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Impact of 5Es teaching strategy on chemistry students' academic achievement in electrochemical cell reactions in Calabar, Nigeria

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ABSTRACT

This study aimed to examine the impact of the 5Es (Engagement, Exploration, Explanation, Elaboration, and Evaluation) instructional strategy on secondary school chemistry students' academic achievement in Calabar, Nigeria. A quasi-experimental design was adopted for this study. The population comprised 2,350 Secondary School (SSII) chemistry students drawn from the Calabar Education Zone, Nigeria, from which a sample of 240 students was identified through proportionate stratified random and judgmental sampling techniques. The data was collected through an instrument called "chemistry achievement test" (CAT). Two research hypotheses were stated to direct the study. Data obtained were analyzed using the analysis of Covariance and Multiple Classifications Analysis. Results indicated that learners tutored with 5Es instructional strategy enhanced academic achievement more than those tutored using the conventional method. However, students' gender did not make any impact on their achievement when tutored with 5Es instructional strategy and lecture method. It was concluded that the utilization of inquiring and critical thinking skills when students were tutored using the 5ES instructional strategy would be responsible for their high achievement. It was recommended that the introduction of the 5Es instructional strategy should be implemented from the basic primary science to build the younger scientist minds into more creative, goal-oriented, problem-solving individuals.

Contribution/Originality: The major contribution of this study was to establish 5Es instructional strategy as a much useful pedagogical technique for enhancing students' inquiring and critical thinking skills, specifically in the subject of electrochemical cell reactions. This strategy helped teachers to develop a scientific approach to learning enabling students to become more creative, goal-oriented, and problem-solving individuals

1. INTRODUCTION

Science is a field of study that enhances the health, agriculture, transportation, and education of a nation; thus its knowledge determines how people can manipulate their environment for quality living (Akpan, 2008; Nja & Ideba, 2021). The learning of science is upheld as a pragmatic model of stimulating curiosity, arousing natural endowment, fostering ingenuity, and acquiring an urge for problem-solving. It thereby helps in inculcating in young people the right scientific skills and attitude needed to pursue science-based careers and also enabling citizens to develop the elementary information, expertise, comprehension, and competencies for effective accomplishment in their career for self-reliance and national development (Aghogho & Donor, 2012).

Science education inculcates scientific literacy to individuals that were not originally part of a scientific community, as well as pedagogy (Clement, Bello, & Sunusi, 2017). It is that particular field of study that students are tutored on the subject matter and the methods used in the acquisition of knowledge in science for practical application (Nja et al., 2022). This espouses the fact that appropriate delivery of science content in secondary schools can enhance the effective impartation of scientific literacy and consciousness in citizens, and prepare students for exploits in science and technology in the country. Knowledge of chemistry is very important and it is useful in every facet of life. Its absence makes the standard of living low and humans lives woeful and primeval (Babajide, 2015). This research further stressed that the production of essential human needs such as soap of all kinds, creams, drinks, petroleum and its by-products, clothing, drugs, and household utensils and chemicals for the preservation of food items as well as textiles are all products of chemistry. Chemistry deals with the properties, composition, and changes that occur in matter (Akanbi, 2016; Idiege, Nja, & James, 2021). This implies that adequate knowledge of chemistry is very significant to the standard of living and progressive society.

The general performance of students in Chemistry WAEC examinations from 2013 to 2018 at the national level indicated that the performance of students ranges from 58% to 63% credit pass (Nja et al., 2022a). This showed that students have not been doing well in chemistry examination in WAEC as there was no year that students score up to 70% in the years under review. The method of imparting knowledge to a learner is one of the most cited areas of science education that has been facing several challenges which according to Nja, Orim, Cornelius-Ukpepi, and Ndifon (2022b) most researchers internationally and locally are seeking for solutions to problems or to improve on existing situations. Based on this fact, Okebukola (2002) identified three fundamentally different approaches to learning science: behaviorism, cognitivism, and constructivism. Akpan (2008) observed that one of the challenges faced by students is the inability to be involved in inexplicable problem-solving exercise and to apply skills, learned in the classroom to concrete problems in life. Given this, there is a decline in the performance of Nigerian students in science as well as other challenges.

To proffer a solution to the downward trend in the performance of students in science in Nigeria, Nja et al. (2023) and Oludipe and Oludipe (2010) asserted that students should be prepared to transfer knowledge acquired in the science classrooms to various unpredictable practical circumstances. Thus, such preparation excludes the traditional method of instruction and embraces the constructivist approach where the learner is put in charge of his/her learning.

