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Adopting and Implementing Collaborative Invitation, Exploration, Proposing-Explanation and Taking-action (CIEPT) Instructional Approach and Students' Academic Performance in Chemistry

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Abstract—The study was on the adoption of the Collaborative Invitation, Exploration, Proposing-Explanation, and Taking action (CIEPT) instructional approach to design chemistry lesson plans and investigating if the implementation the of CIEPT instructional approach in chemistry classrooms could improve students' academic performance. A pretest, posttest, control group, and quasi-experimental research design was adopted in this study. The instrument used for data collection was the Chemistry Academic Performance Test (CAPT). CAPT was adopted from the West African Examination Council (WAEC) past examination question papers of 2005-2022. Kuder-Richardson (KR-21) formula was used to test the internal consistency of CAPT which yielded a reliability value of 0.91. A sample of 152 students was purposively sampled from 4 schools out of 47 schools in the study area. Three research questions and three null hypotheses guided the study. The research questions were answered using Mean and Standard Deviation scores while the null hypotheses were tested at 0.05 level of significance using results from Analysis of Covariance (ANCOVA). The study revealed that there is a significant difference between the mean academic performance of students taught Chemistry using CIEPT and the discussion method of teaching [$F_{1, 151}$=111.210, $p<0.05$]. It was found that no significant difference between the mean academic performance of male and female students taught Chemistry using the CIEPT approach [$F_{1, 78}$=.420, $P>0.05$]. It was recommended among others that since the CIEPT approach was found to be an effective approach for improving students' academic performance irrespective of gender; Chemistry teacher's trainee and serving teachers should be trained on how to adopt and use the CIEPT approach.

Keywords: Collaborative Invitation, Exploration, Proposing-Explanation and Taking action (CIEPT) instructional approach, students' academic performance, chemistry

1. INTRODUCTION

To achieve the nation's quest for science and technology advancement, students need to be trained to think in more purposive ways to organize their environment more systematically and view the world with more meaning (Ajayi, 2017). By implication, the faith in solving problems and experimental verification needs to be encouraged in students and there is need for teachers to guide students to verify the processes and principles. The students' curiosity needs to be nurtured and objective attitude need to be promoted. Thus**,** to facilitate teacher to enable the students to engage in acquiring methods and processes that nurtures their curiosity, problem solving and creativity, there is need to equip teachers with innovative teaching approaches that have the potentials to arouse students' curiosity, problem solving ability and creativity.

For a nation to develop in science and technology the teaching and learning of chemistry need to be improved and continually assessed (Ajayi & Ogbeba, 2017). Chemistry is an experimental science that systematically studies the composition, chemical and physical properties and activities of substances or elementary forms of matter (Ajayi, 2019). The objective of teaching chemistry in senior secondary schools is to prepare students for tertiary institution chemistry courses. To conceptualize the basic facts, introduce students to scientific methods, to develop their scientific attitude and reasoning and to stimulate their curiosity and interest towards the chemistry, to develop an understanding of the consequences of chemistry on humans and their environment (NERDC, 2012). Therefore, there is need for chemistry to be proper taught in senior secondary schools to achieve its objectives.

Teaching of chemistry is planned process of transformation of knowledge into principles and the required planned action (experimentation) for understanding (Ajayi, 2017). The chemistry teacher tries to describe, elucidate, and explain concepts and solve problems of relevance. The chemistry curriculum needs to be essentially local specific to cater to the needs of the people. The researchers opine that, the chemistry curriculum need to be more constructive, and the teacher need to be facilitative in order that the students engage scientific inquiry, do experiments, and discuss concepts in chemistry to refine ones understanding of the nature of chemistry and its application in life. Therefore, to develop a basic knowledge and understanding of Chemistry at senior secondary school level of education, teachers of Chemistry need to provide the conceptual structure of chemistry to students in an organized way through continuous interaction and active participation of students in developing the conceptual structure. The teacher needs to facilitate the students to show the inter-relationships between concepts and integration of it in a meaningful way for a clear understanding of chemistry concept using 21st innovative teaching approaches.

