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Comparative Effects of Experiential and Demonstration Instructional Strategies on Chemistry Students' Academic Performance in Titrimetry in Uyo Local Government Area, Akwa Ibom State

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Abstract

This study investigated the comparative effects of experiential and demonstration instructional strategies on chemistry students' academic performance in titrimetry in Uyo Local Government, Akwa Ibom State, Nigeria. Two research questions were raised, and two research hypotheses were formulated to guide the study. The study was a quasi-experimental research consisting of a pretest, posttest, and non-equivalent groups design. A sample size of 130 senior secondary two (SS2) chemistry students from two co-educational secondary schools in Uyo Local Government Area was used for the study. The Chemistry Performance Test (CPT) was used for data collection. The reliability of the instrument was calculated using Kuder-Richardson-20 (KR-20), and the reliability coefficient (r) of 0.75 was obtained. Mean and standard deviation scores were used to answer the research questions, while Analysis of Covariance (ANCOVA) was used to test the null hypotheses that guided the study. All null hypotheses were tested at the .05 level of significance. The findings showed that there is no

significant difference between academic performance and retention mean scores of students taught titrimetry using experiential and demonstration strategies. The study recommended that both experiential and demonstration instructional strategies should be used in the teaching and learning of chemistry concepts to improve students' academic performance.

Keywords: experiential and demonstration instructional strategies, students' academic performance and gender

Introduction

The strategy adopted by any classroom teacher may promote or hinder learning. Chemistry is one of the science subjects that has the potential to promote scientific, technological, and economic development of any nation. The fundamental principles of teaching chemistry are to enable students to investigate, explain, demonstrate, and predict new phenomena in chemistry. This could be achieved through the use of appropriate and effective instructional strategies to equip students with innovative knowledge, skills, and competencies as tools for solving societal problems.

The major aim of chemistry teaching in secondary school education is to equip students with scientific knowledge, skills, attitudes, and scientific thinking abilities for national and technological development. As noted by Onwodikkut (2015), any knowledge of science that cannot be applied towards the development of society is not meaningful. Hence, the ability to enhance students' academic performance is not only tied to titrimetry but also more on the critical mass of innovative instructional delivery, particularly in chemistry. Teachers of chemistry at secondary schools are expected to employ student-centered instructional strategies that would make teaching participatory, exploratory, experimental, and relevant for students to demonstrate practical skills. This invariably would improve students' academic performance and retention in any chemistry concept.

Academic performance is the measurement of a student's success in a particular subject, reflecting how well they have achieved learning goals, typically shown through grades, test scores, and final examination grade. In secondary school, it is the knowledge gained that is assessed by marks or grades obtained in external examinations like the West African Examination Council. For learning to be effective and meaningful, Oyelekan et al. (2017) stressed that chemistry teachers must use appropriate teaching strategies to stimulate and encourage students' involvement in the learning processes. These strategies would encourage enhanced students' critical thinking, problem-solving abilities, academic performance, retention, and learning through experience.

Successful teaching and learning of chemistry demands flexible pedagogy for effective self-monitoring and deep understanding of concepts (Udofia & Edem, 2019). Gohar (2018) emphasizes that when a teacher teaches students with effective and innovative instructional strategies, the students will be able to develop relevant skills and experiences through active participation in the teaching and learning process. Instructional strategies help to promote retention, interest, engagement, active learning, motivation, academic performance, and self-concept among students (Park, 2020). Esu and Inyang (2018) reported that teaching and learning become fun when student-centered instructional strategies are used along with relevant instructional materials.

Experiential instructional strategy is an innovative student-centered strategy that engages students in inquiry-based hands-on activities. In experiential instructional strategy, experiences are structured to require the student to take initiative, make decisions, and be accountable for results (Rosa, 2019). The students are actively engaged in investigating, experimenting, and solving problems. Students are engaged intellectually, emotionally, and socially during experimental teaching. Experiential instructional strategy, according to Udofia (2022), is an innovative strategy that enhances learning through conceptual change with the teacher providing an engaging learning environment for the students to be actively involved in the learning process. This involvement produces a perception that the learning task is authentic and practical. The results of learning from experiential instruction are personal and form the basis for future experience and learning. The teacher's primary roles include setting suitable experiences, posing problems, setting boundaries, and supporting students to enhance academic performance and retention, especially in chemistry concepts.

