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In Search of Appropriate Pedagogy that Could Enhance Students' Interest and Academic Achievement in Qualitative Analysis: A Consideration of Predict-Observe-Explain-Explore (POEE) and Demonstrate-Observe-Explain (DOE) Strategies?

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Abstract

This research investigated if secondary school students' interest and achievement in the context of qualitative analysis could be enhanced using predict-observe-explain-explore (POEE) or demonstrate-observe-explain (DOE) instructional strategies. The study was conducted in Kogi Central Education zone of Kogi State, Nigeria. The study adopted quasi-experimental design. 1489 senior secondary three (SS3) students offering chemistry was the population of the study. The sample of the study was 206 students offering chemistry drawn from the population using purposive sampling technique. Qualitative Analysis Interest Questionnaire (QAIQ) and Qualitative Analysis Academic Achievement Test (QAAAT) were the instruments used for data collection. Cronbach's Alpha was used to calculate the reliability coefficient of QAIQ which yielded 0.93 while the Kendell Coefficient of Concordance was used to calculate the inter-rater reliability of the QAAAT which yielded 0.86. Mean and standard deviation were used to answer the four research questions while analysis of co-variance (ANCOVA) was used to test the four null hypotheses that guided the study. The finding revealed that that the mean difference in the interest rating between the groups (POEE group and DOE group) was significant in favour of POEE group [$F_{1, 205}$=4.604, P<0.05]. It was further revealed that the mean difference in the academic achievement scores between the groups was statistically significant in favour of POEE [$F_{1, 205}$=89.004, P<0.05]. Thus, it was recommended that in-service chemistry teachers should be encourage to adopt POEE strategy in order to enhance students' interest and academic achievement in the context qualitative analysis.

Keywords: Predict-Observe-Explain-Explore (POEE), Demonstrate-Observe-Explain (DOE), qualitative analysis, students' interest, academic achievement

1. Introduction

Chemistry as a subject is made up of both theory and practical. The practical aspect consists of quantitative and qualitative analysis. Qualitative analysis is often associated with compound identification. The teaching of chemistry, especially qualitative analysis, involves both manipulative/process skills of teaching theoretically and conducting a laboratory practical session. Students lack practical experience due to the fact that they are not familiar with laboratory apparatus and could not deduce correct inferences from observation. The students' poor achievement in chemistry, especially in qualitative analysis may be attributed to their non-familiarity with the use of simple laboratory equipment; poor teaching styles, imprecise statements; spelling errors; inadequate exposure to laboratory techniques; lack of observational skills; inability to write symbols properly and assign correct charges to ions, among others (WAEC Examiner, 2021). In the same vein, students' lack of understanding of the procedures and reactions involved in chemistry, especially in qualitative analysis is one of the causes for poor academic achievement in qualitative analysis (Lay & Osman, 2023).

Berger (2015) opined that theoretical understanding of qualitative analysis is abstract or difficult because the students did not know what to think about it because during laboratory practical, students usually find it difficult to link the theoretical knowledge gained to the laboratory experiments performed. It seems that students are not interested in the manipulative or process skills involved in laboratory works such as arranging the apparatus, carry out experimental activities, taking measurements and recording the results/inference which may invariably affect their academic performance especially in the context of qualitative analysis. Chemistry is generally taught as both theory and practical. The practical is divided quantitative and qualitative analysis. Qualitative analysis which is the main focus of this research deals with the identification of elements or group of elements present in a sample of compound and also reveals whether a particular ion is present or absent.

Shamsulbahri and Zulkiply (2023) opine that poor interest and academic achievement in chemistry is often blamed on poor teaching methods adopted by chemistry teachers because most students carried out the laboratory experimental activities without a clear understanding physical or chemical changes involved. Thus, these students' poor scientific understanding is likely to be as a result of ineffective instructional teaching strategies adopted by teachers which have invariably affected students' interest toward studying chemistry especially in the context of qualitative analysis. Interest may greatly affect students' alertness, degree of dedication and cognitive engagement toward learning chemistry especially qualitative analysis. When a scientific task is made interesting, students are usually passionately involved (Nwoji, 2024). Thus, an instructional lesson plan or objective should be practically aligned, engaging and interesting. The readiness to be involved in chemistry activities depends on the level of students' interest and considering the fast pace of innovation in scientific understanding, being intellectually active learners who are aware of their own thinking, interest seem required (Ajayi, 2025). Qualitative analysis is often action-based. If chemistry teachers can utilize hands-on based instructional strategies effectively during chemistry instruction especially qualitative analysis, there is tendency that students' interest may be enhanced, ultimately leading to a higher academic performance.