1.1 Collaborative Invitation, Exploration, Proposing-Explanation and Taking action (CIEPT)

Collaborative Invitation, Exploration, Proposing-Explanation and Taking action (CIEPT) is a constructivist strategy where learners in a small group setting are engaged actively in constructing knowledge through exploration of activities, discussion, and evaluation of the results of these activities thereby enhancing conceptual understanding. In other words, this approach arranges learning experiences through invitation (Invitation involves recognition of the problem), exploration, proposing explanation and taking action so that learners could construct their understanding of a concept collaboratively (Ajayi, 2022). CIEPT is an approach adopted by a teacher to teach through activity in which the students collaboratively participate thoroughly and bring about efficient learning experience. It is an approach in which the child is actively involved both mentally and physically. CIEPT approach is a form of teaching approach that encourages thoughtful reflection on activity explored (Ajayi, 2022).

Collaborative Invitation, Exploration, Proposing-Explanation and Taking action (CIEPT) was designed from Invitation, Exploration, Proposing-Explanation and Taking action (IEPT) by Ajayi (2022) to emphasize that, knowledge is a social construct and as a result, instruction need to involve learners working in a small groups or teams to accomplish a common goal easily and successfully. Invitation, Exploration, proposing explanation, Taking action (IEPT) as presented by Bybee (1989) focuses on a student role of formulating, representing, clarifying, communicating, and reflecting on ideas that lead to an increase in learning. Learner learns by exploration and not by being told what

will happen and they are left to make their inferences, discoveries, and conclusions. Here, the teacher plays the role of mediating, facilitating, and enhancing learning. The difference between Collaborative Invitation, Exploration, Proposing-Explanation and Taking action (CIEPT) and Invitation, Exploration, Proposing-Explanation and Taking action (IEPT) is that IEPT emphasizes on collaborative learning. Collaborative learning is an umbrella for a variety of educational strategies involving joint efforts by both teacher and learners. Collaborative learning is broadly defined as a leaning situation in which two or more people learn or attempt to learn something together, and more specifically as joint problem solving. Collaborative learning engages learners in active learning where they work and learn together in small groups to accomplish shared goals. Ajayi (2022) concluded that CIEPT approach emphasizes active students' participation in the learning process in a collaborative setting through exploration, problem solving and discussion. Ajayi (2022) designed a 6-step format for Collaborative Invitation, Exploration, Proposing Explanation and Taking Action (CIEPT) instructional approach as follows.

Step I: Set Induction

Teacher Activity; Teacher to

Arouse students' interest by making clear to the students the objectives of the day's study and making clear to them the importance of the subject matter and its relevance to daily life.

- Give the students a resume of what is to be taught, after asking them a few questions to probe into their prior knowledge, teacher then explains what the concept/ topic to be taught is all about.

Students' Activity; students

- Answer the questions orally.
- Students jot down some points as the teacher speaks. They are also allowed to ask questions.

Step II: Formation of Groups

Teacher Activity; Teacher to

- Share students out into groups of five to seven depending on the class size.
- Ask students to assume different roles.
- A few minutes of full-class discussion will provide the students on the concept to be taught.

Students' Activity; Students to

- Move to their respective groups and assume their different roles viz: captain, recorder, timekeeper and so on
- Jot down some points as the teacher speaks. They are also allowed to ask questions.

Step III: Invitation (I)

Teacher Activity; Teacher to

- Invitation involves recognition of the problem by students through questioning or observation and the way out or the decision to tackle such problem. Thus, ask the students challenging question(s) that can be addressed through the experiments or activities that follows in step 4.
- The recorder for the group or whoever is assigned is expected to write out the challenging questions on the IEPT worksheet.