The use of experiential instructional strategy in Nigerian secondary schools to teach chemistry is to the extent of empowering chemistry students and increasing academic success and performance. It enables students to be responsible for their learning during teaching and learning processes. Georgia (2019) found out that experiential instructional strategy encourages students' participation in a classroom, supports learners' critical role for success, promotes active cooperation, and improves students' academic performance. Effective implementation of experiential instructional strategy helps to reduce abstraction in chemistry, promotes better learning, and improves students' motivation and interest that leads to better academic performance. Udofia (2022) reported that students exposed to the experiential instructional strategy performed much better than those in the conventional instruction strategy in the demonstration of the science process skills. The author also reported that students taught with experiential learning were better in demonstration of skills of observing, measuring, recording, inferring, manipulating, reporting, and reasoning, while students exposed to conventional instruction strategy did better in problem solving.

Demonstration strategy is a learning-by-doing approach and so enables the teacher to teach manipulative and operational skills within a short time using little material. Edu et al. (2022) reported that teaching using the demonstration strategy helps to improve students' understanding and academic performance. Demonstrations in science teaching, especially in chemistry, encourage generalization because they promote active involvement by students and also enhance students' attention level, students' understanding of what is being taught, retention, and academic performance (Eriks et *al*. 2023). Demonstration methods as a teaching strategy are expected to help students to understand the concept of titrimetry in chemistry better in the teaching-learning process. This is because demonstration strategies are effective in demonstrating steps and procedures required to carry out chemistry practicals. Exposure of students to demonstrations as an instructional strategy helps to improve students' performance and retention in chemistry (Sweder & Jeffery, 2023). Demonstrations, an instructional strategy according to Kuntzleman et al. (2022), when properly integrated into the teaching and learning process, help to facilitate students' academic performance and understanding of certain chemistry concepts like titrimetry.

Chamberlain and Kelly (2019) reported that demonstration strategies are used to show procedures and to explain techniques. This strategy is effective in teaching skills because it enables the teacher to cover all the necessary steps required for practical application. Thus, the demonstration strategy gives students the opportunity to see and hear the related details being taught in the classroom. These details include the necessary background knowledge, steps, procedures, and precautions that give students the opportunity to become proficient (Chingombe 2023). As reported by Olatoye and Adekoya's (2021) demonstration strategy, students' specific skills, techniques required for them, uses, and procedures involved in carrying out the skills are independent of gender.

Gender is a variable that influences learning. Kanno (2019) reported that male students are better at calculations and balancing chemical reactions in chemistry than female counterparts taught using instructional strategies like demonstration and experiential strategies. Wax (2018) found that both male and female students performed equally when taught using innovative instructional strategies like experiential and demonstration instructional strategies. According to Ezeh (2018), when students are taught using effective instructional strategies, it helps to promote students' academic performance irrespective of gender. Udofia (2022) reported that there was a difference in the mean scores of male and female students in the demonstration of science process skills taught using experiential learning and conventional instruction strategies in favor of the male students.

Gender had significant effects on students' academic performance in chemistry, and it was reported that male students performed better than their female counterparts. In addition,

Nnenji (2022) pointed out that there is a significant gender difference in students' academic performance when taught using experiential and demonstration strategies in science subjects. Amosun (2021) found a significant difference in academic performance of male and female students in chemistry when taught experiential and demonstration strategies. Medwick and Kirshner (2020) reported that students taught using experiential instructional strategies performed better than those taught using demonstration strategy.