In recent times, stake-holders in education, have been attempting to see how the students' interest and academic achievement in Chemistry can be influenced positively through the effective teaching. Most teaching methods such as lecture method, field-trip, team method and discussion method only encourage rote learning without really exposing students to problems that will make them to be actively involved in teaching/learning process (Ajayi & Achor, 2021). Since some of these methods conventional according to Gabriel, Osuafor, Cornelius, Obinna and Francis (2018), have not really bring about much needed improvement in the teaching and learning of chemistry especially qualitative analysis, the present concern is; How do we teach chemistry especially qualitative analysis effective in order for enhance students' interest toward qualitative analysis, and ultimately enhance their academic achievement? Thus, there is a need to search for innovative instructional strategies that have the potential to encourage hand-on activity and link students prior or existing ideas and explore the aptness of these ideas. In this regard, the researchers investigated if Predict-Observe-

Explain-Explore (POEE) or Demonstrate-Observe-Explain (DOE) instructional strategies could enhance students' interest and academic performance in chemistry especially in the context of qualitative analysis.

Predict-observe-explain-explore (POEE) teaching strategy investigates apprehension by demanding the students to carry out some activities. The students must make the expected result of such activities known and must justify the reason for their prediction. Then, depict what they see happen and finally reconcile any disagreement between their prediction and observation. In 1992, Gunstone suggested Predict-Observe-Explain (POE), the approach of POE necessitate students forecasting the result of tasks, then carry out and observe the event and make explanations based on their observations of such event (Hilario, 2015). Ajayi and Achor (2021) opined that the most important feature of the POE is providing the opportunity for students to make predictions based on their prior experiences of related events that happened in their day-to-day lives. However, the researcher adopted Predict-Observe-Explain-Explore (POEE) to emphasis the importance of exploring.

Predict-Observe-Explain-Explore (POEE) allows students' initial ideas to be investigated, giving teachers the information about students' thinking and the need to investigate the concept. POEE fosters students' exploration and challenge the prior conceptions they bring to the classroom. POEE instructional strategy encourage students to reflect on their previous knowledge before making a prediction about tasks and discuss their prediction with peers. Then, carry out and observe a laboratory activity and scientific explanations of the result giving students a more in-depth conceptual understanding (Acar-Sesen & Mutlu, 2016). In POEE students are required to predict the expected result of an experiment. Then, carry out the experiment and observe. In a situation where there is any conflict between the students' predictions and observations, then students' explanations are explored (Hilario, 2015). The importance of using DOE strategy in teaching lies in the fact that it bridges the gap between theory and practice, allows learners to become good observers and generates their interest.

Demonstrate-observe-explain (DOE) instructional strategy involves the presentation of the activities or tasks related to the facts and principles of an instruction by the teacher in the laboratory, aiming to facilitate the task of learning by showing or practically revealing to the students' certain scientific processes or activities without the students necessarily involved in hands-on task. In most cases, DOE is usually aided by the teacher. This is because the teacher demonstrates the tasks while the students observe and explain the process through the teacher's guide. The teacher must understand and be equal to the task of carrying out the activities for the students to observe and explain (Dorgu, 2015). In, DOE teaching strategy, the teacher is the principal actor while the learners watch with the intention to act through explanation later. Demonstrate-observe-explain (DOE) display or exhibition usually done by the teacher while the students watch with keen interest. The act of demonstration by the teacher while the students observe readily helps to kindle more natural interactions between the students and the teacher (Okotubu, 2020). DOE allows teaching of concepts and principles of real things by combining explanation with handling or manipulation of real events.

Gender is an important component of psychological and self-concept experience of being a masculine or a feminine. Some researchers revealed significant gender differences in cognitive engagement, attitude, academic performance, skill acquisition, interest and critical thinking in chemistry. Some of the factors identified to have accounted for the observed differences in the achievement of male and female students in Chemistry. Ajayi (2025) and Anazor (2019), concluded that male students had higher academic achievement and motivation toward chemistry respectively than their female counterparts. However, the findings in Shamsulbahri and Zulkiply (2021) revealed that there was no significant difference between gender and achievement in separation techniques. Thus, the issue of gender in relations to interest and academic achievement has attracted the attention of many science education researchers and remains contradictory. It can be concluded that the students' poor interest and poor academic achievement in chemistry, especially in qualitative analysis have persisted which is often blamed on poor teaching strategies adopted by teachers. However, studies on DOE and POEE on students' interest and achievement in qualitative analysis have not been investigated. Hence, the present study investigated if secondary school students' interest and academic

achievement in the context of qualitative analysis could be improved using predict-observe-explain-explore (POEE) or demonstrate-observe-explain (DOE) instructional strategies in Kogi Central Education zone of Kogi State, Nigeria.