Students' Activity; Students to

- The recorder for the group or whoever is assigned write out the challenging questions on the IEPT worksheet.

Step IV: Exploration of Activity (E)

Teacher Activity.

- Ask the students to watch a demonstration or carryout the experiments or activities related to the challenging questions asked in step 3.
- Ask each member of the group to write down their observation from the activities.
- Ask the students to write down their observations on the piece of paper as agreed upon by the group.
- Goes round various groups to supervise the activities. While students are carrying out the activities, you might stroll around to prepare yourself for the discussion that will follow.

Students' Activity.

- Undertake the experiments or activities (discrepant events) which are designed to provide answers to the challenging questions.
- Each member of the group is expected to write out their observation(s) on a piece of paper.
- All members spread out their papers on a flat surface (desk), where it can easily be read. Have a look at each other's observation(s) and make quick comments.
- Then, the recorder for the group or whoever is assigned, write down their observation(s) as agreed upon by the group and directed by the group captain on the piece of paper.

Step V: Proposing Explanation (P)

- The activities are discussed one after the other. Then propose answers to the challenging questions at this stage.
- Ask each member of the group to write down the explanation to each of the challenging questions on a piece of paper.
- Ask the students to write down their explanation on the IEPT worksheet as agreed upon by the group.
- Then, ask each group to present their answers in full-class discussion.
- Engage the students in full class discussion to reconcile any conflict between their proposed explanations to the challenging questions.

Students' Activity; Students

- Each member of the group is expected to write out the explanation for their observation on a piece of paper.
- All members spread out their papers on a flat surface (desk), where it can easily be read. Have a look at each other's explanation and make quick comments.
- Then, the recorder for the group, write down the explanation for the challenging questions as agreed upon by the group on the IEPT worksheet.
- Term leaders' representatives makes their respective presentations in full class discussion.
- Students listen to the teacher's explanations in full class discussion.

Step VI: Taking Action (T)

Teacher Activity; Teacher

- This stage is where new knowledge is used or transferred to develop products to produce ideas. Thus, ask students to provide instances of the application of the concept.
- To disengage from their groupings.

Students' Activity; Students

- Students provide instances of the application of the new knowledge.
- They are allowed to ask questions for clarification.
- Students move to their respective sits.

With a view to improving chemistry instructions, the researchers opine that, since CIEPT is grounded in constructivist framework, it is very likely that chemistry could be simplified and made easier to understand as students go through CIEPT teaching/learning steps or phases.

1.2 Statement of the Problem

The poor academic performance of students in chemistry in external examination has been a major concern to researchers. Studies by Ogbeba, Enemarie, and Ajayi (2019); Achor Ajayi, Ikwu and Onyeche (2020); Ajayi, Achor and Otor (2020) revealed that poor teaching methods, poor performance in basic science in Basic Education level, teacher content knowledge, truancy, indiscipline, peer pressure, assessment pattern and school related factors are the causes of students' poor performance. The poor academic performance is attested to in the Chemistry result of students in Nigeria and Ekiti State in particular in the West African Senior Secondary School Certificate Examinations (WASSCE) May/June, 2012 to 2022 However, the West African Examination Council (WAEC) Chief Examiners' report (2020/2021) on Chemistry result indicates that students are weak in Chemistry due to the fact that candidates do not familiarize themselves with the required syllabus; teachers do not emphasize on areas of the syllabus where candidates appear to be weak such as Organic Chemistry; and teachers do not employ effective instructional methods. Thus, ineffective teaching method is the most prominent among the identified causes of students' poor academic performance in chemistry.

Despite the effort of researcher to improve on its teaching and learning, students' poor academic performance in Chemistry in external examinations appears to have persisted which is often blamed on poor teaching methods that does not put into consideration the students' activity in teaching and learning processes. Chemistry being a core science subject at the senior secondary level of education is expected to serve as a base to guide students to know and be conscious science and technological values. Despite the importance of chemistry, it has been observed that not much attention is placed on effective teaching strategies of this subject. This has led to failure to produce the desired results in terms of academic performance on the part of students and even in terms of science advancement which in most cases has drastic consequences on the science and technological development in our nation.