It is effective in bridging the gap between abstract acid-base theory and practical application. It transforms complex concepts into tangible experiences, enhancing conceptual understanding and developing essential laboratory skills. Experiential instructional strategy also helps to boost students' engagement and retention of steps in calculations involving titrimetric analysis. However, among the literature reviewed, there was no study carried out on the effects of experiential and demonstration instructional strategies on chemistry students' academic performance in titrimetry in Uyo Local Government, Akwa Ibom State. This has created a gap in knowledge and information that this study sought to fill. Based on this background, the present study investigated the comparative effects of experiential and demonstration instructional strategies on chemistry students' academic performance in titrimetry in Uyo Local Government, Akwa Ibom State, Nigeria.

Purpose of the Study

The purpose of the study was to determine the comparative effects of experiential and demonstration instructional strategies on chemistry students' academic performance in titrimetry in Uyo Local Government, Akwa Ibom State, Nigeria. The specific objectives are to:

i. determine the difference between academic performance mean scores of students taught titrimetry using experiential and those taught using demonstration strategies

ii. determine the difference between academic performance mean scores of male and female students taught titrimetry using experiential and those taught using demonstration strategies.

Research Questions

The study answered the following research questions:

i. What is the difference between academic performance mean scores of students taught titrimetry using experiential and those taught using demonstration strategies?

ii. What is the difference between the academic performance mean scores of male and female students taught titrimetry using experiential and those taught using demonstration strategies?

Research Hypotheses

The following null hypotheses were formulated to guide the study at 0.05 levels of significance:

i. There is no significant difference between academic performance mean scores of students taught titrimetry using experiential and those taught using demonstration strategies.

ii. There is no significant difference between academic performance mean scores of male and female students taught titrimetry using experiential and those taught using demonstration strategies.

Statement of the Problem

Despite the importance of chemistry, poor academic performance in chemistry in public examinations in Nigeria, like the West African Examinations Council and National Examinations Council, has been a recurring problem. The researchers become worried about what could be the main reason behind this problem of students' academic performance in chemistry. Studies in Nigeria have highlighted different instructional strategies and their efficacies in enhancing students' academic performance in chemistry, with little or nothing done on students' academic performance and retention using experiential and demonstration instructional strategies in teaching the concept of titrimetry in chemistry. This fluctuating academic performance of students in chemistry leaves one in doubt about the efficacy of instructional strategies used by chemistry teachers during the teaching and learning process. The problem of this study, therefore, was to determine the comparative effects of experiential and demonstration instructional strategies and secondary school students' academic performance and retention in titrimetry in Uyo Local Government, Akwa Ibom State, Nigeria, based on gender.

Methodology

A quasi-experimental research design consisting of a pretest, posttest, non-equivalent group design was used in the study. The target population for the study comprised all 1926 senior secondary two students (SS11) offering chemistry in 14 co-educational public secondary schools in the Uyo Local Government Area of Akwa Ibom State during the 2025/2026

academic session. A sample size of 130 senior secondary two (SS2) chemistry students was purposively selected from two intact classes and co-educational secondary schools in the Uyo Local Government Area. The two intact classes were selected by identifying the total number of available students in each class. The selected schools were randomly assigned to treatment and control groups.

The instrument's title, "Chemistry Performance Test (CPT)," was used by the researcher for data collection in the study. The Chemistry Performance Test (CPT) contained two parts, A and B. Part A sought information on students' demographic characteristics, and Part B contained forty (40) multiple-choice questions on the Chemistry Performance Test (CPT) with options A-D. The forty 40 items were administered to the study subjects in the two experimental groups before and after the experimental treatment, respectively. Three experts validated the Chemistry Performance Test (CPT). The reliability of the instrument was calculated using Kuder-Richardson-20 (KR-20), and the reliability coefficient of 0.75 was obtained, which was deemed adequate for the study.

Mean and standard deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the null hypothesis. All null hypotheses was tested at .05level of significance and $P \leq 0.05$ alpha level.

Results

The results of this study are presented based on research questions and hypotheses.