1.1 Purpose of the Study

The purpose of this study was to investigate if senior secondary school students' interest and academic achievement in the context of qualitative analysis could be improved using predict-observe-explain-explore (POEE) or demonstrate-observe-explain (DOE) instructional strategies. Specifically, the study:

1) determine if students' interest rating could be enhanced in qualitative analysis using POEE or DOE instructional strategies;
2) find out if students' academic achievement scores could be enhanced in qualitative analysis using POEE or DOE instructional strategies;
3) determine the interaction effects of strategies and gender on students' interest rating in qualitative analysis; and
4) find out the interaction effects of strategies and gender on students' academic achievement in qualitative analysis.

1.2 Research Questions

The following research questions guided the study.

1) What is the mean interest ratings difference between students taught qualitative analysis using predict-observe-explain-explore (POEE) instructional strategy and those taught using demonstrate-observe-explain (DOE) instructional strategy?
2) What is the mean academic achievement scores difference between students taught qualitative analysis using POEE instructional strategy and those taught using DOE instructional strategy?
3) What is the interaction effect of the instructional strategies and gender on students' interest ratings of in qualitative analysis?
4) What is the interaction effect of the instructional strategies and gender on students' academic achievement scores of in qualitative analysis?

1.3 Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance:

HO_1: There is no significant difference in the interest ratings of students taught qualitative analysis using predict-observe-explain-explore (POEE) instructional strategy and those taught using demonstrate-observe-explain (DOE) instructional strategy.

HO_2: There is no significant difference in the academic achievement scores of students taught qualitative analysis using predict-observe-explain-explore (POEE) instructional strategy and those taught using demonstrate-observe-explain (DOE) instructional strategy.

HO_3: There is no significant interaction effect between instructional strategies and gender on students' interest ratings in qualitative analysis.

HO_3: There is no significant interaction effect between instructional strategies and gender on students' academic achievement scores in qualitative analysis.

2. Research Design and Procedure

A quasi-experimental design was used for this study. The non-randomized pre-test post-test design in which each of the two groups controlled the other since the researcher wanted to know the comparative effects of the two groups. According to Nworgu (2018), this design is often used in classroom experiment when experimental and control groups are naturally assembled in intact classes so as not to disrupt the school setting. The study was carried out in Kogi Central District in Kogi State, Nigeria. Kogi Central has an area of 328 km² and a population of 320,260 at the 2006 census. Kogi central comprises three education zones namely: Okene/Ogorimagongo, Ajaokuta and Adavi/Okehi. The population of the study was 1489 senior secondary three (SS3) students offering chemistry for 2022/2023 session in all the 44 public secondary schools in Kogi Central. This consists of 36 co-educational schools and 8 single sex schools (Source: Kogi State Science, Technical Education & Teaching Service Commission (STETSCOM) Zonal Office, Okene, 2023).

A sample size of 206, (84 males and 122 females) SS3 students offering chemistry took part in the study using multi-sampling procedures. Senior secondary three (SS3) students offering chemistry were used because the content scope is from SS3 Chemistry curriculum. Qualitative Analysis Interest Questionnaire (QAIQ) and Qualitative Analysis Academic Achievement Test

(QAAAT) were instruments used for data collection. The QAIQ comprises two sections. Section A elicits the biography data of the students while section B consists of 40 items statements which was intended to help students express their interest toward learning qualitative analysis. The instrument is rated on a 4-point Likert-rating scale with four response options. The options are Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) with number indicators as (SA) = 4, (A) = 3, (D) = 2, (SD) = 1. QAAAT also consists of two sections. Section A consists of bio-data information of the respondents, while section B consisted of 12 essay questions with a total of 40 marks distributed across the 12 essay questions.

Qualitative Analysis Interest Questionnaire (QAIQ) and Qualitative Analysis Academic Achievement Test (QAAAT) were face validated. QAIQ and QAAAT were subjected to construct validity while the lesson plans were vetted. The reliability coefficient of QAIQ was estimated using Cronbach's Alpha (α) with a value of 0.93. while inter-rater reliability of the QAAAT was calculated using Kendall Coefficient of Concordance (W) and a value of 0.86 was obtained. Four research assistants were selected and trained on the teaching strategies and the contents to be covered. The researcher, having prepared the lesson notes using predict-observe-explain-explore and demonstrate-observe-explain strategies that covered all the contents to be taught for three weeks explained to the teachers the steps involved. The training lasted for a period of one week. QAIQ was rated and QAAAT was marked and scored based on marking scheme with the maximum score of forty marks and minimum of zero. Mean and Standard Deviations were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the formulated hypotheses at 0.05 level of significance. Since there is no randomization of subjects, it became necessary to use ANCOVA to avoid the error of non-equivalence and to reduce the initial group differences. The pre-test scores were used as covariates to the post-test scores.

3. Results and Interpretation

3.1 Research Question 1

What is the mean interest ratings difference between students taught qualitative analysis using predict-observe-explain-explore (POEE) instructional strategy and those taught using demonstrate-observe-explain (DOE) instructional strategy? The answer to research question 1 is presented in Table 1 and Figure 1 respectively.