Poor teaching method invariably translates to students' poor academic performance. Most Nigerian chemistry teachers use discussion method most frequently in their classrooms which usually degenerate into mere talk and may be monopolized by few individuals. Based on this, the nation's quest for science and technology advancement to produce the right calibre of citizens equipped with the right type of scientific skills and attitudes for national development will become a mirage, if effective modality is not put in place to incorporate innovative methods that promote meaningful

learning, thus, there is needs to ensure that chemistry is properly taught using 21st century innovative teaching approaches. Thus, the researchers adopted Collaborative Invitation, Exploration, Proposing-Explanation and Taking Action (CIEPT) instructional approach designed by Ajayi (2022) to develop chemistry lesson plans and investigated if the implementation of CIEPT instructional approach in chemistry classrooms could improve students' academic performance.

1.3 Purpose of the Study

The purpose of the study was to investigate if the implementation of the Collaborative Invitation, Exploration, Proposing-Explanation and Taking action (CIEPT) instructional approach can enhances students' academic performance in Chemistry. Specifically, the study.

1. Find out the effect of CIEPT on students' academic performance in Chemistry.
2. Investigate the difference in effect of CIEPT between male and female students' academic performance in Chemistry.
3. Investigate the interaction effect between strategies and gender on students' academic performance in Chemistry.

1.4 Research Questions

The following research questions guided the study:

1. What is the difference in the academic performance between students taught Chemistry using CIEPT and those taught using the discussion method?
2. What is the difference in the academic performance between male and female students taught Chemistry using CIEPT?
3. What is the mean interaction effect of treatments and gender on students' academic performance in Chemistry?

1.5 Hypotheses

The following null hypotheses were tested:

1. There is no significant difference in the academic performance between students taught Chemistry using CIEPT and those taught using the discussion method.
2. There is no significant difference in the academic performance between male and female students taught Chemistry using CIEPT.
3. There is no significant interaction effect of treatments and gender on the mean academic performance scores of students in Chemistry.

2. METHODS

2.1 Research Design

The study employed a pre-test, post-test quasi-experimental design.

2.2 Study Area

The study area was Ado Local Government Area of Ekiti State, Nigeria.

2.3 Population

The population of the study was made up of 8,637 Senior Secondary 2 students offering chemistry in the 47-government approved secondary schools.

2.4 Sample

152 students were purposively sampled from 4 schools.

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2.5 Research Instrument

One instrument known as the Chemistry Academic Performance Test (CAPT) was used to collect data for this study. CAPT was adopted from the West African Examination Council (WAEC) past examination question papers of 2005-2022. CAPT items were based on WAEC, which is standardized, since the target of the study was to improve the students' academic performance, at SSCE level. The CAPT items (WAEC past examination question) selected were based on the topics taught using the CIEPT instructional approach. The instrument contains two sections. Section A contains bio-data information of the respondents, while section B contains 40 multi-choice objective items questions which respondents are expected to provide the correct answer by ticking the correct options (A-D).

2.6 Validation of Instrument

The Chemistry Academic Performance Test (CAPT) was validated by three experts of Science Education and two experts in Measurement and Evaluation all from Benue State University, Makurdi. Corrections and suggestions arising from these experts were used to review the instrument before it was used.

2.7 Reliability of the Instrument

Kuder-Richardson (KR-21) was used to obtain the CAPT reliability, which yielded a coefficient value of 0.91.

2.8 Experimental Procedure

The conduct of the study took place during the normal school lesson periods. The normal timetable of the schools for the study were followed. Before the commencement of the actual treatment, the researcher used one week for the training of the Chemistry teachers who served as research assistants. The training programme was to ensure the homogeneity of instructional situation across all groups. The training for the experimental group only differs from that of the control group using CIEPT. The sample was divided into two groups namely, experimental and control group.