Cognitive constructivism, also known as the theory of cognitive development, was published by Piaget (1953). This theory was divided into two parts namely: ages and stages components. This theory proposes what learners can and cannot perform at different ages and stages of development. Piaget's theory of cognitive development stated that human learning is not instantaneous rather the information provided to learners should be in such a way that time will be given to learners to process the information before use. Learners develop literacy via building the knowledge on what they have learned before. There is a connection between the learners' prior knowledge and what is presented before the students if acquisition of knowledge is to be achieved. The theory has the following basic assumptions:

1. Learners get information from their environment if they are actively involved in the environment through exploration.
2. Knowledge is built through learners' prior experiences.
3. Humans learn through assimilation and accommodation.
4. Construction of new knowledge is done when individuals interact with physical and social environments.

Jean Piaget's theory of cognitive constructivism is relevant to this study because it explained how learners' active engagement and interaction with their environment can help them build new knowledge and understanding of their environment and creates a lasting impression about their environment. This theory is based on the general principle of constructivism which explains that students construct knowledge out of their experiences and learn

better when they are actively involved in the learning process. Assisting students to discover concepts, and knowledge and understand phenomena through an inquiry-based instructional approach can enhance their ability to retain learning and perform better in achievement tests. This theory applies to the 5Es instructional strategy and explains that engaging students in the teaching process and guiding them to explore information and construct meaning about lesson contents can boost their retention level, as well as enhance their level of achievement. From this perspective of learning, other new pedagogical approaches in teaching science like learning cycle, concept mapping, cooperative strategy, problem-based, among others were developed. The Piaget's theory advocates for active classroom participation by students.

The 5Es (Engagement, Exploration, Explanation, Elaboration, and Evaluation) instructional strategy emphasize learners' centeredness where students are actively involved in the learning process. The 5Es instructional strategy is used in the teaching of science that has gained acceptability and is in accordance with the constructivist principles and ideas of the nature of science. This strategy does not indicate that the scientific view is transmitted, rather teachers help students to clarify their thinking in the explained stage. Students are active learners at all phases. Bybee (1977) declared this approach as best practice in science, stipulating that by using this approach students' learning is better organized, and self-realization and collaboration with classmates are actualized. The strategy is made up of the following five principles: Engagement, Exploration, Explanation, Elaboration, and Evaluation.

Engagement: This phase provides the teacher an opportunity to assess the student's prior knowledge as well as engage students' interest in the use of short activities to promote curiosity.

Exploration: This phase supplies the learners with a regular set of actual scholarship experiences. Here, the learners may use laboratory practices that enable them to employ previous ideas to produce knowledge, investigate questions and chances, and design and carry out preliminary investigations. Learners are given hands-on experience.

Explanation: In this phase, learners are given mind-on experience. It provides an opportunity for which learners corrects' their prior knowledge and begin to make sense of the ideas presented before them by the teacher in the class.

Elaboration: In this phase, students are allowed to outstretch the ideas to novel circumstances and connect what knowledge they had before to the present. By doing so, they develop creative thinking abilities, a deeper and broader understanding of the concepts.

Evaluation: This phase is an ongoing process. The teacher observes and assesses the student using both formal and informal approaches. Students may also be encouraged to carry out self or peers' assessments.

The achievement of chemistry students is measured by scores in achievement tests and practical exercises in the laboratory. A high level of student achievement is recorded when the majority of students score above average in achievement tests and laboratory practical assessments. Chemistry students' results both in external and internal examination have been poor, due to the fact that chemistry concepts are abstract in nature and as such students are passive in the classrooms. The 5Es instructional strategy is an active instructional strategy. This study therefore sought to find out if the use of the 5Es instructional strategy will improve the academic achievement of chemistry students.