Table 1. Mean Interest and Standard Deviation Scores of Students Taught Qualitative Analysis Using POEE and DOE Strategies

Group	N	PRE- QAIQ		POST- QAIQ		Mean Gain within Group
		$\tilde{x}$	δ	$\tilde{x}$	δ	
POEE	95	1.18	0.19	3.82	0.27	2.64
DOE	111	1.16	0.18	3.27	0.24	2.11
Mean diff. between Groups		0.02		0.55		0.53

Key: N=Number of subjects/respondents, $\tilde{x}$= Mean, δ = Standard Deviation.

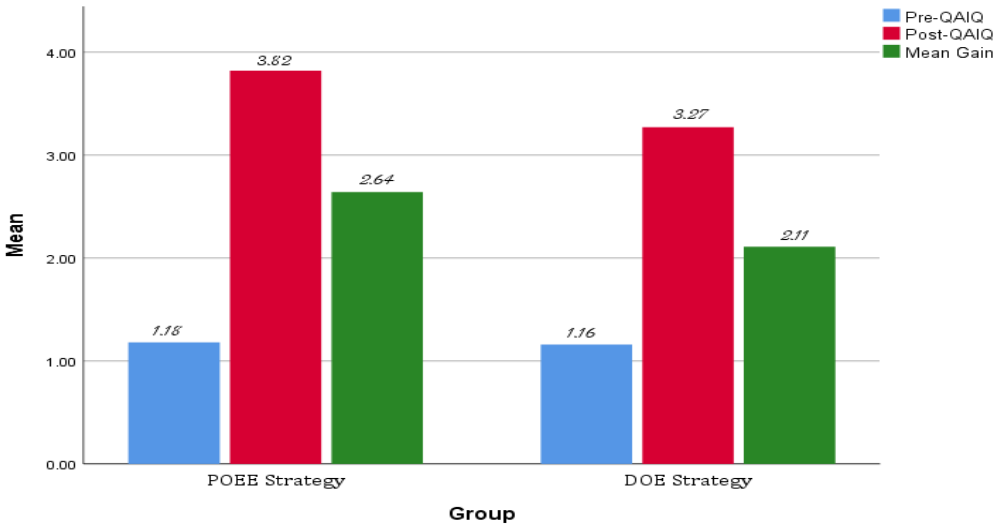

Figure 1. Pre-QAIQ, Post-QAIQ and mean gain in effect of POEE strategy and DOE strategy on students' interest in Qualitative Analysis

The summary of the Pre-QAIQ and Post-QAIQ mean ratings of students taught using POEE strategy and DOE strategy in Qualitative Analysis is represented in Figure 1. The result in Table 1 shows the mean interest rating of students taught using predict-observe-explain-explore (POEE) and demonstrate-observe-explain (DOE) instructional strategies in the context of qualitative analysis on a paired comparative basis. The result shows that students taught qualitative analysis using POEE had a pre-test mean interest rating of 1.18 with a standard deviation of 0.19 ($\tilde{x}$=1.18, δ= 0.19) and a post-test of 3.82 with standard deviation of 0.27 ($\tilde{x}$=3.82, δ= 0.27). The mean interest ratings gain within POEE group was 2.64. Whereas students taught using DOE had a pre-test mean interest rating of 1.16 with a standard deviation of 0.18 ($\tilde{x}$=1.16, δ= 0.18) and a post-test of 3.27 with standard deviation of 0.24 ($\tilde{x}$=3.27, δ= 0.24). The mean interest ratings gain within DOE group was 2.11. However, the data in Table 1 also show that the overall mean interest rating difference between students in POEE and DOE groups was 0.53 in favour of POEE. By implication, this implies that students in POEE group had higher interest rating than students in DOE group.

Hypothesis 1

HO_1: There is no significant difference in the interest ratings of students taught qualitative analysis using predict-observe-explain-explore (POEE) instructional strategy and those taught using demonstrate-observe-explain (DOE) instructional strategy. Table 2 presented the test result of null hypotheses one.

Table 2. Analysis of Covariance (ANCOVA) for Mean Interest Ratings of Students Taught Qualitative Analysis Using POEE and DOE strategies

Source	Type III sum of squares	*df*	Mean Square	F	Sig.	Partial Eta Squared	Decision
Corrected model	557.155[a]	4	139.289	3.647	.007	.068	
Intercept	5270.080	1	5270.080	137.996	.000	.407	
TPr^{QAIQ}	93.789	1	93.789	2.456	.119	.012	
Group	175.822	1	175.822	4.604	.000	.722	S
Gender	55.508	1	55.508	1.453	.229	.007	NS
Group*Gender	75.860	1	75.860	1.986	.160	.001	NS
Error	7676.185	201	38.190				
Total	155667.000	206					

Corrected Total	8233.340	205

Note: S = Significant, NS = No Significant, $\alpha = 0.05$.