During lessons, the experimental group was taught Chemistry using CIEPT in line with lessons procedure prepared by the researcher while the control group was taught the same Chemistry topics using the discussion lesson notes which lasted for four weeks. The study covers three sub-topics under Chemistry which includes alkane, alkene, and ethanol and redox reaction selected from the SS2 scheme of work. The choice of the sub-topics was to help students overcome the difficulties associated with academic performance in Chemistry as one of the areas that stand out as problem areas to Chemistry students in the report by the Chief Examiner's for West African Examination Council (2019/2020). Chemistry Academic performance Test (CAPT) was administered as pre-test by the researcher with the assistance of the sampled schools Chemistry teachers. This lasted for one week before actual teaching commences. At the end of these periods, the post-CAPT was administered which lasted for one week.

2.9 Data Analysis

The descriptive statistics of Mean and standard deviation were used to answer to the research questions while the inferential statistics of ANCOVA were used to test the null hypotheses.

3. RESULTS

Presentations in this section are based on research questions and hypotheses.

3.1 Research Question 1

What is the difference in the academic performance between students taught Chemistry using CIEPT and those taught using discussion method? The answer to research question one is contained in Table 1.

Table 1. Mean Academic Performance and Standard Deviation Scores of Students using CIEPT and Discussion Method

Group	N	PRE- CAPT		POST- CAPT		
		$\tilde{x}$	δ	$\tilde{x}$	δ	Mean Gain
CIEPT	79	9.46	1.12	36.64	1.31	27.18
Discussion	73	9.44	1.14	17.22	1.22	7.78
Mean difference		0.02		19.42		19.40

The results in Table 1 reveal that, the pre-test mean scores for CIEPT, and discussion groups are 9.46 and 9.44 respectively with their standard deviation scores of 1.12 and 1.14 respectively. The post-test mean scores accordingly were 36.64 and 17.22 with their standard deviation scores of 1.31 and 1.22 respectively. The overall difference between the CIEPT and discussion groups was 19.40 in favour of CIEPT group. This implies that the learners in CIEPT had higher academic performance than their counterpart in discussion group.

3.2 Research Question 2

What is the difference in the academic performance between male and female students taught Chemistry using CIEPT? The answer to research question two is presented in Table 2.

Table 2. Mean Academic Performance and Standard Deviation Scores of Male and Female Students Taught Chemistry using CIEPT Approach

Group	Gender	N	PRE- CAPT		POST- CAPT		Mean Gain within Gender
			$\tilde{x}$	δ	$\tilde{x}$	δ	
CIEPT Approach	Male	44	9.23	1.64	38.21	2.25	28.98
	Female	35	9.07	1.66	37.53	2.02	28.46
Mean diff. between Gender			0.16		0.68		0.52

Table 2 reveals the mean academic performance and standard deviation scores of male and female students taught Chemistry using Collaborative Invitation, Exploration, Proposing-Explanation and Taking action (CIEPT). The data in Table 2 show that the pre-test mean scores for male and female students were 9.23 and 9.07 with standard

deviation scores of 1.64 and 1.66 respectively while the post-test mean scores were 38.21 and 37.53 with standard deviation scores of 2.25 and 2.02 respectively. The mean difference of both sexes was 0.52. This difference though small is in favour of the male students. This implies that male students achieved slightly higher than their female counterparts in discussion method class.

3.3 Research Question 3

What is the mean interaction effect of treatments and gender on students' academic performance in chemistry? The answer to research question three is presented in Figure 1.