Research Question 1: What is the difference between the mean academic performance scores of students taught titrimetry using experiential and those taught using demonstration strategies?

Table 1: Mean and Standard Deviation of the difference between academic performance mean scores of students taught titrimetry using experiential and those taught using experiential demonstration strategies.

Strategies		Pretest		Posttest		
	N	Mean	SD	Mean	SD	Gain score
Experiential	70	13.20	17.41	33.63	2.49	20.43
Demonstration	60	13. 08	I7.49	32 .90	2.33	19.82

The result presented on Table 1 shows that the pretest mean scores of students' academic performance taught using experiential strategy and those taught using demonstration strategy were 13.20 and 13.08, with the standard deviations of 17.41 and 17.49, respectively, indicating that both groups of students were at a similar cognitive level before the treatment. Also, the posttest performance mean scores of students taught using the experiential strategy and those taught with the demonstration strategy were 33.63 and 32.90 for females, with standard deviations of 2.49 and 2.43, respectively, and gain scores of 20.43 for the experiential strategy and 19.82 for students taught using the demonstration strategy. This indicates that students taught using experiential and demonstration strategies have approximately the same mean performance scores as those taught using expository strategies.

Research Question 2: What is the difference between academic performance mean scores of male and female students taught titrimetry using experiential and those taught using demonstration strategies?

Table 2: Mean and Standard Deviation of the difference between academic performance mean scores of male and female students taught titrimetry using experiential and those taught using demonstration strategies.

Strategies	Gender		Pretest		Posttest		
		N	Mean	SD	Mean	SD	Gain score
Experiential	Male	30	13.11	1.96	37.90	2.51	24.79
	Female	40	10.07	1.27	39.35	2.32	29.28
Demonstration	Male	25	11. 82	1.83	34.60	2.41	22.78
	Female	35	12.19	1.77	35.00	2.40	22.81

The result presented in Table 2 shows that the pretest mean scores of the difference between the academic performance mean scores of male and female students taught titrimetry using an experiential strategy were 13.11 and 10.07, with the standard deviations of 1.96 and 1.27, respectively. While the pretest mean scores of male and female students taught using the demonstration strategy were 11.82 and 12.9 with the standard deviations of 1.83 and 1.77, indicating that students were at different cognitive levels. Also, the posttest mean scores of male and female students taught using the experiential strategy were 35.90 and 39.35, with the standard deviations of 2.51 and 2.32, respectively. This indicates a gain score of 24.79 for male and 29.28 for female students. While the posttest academic performance

mean scores of male and female students taught using the demonstration strategy were 35.60 and 37.00, with the standard deviations of 2.41 and 2.40, respectively. This indicates the gain score of 22.78 for male and 22.28 for female students. The results indicate that male and female students taught using the experiential strategy had the highest mean scores compared to those taught using the demonstration strategy. It was also indicated that female students in the experiential group had the highest mean score.

Hypothesis One: There is no significant difference between academic performance mean scores of students taught titrimetry using an experiential strategy and those taught using a demonstration instructional strategy.

Table 3: Summary of Analysis of Covariance (ANCOVA) of the difference between academic performance mean scores of students taught titrimetry using an experiential strategy and those taught using a demonstration instructional strategy.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Decision at p<.05 alpha
Corrected Model	4041.632	1	4041.63	719.151	.000	S
Intercept	3057.254	1	3057.254	543.995	.000	S
Pretest	8.144	1	8.144	1.449	.213	Ns
Strategy	30.848	1	30.848	5.488	.032	NS
Error	702.814	125	5.62	-	-	-
Total	147451.000	129	-	-	-	-
Corrected Total	753.392	130	-	-	-	-

a. R Squared = .067 (Adjusted R Squared = .005)

The result presented in Table 3 indicated that the F-value is 5.488 at 1 and 125 degrees of freedom and had an associated p-value of 0.032, which is less than the 0.05 alpha level of significance. Therefore, the null hypothesis is accepted; hence, there is no significant difference between academic performance mean scores of students taught titrimetry using an experiential strategy and those taught using a demonstration instructional strategy.