2. LITERATURE REVIEW

The constructivist learning approach has identified the 5E learning model as one of the learning models that provide instructors with the opportunity to employ, and devise methods and strategies in the classroom environment that can be effectively used in a science class (Hun, 2017). The findings of the Bahadir and Dikmen (2022) study on the impact of the 5E learning model showed that the 5Es instructional strategy greatly affected the academic achievement of students as reported by the random effects of the model. Studies have indicated that the 5E

learning model enhanced the academic achievement of learners (Kozcu Çakır & Güven, 2019; Yaman & Karaşah, 2018). Varoglu, Yilmaz, and Sen (2023) examined the effect 5E learning model on the conceptual understandings of 8th-grade students and reported an improved students' conceptual understanding of the concept under investigation. Karthikeyan and Densia (2021) study reported a positive increase in the academic achievement of physics students who were tutored using the 5E learning cycle when compared with students who were not tutored with the 5Es model. The results of the study conducted by Umar et al. (2023) indicated that students, who attended classes where the 5Es model was used as mode of instruction, gained more of the concept tutored than their peers exposed through conventional methods. Boakye and Nabie (2022) also reported an enhanced performance of students in the experimental group tutored with the 5Es strategy when compared with the control group.

Studies conducted on the effect of 5E instructional strategy reported a glaring difference in the learning outcome of learners. Their results were in favor of students who were tutored using the 5Es model as against students tutored using the conventional method (Ramlawati, Aqil, Adam, & Mun'im, 2019; Umahaba, 2018). For instance, the 5E learning model improves the cognition effect of students (Koyunlu & Dökme, 2020), problem-solving ability (Kalantarnia et al., 2020), higher-order thinking/cognitive skills (Ramlee, Rosli, & Saleh, 2019), creativeness (Conradty et al., 2020; Güven, Kozcu Cakir, Sulun, Cetin, & Guven, 2020; Kalantarnia et al., 2020) and curiosity (Gillies & Rafter, 2020).

Igwe in Tagbo (2014) asserted that gender is an important factor that needs to be considered during teaching and learning as it is capable of influencing the academic achievement of students. Nwagbo and Obiekwe (2010), however, indicated that gender of science students did not influence their performance. The result of Tagbo (2014) showed that gender influenced the academic performance of learners with the male learners having a better mean score than the female students. Patrick and Urhievwejire (2012) and Umar et al. (2023) studied the impact of the 5Es learning strategy on learners' performance with relation to gender reported no statistical difference in learners' academic performance. The impact of the 5Es constructivist instructional approach was found not to be gender-related. Their studies maintained that students tutored using the 5Es model performed very well in school irrespective of gender and that no gender difference was observed when the lecture method was used as the mode of instruction.

The above observation seems to establish the link between poor students' achievement in chemistry in Cross River State, specifically in Calabar Education Zone to the instructional problems, which may range from teachers' knowledge of appropriate instructional approaches to their effectiveness in the utilization of proper instructional practices for efficient instruction of chemistry lessons. Given this scenario, it becomes necessary to examine the effect of the 5Es instructional strategy, which is one of the constructivist approaches to learning, on chemistry students' achievement in Calabar, Nigeria.

2.1. Statement of the Problem

In recent times, the poor performance of students in Chemistry West African Examination Council (WAEC) examinations has attracted attention of educators, the governance, and even individuals in private and public sectors. This is because chemistry is tutored in post primary school as a basic science subject so that the learner can acquire basic scientific skills that will be applied in various fields of science and technology. Given this situation, it becomes necessary to find out whether the low academic achievement of chemistry learners in the Calabar senatorial district could be attributed to the instructional strategies adopted by chemistry teachers in the zone.

2.2. Purpose of the Study

This paper aimed at examining the impact of the 5Es instructional strategy on secondary school chemistry students' achievement in Calabar, Nigeria, with the following research objectives:

1. To examine the impact of the 5Es instructional strategy on chemistry students' achievement in electro-chemical reaction.
2. To study the impact of gender on students' achievement in electro-chemical reaction when tutored with and without the 5Es instructional strategy.

2.3. Statement of Hypotheses

The following hypotheses guided the study;

1. The chemistry students' achievement average scores when tutored electrochemical reactions with the 5Es instructional strategy do not differ from those tutored with lecture methods.
2. There exists no significant variation in the average achievement scores of male and female chemistry learners in electrochemical reactions when they are exposed to 5Es instructional strategy and lecture method.

3. METHOD

This study employed a 2x2 factorial design. It was a non-randomized quasi-experimental design. It was a pre-test post-test control group type. The researchers adopted this design because it had a control and allowed for manipulation of the independent variable to ascertain the causal nexus of events. The research was conducted through the administration of treatment and inculcation of a control group (Onwioduokit, 2000).