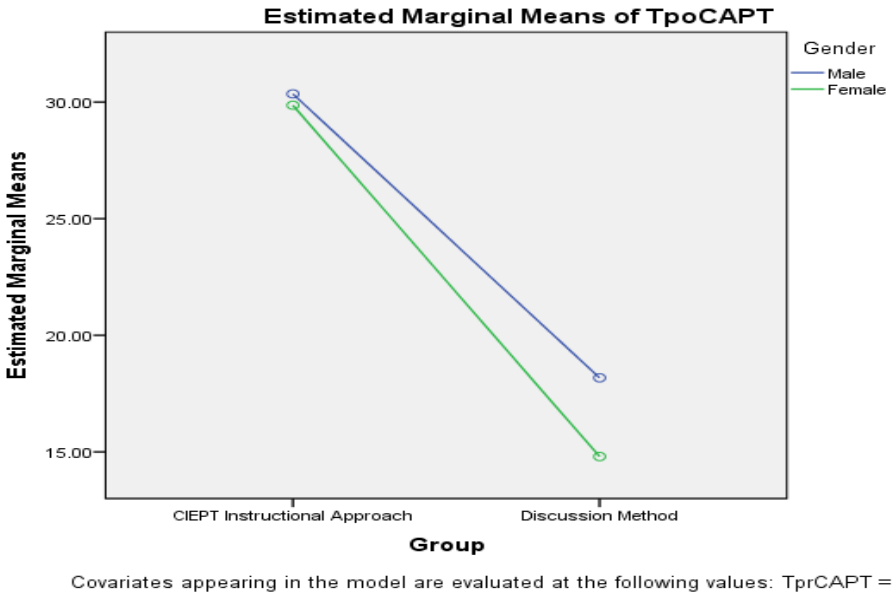

Figure 1. Interaction Plot of Treatments and Gender on Students' Academic Performance in Chemistry

Figure 1 presents a graph of the interaction effect of treatments and gender on the mean scores of students in chemistry. The graph lines for gender did not intercept which suggests that interactive effect of treatments and gender on students' academic performance in chemistry was very minimal.

3.4 Hypothesis 1

There is no significant difference in the academic performance between students taught Chemistry using CIEPT and those taught using discussion method.

ANCOVA Test result in Table 3 reveals that there is a significant difference between CIEPT and discussion method of teaching in favour of CIEPT approach [$F_{1, 151}$=111.210, $p<0.05$]. The null hypothesis is therefore rejected. This implies that CIEPT was highly effective than discussion method in improving students' academic performance in chemistry. Meanwhile, the effect size was 0.692 as shown by the corresponding partial eta squared value is considered as large effect size. This implies that, 69.2% of the variance in the academic performance scores among the groups was explained by the treatments. Hence, the difference in the academic performance among the groups has a large statistical effect size.

Table 3. Analysis of Covariance for Academic Performance Scores of Students taught using CIEPT and Discussion Method

Source	Type III sum of square	*df*	Mean Square	F	Sig.	Partial Eta Squared
Corrected model	7217.454[a]	4	1804.363	30.242	.000	.437
Intercept	5419.906	1	5419.906	90.841	.000	.408
TPr^{CPT}	140.858	1	140.858	2.361	.127	.017
Group	6635.209	1	6635.209	111.210	.000	.692
Gender	133.485	1	133.485	2.237	.401	.002
Group*Gender	76.691	1	76.691	1.285	.259	.000
Error	8770.540	147	59.664			
Total	99883.000	152				
Corrected Total	15987.993	151				

a. R squared = .451 (Adjusted R Squared= .437)

3.4 Hypothesis 2

There is no significant difference in the academic performance between male and female students taught Chemistry using CIEPT.

