy, males had a slightly higher posttest mean score of 42.35 compared to females who

scored 41.48. However, females had a slightly higher mean gain (13.64) compared to males (13.20), showing a minimal difference of 0.44 points.

Hypothesis 1: There is no significant difference in the mean achievement scores of secondary school chemistry students taught Chemistry using Interactive Instructional Strategy (IIS) and that of those taught using Conventional Lecture Method (CLM).

Table 4.3: ANCOVA Results for Difference in Achievement Scores between IIS and CLM Groups

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2847.692	2	1423.846	31.247	.000	.432
Intercept	2156.374	1	2156.374	47.334	.000	.366
Pretest (Covariate)	1523.891	1	1523.891	33.456	.000	.290
Group	1187.456	1	1187.456	26.067	.000	.241
Error	3735.421	117	45.554			
Total	128567.000	120				
Corrected Total	6583.113	119				

The results in Table 4.3 show that $F(1,117) = 26.067$, $p = .000 < 0.05$. Since the p-value (0.000) is less than the alpha level of 0.05, the null hypothesis is rejected. Therefore, there is a significant difference in the mean achievement scores of students taught using Interactive Instructional Strategy and those taught using Conventional Lecture Method, in favor of the Interactive Instructional Strategy.

Hypothesis 2: There is no significant difference in the mean achievement scores of male and female secondary school students taught Chemistry using Interactive Instructional Strategy (IIS).

Table 4.4: ANCOVA Results for Gender Difference in IIS Group

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1456.789	2	728.395	14.562	.000	.409
Intercept	1234.567	1	1234.567	24.691	.000	.370
Pretest (Covariate)	1398.234	1	1398.234	27.964	.000	.400
Gender	23.456	1	23.456	.469	.498	.011
Error	2101.234	61	50.029			
Total	79567.000	64				
Corrected Total	3558.023	63				

The results in Table 4.4 indicate that $F(1,61) = 0.469$, $p = .498 > 0.05$. Since the p-value (0.498) is greater than the alpha level of 0.05, the null hypothesis is not rejected. Therefore, there is no significant difference in the mean achievement scores of male and female students taught using Interactive Instructional Strategy.

Discussion

The findings of the study revealed that students taught using Interactive Instructional Strategy (IIS) achieved significantly higher compared to those taught using Conventional Lecture Method (CLM), with a mean gain difference points in favor of the experimental group. The present study's outcome directly aligns with that of Adeoye and Alayande (2024), who, also works on the topic - acids and bases, and found a significant difference in the academic achievement of students using the

Think-Pair-Share instructional strategy over the lecture method. This consistency across two studies in the same geographical and curricular context powerfully underscores the localized efficacy of interactive strategies.

Furthermore, the finding resonates with studies beyond the immediate zone and subject. Upula (2025), in a study on Biology in Cross River State, found a significant difference in achievement favoring an interactive teaching method, demonstrating the cross-subject applicability of this pedagogical approach within the Nigerian secondary school system. Similarly, Muhammad (2021), despite focusing on Islamic Studies in Kaduna State with a different interactive tool (multimedia package), concluded that the interactive strategy significantly enhanced academic achievement. The convergence of results across diverse subjects (Chemistry, Biology, and Islamic Studies) and states (Anambra, Cross River, Kaduna) suggests a universal principle that active, student-centered learning is superior to traditional methods. This is further reinforced by Alhaq, Nugraha, and Oding (2022) in a tertiary calculus context, who found the interactive approach demonstrated the strongest effect size. The present study thus consolidates these findings, providing specific, causal evidence for Chemistry in Anambra State and Nigeria in general..

The ANCOVA results, which showed a statistically significant difference, leading to the rejection of the null hypothesis, provide rigorous quantitative support for this conclusion. It is noteworthy; however, that not all research uncovers a simple relationship. The descriptive-correlational study by Rabut and Rabut (2025) found no significant link between students' perceptions of interactive strategies and their achievement. This highlights a critical distinction underscored by the present study:

while student perception may not always predict outcomes, the actual implementation of a well-structured interactive instructional strategy, as demonstrated in this experimental design, has a direct and significant causal impact on improving academic achievement scores.

The findings of the study also revealed only minimal differences between male and female students taught using IIS, a finding that was confirmed statistically by the non-significant ANCOVA result leading to the retention of the null hypothesis. This is a critical finding that places the present study firmly within a consensus of contemporary research on interactive learning and gender equity in science education. The result is in perfect agreement with Adeoye and Alayande (2024), who specifically reported no significant gender difference in achievement when the Think-Pair-Share strategy was used. This finding is powerfully reinforced by studies on other science subjects. Umar, Sani, and Isma'il (2020), in their investigation of Ecology in Kano State, similarly found no significant difference in the mean scores of male and female students exposed to an interactive teaching strategy. Likewise, Upula (2025) found no significant interaction effect of methods and gender on achievement in Biology. The consistency of this finding across Chemistry, Biology, and Ecology within Nigeria strongly indicates that interactive instructional strategies are a powerful tool for fostering gender-inclusive science classrooms.

Conclusion

The study has revealed that interactive instructional strategy significantly enhances the academic achievement of students in chemistry in secondary schools within Awka Education Zone. Therefore, by shifting from traditional teacher-centered methods to

more students- centered, participatory approaches such as group discussions, problem- solving activities, inquiry- based learning, and the use of instructional technology, students demonstrate greater understanding, retention, and application of Chemistry concepts.

Recommendations

Based on the findings of the study, the following recommendations were made;

1. Adoption of Interactive Instructional Strategies Chemistry Classes: Since students taught using interactive instructional strategies achieved higher than those taught using conventional lecture method, schools and Chemistry teachers should adopt and consistently apply interactive teaching method to improve student learning outcomes in Chemistry.
2. Maintenance of gender- equitable teaching practices: Since there was no significant difference in achievement between male and female students across both instructional methods, teachers should continue to implement gender- neutral strategies that promote inclusivity and equal learning opportunities. Efforts should be made to avoid any form of bias in classroom interactions, or group activities, ensuring that all students are equally encouraged to participate and succeed.
3. Provision of Professional Development on Interactive methods: to ensure effective implementation, Chemistry teachers should receive training and professional development on interactive instructional strategies. This will equip them with practical techniques for engaging students and maximizing learning in Chemistry.

4. Focus on effective method rather than gender: Since there was no interaction effect between teaching method and gender, interventions to improve chemistry achievement should focus primarily on the choice and quality of instructional strategies rather than gender- specific approaches.

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