Hypothesis two: There is no significant difference between academic performance mean scores of male and female students taught titrimetry using experiential strategy and those taught using demonstration instructional strategy.

Table 4: Summary of Analysis of Covariance (ANCOVA) of the difference between academic performance mean scores of male and female students taught titrimetry using an experiential strategy and those taught using a demonstration-instructional strategy.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Decision at p<.05 alpha
Corrected Model	5181.450	1	5181.450	1265.450	.000	S
Intercept	213.44	1	213.440	52.134	.230	NS
Pretest	18.550	1	18.550	4.531	.004	S
Treatment	218.936	1	218.936	312.921	0.00	S
Error	511.817	125	4.094	-	-	-
Total	147451.000	129	-	-	-	-
Corrected Total	753.392	130	-	-	-	-

a. R Squared = .914 (Adjusted R Squared = .912)

The result presented in Table 4 indicated that the F-value is 312.921 at 1 and 125 degrees of freedom and had an associated p-value of 0.000, which is less than the 0.05 alpha level of significance. Therefore, the null hypothesis is accepted; hence, there is a significant difference between academic performance mean scores of male and female students taught titrimetry using an experiential strategy and those taught using a demonstration instructional strategy.

Discussion of Findings

The result presented in Table 1 indicated that students taught using experiential and demonstration strategies have approximately the same performance mean scores as those taught using expository strategies. The corresponding finding in Table 3 indicated that there is no significant difference between academic performance mean scores of students taught titrimetry using experiential strategy and those taught using demonstration instructional strategy. This finding may be attributed to the fact that both experiential and demonstration instructional strategies are effective in enhancing students' academic performance in chemistry concepts. This finding corroborates the finding of Udofia (2022), who reported that students exposed to experiential instructional strategy performed much better than those in the conventional instruction strategy in the demonstration of the science process skills.

The author also reported that students taught with experiential learning were better in demonstration of skills of observing, measuring, recording, inferring, manipulating,

reporting, and reasoning, while students exposed to conventional instruction strategy did better in problem-solving. The finding is also in line with the finding of Maiden (2022), who reported that teaching using experiential instructional strategies is an efficient way for students to become engaged in their learning activity. Afam (2020) also reported that experiential instructional strategy is effective in enhancing students' academic performance in chemistry.

The result presented in Table 2 showed that male and female students taught using the experiential strategy had the highest mean scores compared to those taught using the demonstration strategy. It was also indicated that female students in the experiential group had the highest mean score. The corresponding hypothesis in Table 4 indicated that there is a significant difference between academic performance mean scores of male and female students taught titrimetry using an experiential strategy and those taught using a demonstration instructional strategy. The finding of this study corroborates the earlier finding of Udofia (2022), who reported that there was a difference in the mean scores of male and female students in the demonstration of science process skills taught using experiential learning and conventional instruction strategies in favor of the male students. Eric *et al.* (2021) also found a significant difference among genders in favor of the female students: female students retained information better than male students when taught using innovative instructional strategies and demonstration strategy. The finding is also in line with the finding of Sweder and Jeffery (2023), who reported that exposure of students to demonstrations as an instructional strategy helps to improve students' performance and retention in chemistry.

Conclusion

This result of the study indicates that experiential and demonstration instructional strategies are effective in enhancing students' academic performance in chemistry. Therefore, experiential and demonstrative instructional strategies should be used in teaching and learning chemistry irrespective of students' gender.

Recommendations

Based on the findings and the conclusions reached, the following recommendations were made:

i. Experiential and demonstrative instructional strategies should be adopted by chemistry teachers to enhance students' academic performance in chemistry.

ii. The teachers' training program facilitators in Nigerian universities and colleges of education should train teachers on teaching using innovative instructional strategies like experiential and demonstrative instructional strategies.

iii. School administrators should encourage teachers in the use of experiential instructional and demonstration instructional strategies during teaching and learning processes.

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