Table 4. ANCOVA Result for Academic Performance of Male and Female Students Taught Chemistry using CIEPT Approach

Source	Type III sum of squares	*df*	Mean Square	F	Sig.	Partial Eta Squared
Corrected model	15.224[a]	2	7.612	.284	.753	.006
Intercept	6811.882	1	6811.882	254.507	.000	.722
TPr^{CPT}	3.655	1	3.655	.137	.713	.001
Gender	11.231	1	11.231	.420	.519	.004
Error	2622.974	76	26.765			
Total	81319.000	79				
Corrected Total	2638.198	78				

a. R squared = .006 (Adjusted R Squared= -.015)

ANCOVA Test result in Table 4 reveals that there is no significant difference between the mean academic performance of male and female students taught Chemistry using Collaborative Invitation, Exploration, Proposing-Explanation and Taking action (CIEPT) approach [$F_{1, 78}$ =.420, P>0.05]. The null hypothesis is therefore not rejected. This means that CIEPT approach enhanced both male and female students' academic performance in Chemistry. Meanwhile, the effect size was 0.004 is considered as very small effect size. This implies that, only 0.4% of the difference in the academic performance of male and female students taught Chemistry was explained by CIEPT approach. Hence, the difference in the academic performance of male and female students taught Chemistry using CIEPT approach has small statistical effect size.

3.5 Hypothesis 3

There is no significant interaction effect of treatments and gender on the mean academic performance scores of students in Chemistry.

The data analysis of Table 3 is used to explain hypothesis 3. The table presents the ANCOVA for academic performance of students taught Chemistry using Collaborative Invitation, Exploration, Proposing-Explanation and Taking action (CIEPT) and discussion method (DM). The table also presents the interaction effect of instructional strategies and gender. The data in Table 3 reveals that there is no significant interaction effect of treatments and gender on the mean academic performance scores of students in Chemistry [$F_{1, 151}$=1.285, P>0.050]. The null hypothesis is therefore not rejected. Meanwhile, the effect size was 0.000 as indicated by the corresponding partial eta squared value which is considered as small effect size. This implies that, only 0.0% of the interaction in the academic performance scores among groups was explained by treatments and gender. Hence, the interaction of treatments and gender on students' academic performance has small statistical effect size.

4. DISCUSSION

This research was on adaptation of Collaborative Invitation, Exploration, Proposing-Explanation and Taking action (CIEPT) instructional approach to design chemistry lesson plans and investigated if the implementation of CIEPT instructional approach in chemistry classroom could enhance students' academic performance in Chemistry. The failure to produce the desired results in terms of students' academic performance in chemistry due to ineffective teaching methods used by teachers, the researchers deemed it fit to developed innovative chemistry lesson plans by adopting CIEPT approach phases and investigated its effectiveness. The researchers opined that, CIEPT instructional approach has the potential to help students tap into exploration as they attempt to solve a problem. Thus, students continually integrate new knowledge into existing knowledge, thereby providing context, and creating a personal "storage room" of resources that will be available for future societal problem-solving needs.

The finding of the study revealed that students taught Chemistry using Collaborative Invitation, Exploration, Proposing-Explanation and Taking action (CIEPT) performed significantly higher than their counterparts taught using discussion method. Though, there is scarcity of study on CIEPT. The finding of this study agrees with Magana (2018) who found that students taught elementary science using IEPT approach had higher academic performance than those taught using traditional teaching method. Similarly, this is in line with Ogbonna (2015) and Olajide (2017) findings that students improved significantly in their academic performance in Home Economics and Mathematics respectively when taught using IEPT compared to those taught using modified lecture method. The likely explanation for this outcome may also be connected to the fact that the use of CIEPT approach provides a format for students to develop advanced skills such as critical thinking, analysis, evaluation, and creation; and helps students to better relate the information learned in the classroom to their lives. Unlike, when compared to discussion method that only promotes passive learning. Therefore, Using CIEPT approach will make students begin to appreciate Chemistry as they learn collaborative using CIEPT worksheet.