Table 2 presents the ANCOVA result for mean interest rating of students taught qualitative analysis using predict-observe-explain-explore (POEE) and demonstrate-observe-explain (DOE) instructional strategies. The data in Table 2 reveal that the observed mean difference in the interest rating between the groups was significant [$F_{1, 205}$=4.604, P<0.05]. Hence, the null hypothesis that there is no significant difference in the interest ratings of students taught qualitative analysis using predict-observe-explain-explore (POEE) instructional strategy and those taught using demonstrate-observe-explain (DOE) instructional strategy was rejected. This implies that there is a significant difference in the mean interest rating between the groups in favour of POEE. Meanwhile, the effect size was 0.722 as indicated by the corresponding partial eta squared value is considered as large effect size. This implies that 72.2% of the difference or variance in the mean interest ratings between the two groups was explained by the treatments. Hence, the difference in the mean interest rating between the groups has a large statistical effect size.

3.2 Research Question 2

What is the mean academic achievement scores difference between students taught qualitative analysis using POEE instructional strategy and those taught using DOE instructional strategy? The answer to research question 2 is presented in Table 3 and Figure 2 respectively.

Table 3. Mean Academic Achievement and Standard Deviation Scores of Students Taught Qualitative Analysis Using POEE and DOE Strategies

Group	N	PRE- QAAAT		POST- QAAAT		Mean Gain within Group
		$\tilde{x}$	δ	$\tilde{x}$	δ	
POEE	95	11.38	2.20	35.89	3.79	24.51
DOE	111	11.43	2.23	28.98	3.14	17.55
Mean diff. between Groups		-0.05		6.91		6.96

Key: N=Number of subjects/respondents, $\tilde{x}$= Mean, δ = Standard Deviation.

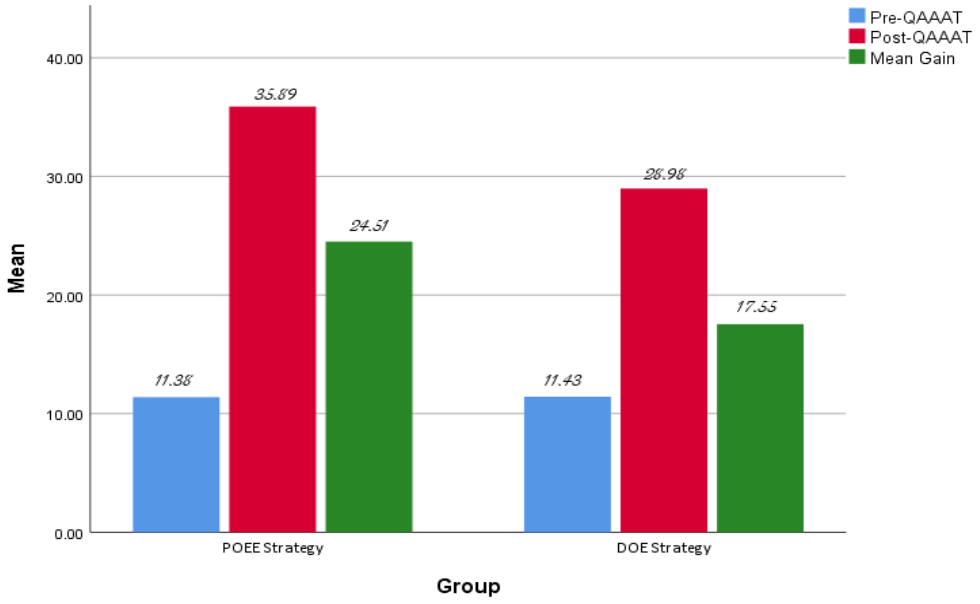

Figure 2. Pre-QAAAT, Post-QAAAT and mean gain in effect of POEE strategy and DOE strategy on students' academic achievement in Qualitative Analysis

The summary of the Pre-QAAAT and Post-QAAAT scores of students taught using POEE strategy and DOE strategy in Qualitative Analysis is represented in Figure 2. The result in Table 3 shows the mean academic achievement scores of students taught using predict-observe-explain-explore (POEE) and demonstrate-observe-explain (DOE) instructional strategies in the context of qualitative analysis on a paired comparative basis. The result shows that students taught qualitative analysis using POEE had a pre-test mean academic achievement scores of 11.38 with a standard deviation of 2.20 ($\tilde{x}$=11.38, δ= 2.20) and a post-test of 35.89 with standard deviation of 3.79 ($\tilde{x}$=35.89, δ= 3.79). The mean academic achievement scores gain within POEE group was 24.51. Whereas students taught using DOE had a pre-test mean academic achievement of 28.98 with a standard deviation of 3.14 ($\tilde{x}$=11.43, δ= 2.23) and a post-test of 28.98 with standard deviation of 3.14 ($\tilde{x}$=28.98, δ= 3.14). The mean academic achievement gain within DOE group was 17.55. However, the data in Table 3 also show that the overall mean academic achievement scores difference between students in POEE and DOE groups was 6.96 in favour of POEE. By implication, this implies that students in POEE group had higher academic achievement than their counterpart in DOE group.