The study also revealed that male students achieved slightly higher than their female counterparts using Collaborative Invitation, Exploration, Proposing-Explanation and Taking action (CIEPT) approach but ANCOVA test shows that the difference was no significant. This implies that, the difference in the academic

performance of male and female students taught Chemistry using CIEPT approach was not statistically significant. This implies that CIEPT approach improved both male and female students' academic performance in Chemistry. Though, there was scarcity of previous study on CIEPT in relation to students' gender. However, studies such as studies by Adamu (2016) and Ubi (2016) where found on IEPT, even though the studies did not involve students in collaborative learning. This finding of this study agrees with Adamu (2016) and Ubi (2016) who found that IEPT facilitated students' attitudes and academic performances in regardless of gender respectively. However, the finding was against the finding of Olajide (2017) who found that female students had higher academic performance than their male counterparts in Home Economics using IEPT. Thus, the interaction effect between strategies and gender on the academic performance of students in Chemistry is very minimal but ANCOVA test shows that the interaction effect was not significant. Therefore, there is no main effect of treatment on gender. There is no need for separation of instructional strategy for male and female students, since either CIEPT instructional approach could be used successfully for the two groups. Therefore, if CIEPT approach is implemented in classroom, it will enable male and female students to understand how concepts and processes are meaningfully learn because its purpose is to interplay between what is familiar and what they have yet to be known or understood in Chemistry in external examinations.

5. CONCLUSION

The developing chemistry lesson plans using Collaborative Invitation, Exploration, Proposing-Explanation and Taking action (CIEPT) phases and implementing it in chemistry classroom is more effective in improving students' academic performance in Chemistry than modified discussion method. By implication, this affirmed that students' academic performance in chemistry depend on the instructional strategies. It is also evident from the findings of this study that CIEPT can foster students' academic performance irrespective of gender differences. Thus, CIEPT is significantly a very useful approach for effective learning and teaching of Chemistry. Based on this the following recommendations are made:

1. Chemistry teachers should adopt CIEPT instructional approach to design or develop chemistry instructions, since it was found to be an effective approach in improving students' academic performances in Chemistry.
2. Workshops should be organised through professional bodies such as Science Teachers Association of Nigeria (STAN) to sensitize Chemistry teachers with a view to improving their skills and experiences on the usage of CIEPT approach aimed at developing students' academic performances in Chemistry.

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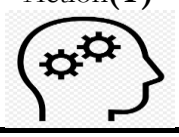
APPENDIX

Sample of expected CIEPT worksheet for Alkenes (Ethene)

	CIEPT WORKSHEET FOR ALKENES
	Group_____ Date_____
Invitation (**I**) 	Recognition of the problem(s): 1. identify the at least two sources of alkenes. 2. mention at least four physical properties of some alkenes. 3. clearly describe the chemical properties of ethene. 4. correctly carryout the laboratory preparation of ethene
Exploration **(E)** 	Carry out the following laboratory activities: 1. Mix ethanol, glass wool and aluminum oxide together in a boiling tube, what do you observed? 2. Heat it mixture and write the equation for the reaction? 3. Light the Bunsen burner and adjust it to a blue flame and heat the aluminum oxide, ethanol will produce an unknown gas, what has happened to ethanol? 4. Add lime water to the unknown gas, what do you observed? 5. If bromine is added to the unknown gas in another test tube, what will happen? 6. What do you think the name of the gas produced would be?
Proposing Explanation**(P)** 	Based on the activity explored, provide answers to the questions asked at the exploration phases: 1. There was no reaction yet until it was heated. This is because it requires heat for the water of ethanol to dehydrate. 2. $CH_3CH_2OH \xrightarrow{Al_2O_3} CH_2=CH_2 + H_2O$ 3. Ethanol has been dehydrated. The gas burns in air to produce carbon dioxide. 4. Lime water turn milky. This is because it is insoluble which produce a milky white precipitate. 5. The brown bromine water turn to colorless 6. The gas produced is ethene
Taking Action**(T)** 	Provide instances of the application. Therefore, what do you think are the uses of ethene? Why is ethene extremely important in the manufacture of plastic?

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