Hypothesis 2

HO_2: There is no significant difference in the academic achievement scores of students taught qualitative analysis using predict-observe-explain-explore (POEE) instructional strategy and those taught using demonstrate-observe-explain (DOE) instructional strategy. Table 4 presented the test result of null hypotheses two.

Table 4. Analysis of Covariance (ANCOVA) for Mean Academic Achievement Scores of Students Taught Qualitative Analysis Using POEE and DOE strategies

Source	Type III sum of squares	df	Mean Square	F	Sig.	Partial Eta Squared	Decision
Corrected model	10465.329[a]	4	2616.332	3.647	.000	.888	
Intercept	1432.618	1	1432.618	137.996	.000	.916	
TPr^{QAAAT}	106.439	1	106.439	2.456	.000	.075	
Group	1662.550	1	1662.550	89.004	.000	.880	S
Gender	.084	1	.084	1.453	.910	.000	NS
Group*Gender	45.076	1	45.076	17.002	.380	.002	NS
Error	1320.598	201	6.570				
Total	134557.000	206					
Corrected Total	11785.927	205					

Note: S = Significant, NS = No Significant, α = 0.05.

Table 4 presents the ANCOVA result for mean academic achievement scores of students taught qualitative analysis using predict-observe-explain-explore (POEE) and demonstrate-observe-explain (DOE) instructional strategies. The data in Table 4 reveal that the observed mean difference in the academic achievement scores between the groups was significant [$F_{1, 205}$=89.004, P<0.05]. Hence, the null hypothesis that there is no significant difference in the academic achievement scores of students taught qualitative analysis using predict-observe-explain-explore (POEE) instructional strategy and those taught using demonstrate-observe-explain (DOE) instructional strategy was rejected. This implies that there is a significant difference in the mean academic achievement scores between the groups in favour of POEE. Meanwhile, the effect size was 0.880 as indicated by the corresponding partial eta squared value is considered as large effect size. This implies that 88.0% of the difference or variance in the mean academic achievement scores between the two groups was explained by the treatments. Hence, the difference in the mean academic achievement scores between the groups has a large statistical effect size.

3.3 Research Question 3

What is the interaction effect of the instructional strategies and gender on students' interest ratings of in qualitative analysis? Research question three is presented in Figure 3.

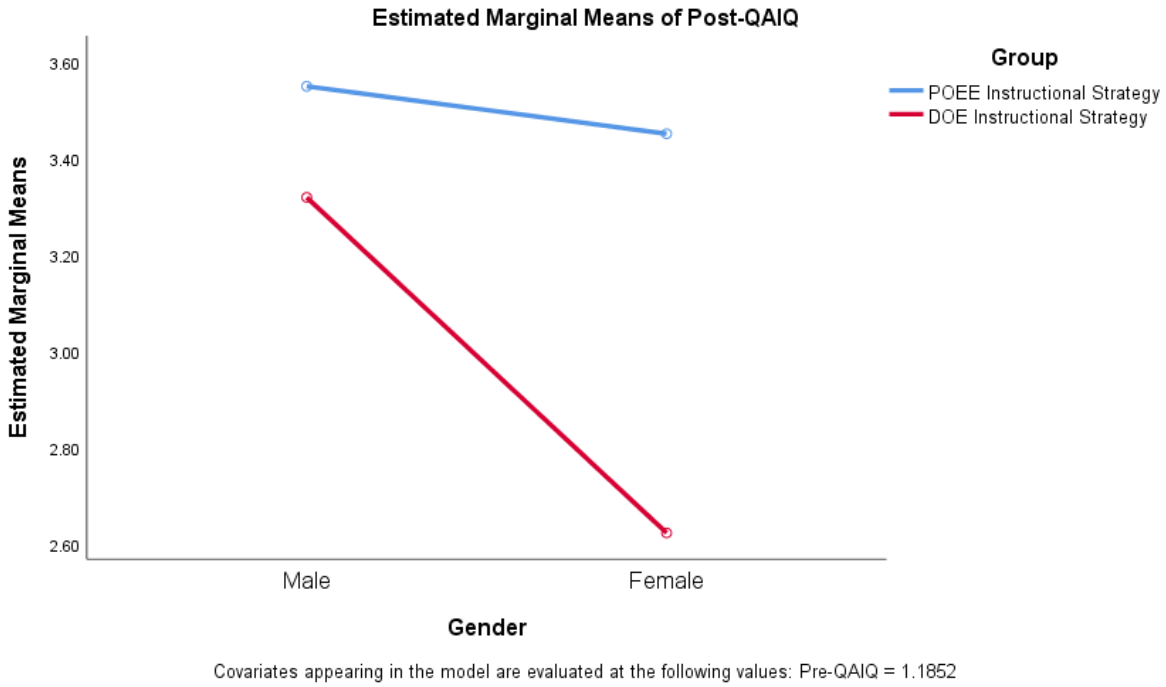

Figure 3. Interaction plot of strategies and gender on students' interest in qualitative analysis

Figure 3 presented a graph of the interaction effect of strategies and gender on the interest rating of students in qualitative analysis. The graph lines for gender did not intercept which suggests that interactive effect of treatments and gender on students' interest in qualitative analysis was very minimal.

Hypothesis 3

HO_3: There is no significant interaction effect between instructional strategies and gender on students' interest ratings in qualitative analysis. The data analysis of Table 2 is used to explain hypothesis 3.

Table 2 presents the interaction effect of instructional strategies and gender on students' interest rating in qualitative analysis. The data in Table 2 reveals that there is no significant interaction effect of treatments and gender on the mean interest rating of students in qualitative analysis [$F_{1\ 205}$ = 1.986, P>0.050]. The null hypothesis is therefore not rejected. Meanwhile, the effect size was 0.001 as indicated by the corresponding partial eta squared value which is considered as small effect size. This implies that only 0.1% of the interaction in the interest rating between the two groups was explained by treatments and gender. Hence, the interaction of treatments and gender on students' interest rating has small statistical effect size.

3.4 Research Question 4

What is the interaction effect of the instructional strategies and gender on students' academic achievement scores of in qualitative analysis?

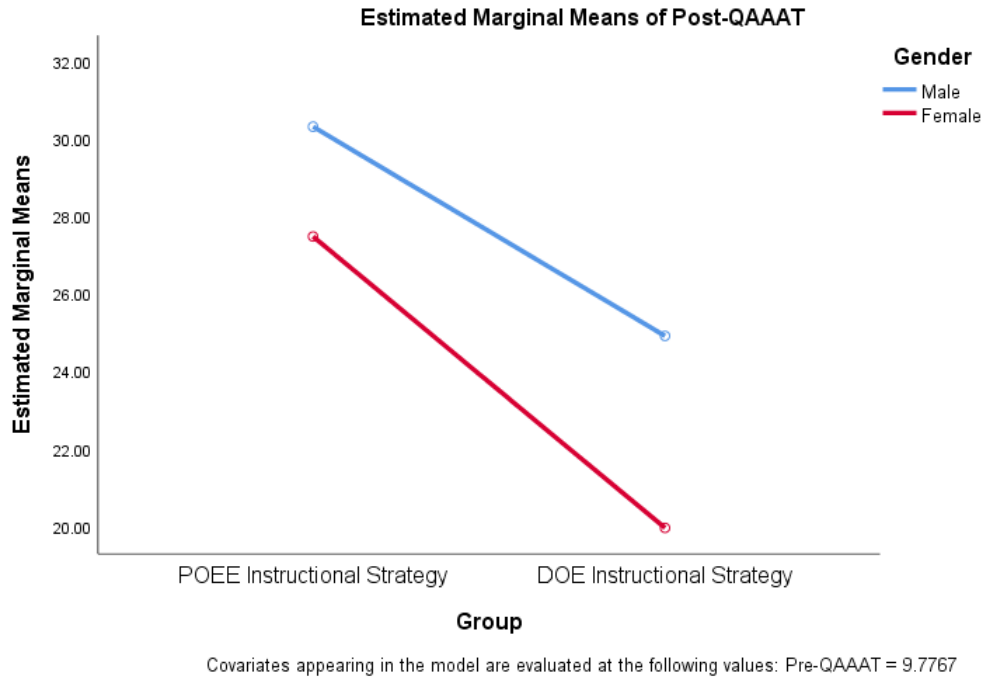

Figure 4. Interaction plot of strategies and gender on students' academic achievement in qualitative analysis

Figure 4 presented a graph of the interaction effect of strategies and gender on the academic achievement scores of students in qualitative analysis. The graph lines for gender did not intercept which suggests that interactive effect of treatments and gender on students' academic achievement in qualitative analysis was very minimal.

Hypothesis 4

There is no significant interaction effect between instructional strategies and gender on students' academic achievement scores in qualitative analysis. The data analysis of Table 4 is used to explain hypothesis 4.

Table 4 presents the interaction effect of instructional strategies and gender on students' academic achievement in qualitative analysis. The data in Table 4 reveals that there is no significant interaction effect of treatments and gender on the mean academic achievement of students in qualitative analysis [$F_{1\ 205}$ =17.002, P>0.050]. The null hypothesis is therefore not rejected. Meanwhile, the effect size was 0.002 as indicated by the corresponding partial eta squared value which is considered as small effect size. This implies that only 0.2% of the interaction in the academic achievement in the two groups was explained by treatments and gender. Hence, the interaction of treatments and gender on students' academic achievement has small statistical effect size.

4. Discussion of Finding

The study investigated the comparative effects Predict-Observe-Explain-Explore (POEE) and Demonstration-Observe-Explain (DOE) instructional strategies on senior secondary students' interest and academic achievement in the context of qualitative analysis in Kogi Central of Kogi State, Nigeria. The findings revealed that students taught qualitative analysis using POEE had higher mean interest rating than their counterparts taught using DOE. ANCOVA result revealed the difference in the mean interest rating of the students taught qualitative analysis using POEE strategy and those taught using DOE strategy was statistically significant in favour of POEE group. The finding of this study is in line with Hilario (2015), Sreerekha, Arun, and Swampna (2016) and Ajayi and Audu (2020). Findings that the POEE strategy was effective in terms of gathering students' predictions and reasons for the prediction of outcomes in an open-ended format. With the consistency in the above previous research findings, it is clear from the findings of this present study that POEE strategy is more efficacious than and superior to

DOE strategy in enhancing students' interest in qualitative analysis. The likely explanation for this outcome may be connected to the fact that the POEE strategy propelled the students and gave them the persisting tendency for critical thinking based on their previous knowledge to forecast, make self-discovery, have willingness to carry out their activities with concentration and enjoy the activities in the content since POEE strategy is activity oriented and more of student-centered. The strategy gives the learners the opportunity to reconcile their prediction with explanation after carrying out the experiment. It was obvious that the introduction of POEE strategy as one of the treatments enhanced the interest of the students in qualitative analysis tremendously.

The result revealed that students taught qualitative analysis using POEE had higher mean academic achievement scores than their counterparts taught using DOE. ANCOVA result revealed the difference in the mean academic achievement scores of the students taught qualitative analysis using POEE strategy and those taught using DOE strategy was statistically significant in favour of POEE group. This finding agrees with Acar Seşen and Mutlu (2016) who reported that laboratory activities based on POEE strategy task were more effective than the traditional cook-book laboratory setting for promoting the pre-service elementary teachers' conceptual understanding. The finding is also in line with Ajayi and Achor (2021) who revealed that predict-explain-observe-explain significantly enhances students' metacognitive awareness than discussion method in organic chemistry. The likely explanation for this may be connected to the fact that POEE strategy allows students to reflect on their experiences with an understanding of a subject before making a prediction about the outcome of an experiment and discussing the prediction with classmates. The performance steps during POEE strategy also give the learners the opportunity to become skillful because it affords them the chance to carry out the task by themselves.

The interaction effect between instructional strategies and gender in relation to the students' interest and achievement in qualitative analysis was found not statistically significant respectively. This indicated that the effect of instructional strategies on Chemistry learning was not significantly different for both female and male participants. The findings in the present study supported Ajayi, Ameh and Alabi (2025) who stated that regarding the interaction between instructional method and gender, no significant interaction effect was found. This indicated that the effect of instructional methods on qualitative analysis learning was not different for female and male students. In this case, there is no need for separation of instructional strategies for male and female students, since POEE approach could be used successfully for the two groups.

5. Conclusion

Based on the findings, the researchers concluded that the students taught qualitative analysis using Predict-Observe-Explain-Explore (POEE) instructional strategy had higher interest and academic achievement respectively than those taught qualitative analysis using Demonstrate-Observe-Explain (DOE) instructional strategy. It was concluded that interaction effect of instructional strategies and gender on students' interest and academic achievement respectively was not statistically significant. In this regard, it was concluded that, there is no need for separation of instructional strategies for male and female students, since POEE approach could be used successfully for the two groups. Thus, the researchers opines that, the difference between the students in POEE group and DOE group in terms interest and academic achievement in favour of POEE group could be due to the fact that POEE instructional strategy being more activity oriented and students-centered which fully demanded students prior-knowledge or experience, hands-on activities, critical thinking, operational and manipulative skills to solve problems related to qualitative analysis compared to DOE group where students only watch the activities demonstrated by the teacher without actively participating (hand-on) in such activities.

Thus, recommendations were made:

1) In-service chemistry teachers should be encouraged to employ the use of Predict-Observe-Explain-Explore (POEE) instructional strategy during teaching/learning process in other to enhance students' interest and academic achievement in the context of qualitative analysis and probably chemistry in general.
2) Workshops, seminars and conferences should be organized by professional and examination bodies such as STAN, TRCN, WAEC, NECO, NABTEB, and JAMB for

science teachers on the use of POEE instructional strategy as to improve students' interest and academic achievement in qualitative analysis.

3) Curriculum developers should be encouraged to include POEE instructional strategy in the training programme of pre-service Chemistry teachers.

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