The structural representation of this design is as follows:

O1 x O2 (E)

O1 x O2 (C)

Where;

O1 is the pretest measurements of experimental and control groups.

O2 is post-test measurements of experimental and control groups.

The population comprised 2,350 Senior Secondary (SSII) chemistry students in Calabar, Nigeria. The sampling that was done to select respondents (students) from the population was proportionate stratified random sampling and judgmental sampling. The stratified random sampling method was used in stage 1 to select Local Government Area and judgmental sampling was done in stage 2 to select students.

A total of 240 Senior Secondary School Chemistry students made up the sample for the study with 120 students in each group. The experimental group of 120 students comprised 67 males and 53 females while the control group had 55 males and 65 females.

3.1. Instrumentation

The researchers developed an instrument for data collection named, ''Chemistry Achievement Test'' (CAT) in Electrochemical Reaction for both the pretest and the posttest. This instrument was the same in both tests except the serial arrangement. It comprised fifty (50) multiple choice objective test items which were selected from the past WAEC examination on redox and electrochemical cell reactions. The pre-test CAT was administered to the students in the schools before the teaching commenced. It was used as a covariate with and without the 5E's instructional strategy. The teaching was done for four weeks. After this duration, the post-test CCAT was administered to the same group of students to measure the learning gained.

Validity of the items in the instrument was done by three professionals in test and measurement in the Faculty of Education by vetting the items for face validity based on the various levels of the cognitive domains they intended to measure. Content validity was done to ensure that sub-topic with more contents had more questions. Items found not suitable were removed, and adequate items were used for the study.

Reliability; The reliability of the instrument was tested by the administration of the CAT to a class of forty SSII Chemistry students in a school that was about 17 km from the experimental school and 30 km from the control

school. This school was chosen because it was found to be similar in all ramifications to the students in the main study. The Kuder Richardson formula 20 coefficient of the reliability was 0.92 as shown in Table 1. Joshua (2005) asserted that a reliability results of .50 and above is accepted as good and the instrument can be used for the study. Hence the reliability of .92 is adjudged good to be used for the study.

Table 1. The reliability coefficient of the chemistry achievement test (CPT) using the Kuder Richardson formula -20.

Variable	K	X	S^2	R
CAT	40	32.2	64.95	0.92

3.2. Procedure for Data Collection

This study was conducted in the second term of the 2019/2020 academic year. This was done for a duration of 4 weeks for both the 5Es model group and the lecture method group. This period of twenty-eight days was to prevent maturation that is capable of jeopardizing internal validity.

Before the study was carried out, consent was sought from all participants, instructors, and heads of schools. All ethical issues governing the administration of research were adhered to. Each week comprised a 45-minute period of teaching with the 5Es instructional strategy for experimental class. The control group also had a 45minute period of teaching but with lecture method. Before the commencement of teaching, the pretest was administered to ascertain their level of knowledge before the treatment.

The experimental and control groups had the administration of the posttest after the end of the teaching. To avoid students being test-wise the numbering in the post-test was changed to give the vague perception of the test items being different from the pretest. Two hypotheses were stated and tested in the study. Analysis of data was done using analysis of covariance (ANCOVA).

4. RESULTS AND DISCUSSION

4.1. Hypothesis 1

The chemistry students' achievement average scores when tutored electro-chemical reactions with the 5Es instructional strategy do not differ from those tutored with lecture methods. This hypothesis was tested using the analysis of covariance with a pre-test used as a covariate.

Table 2a reported that learners tutored in electro-chemical reaction using 5Es instructional strategy had higher average achievement (mean = 38.22) when compared with those tutored using the lecture method with an average score of 26.83. It is also seen that the analysis of data obtained in this study reported a high significant F-ratio of 989.886 for instructional method (use of 5Es instructional strategy) and the p-value was .000; P<.05 at .05 levels of confidence as seen in Table 2b.

Thus, the hypothesis which postulated that the average achievement scores of chemistry students tutored using the 5Es instructional strategy did not differ from those tutored without the 5ES method in electrochemical reactions was rejected.

Table 2a Descriptive statistics and synopsis of the analysis of covariance.

Treatment group	N	$\bar{x}$	s
Experimental	120	38.22	2.844
Control	120	26.83	2.988
Total	240	32.53	6.403

Table 2b. Descriptive statistics and synopsis of the analysis of covariance (contd.)

Source of variation	Sum of squares	Df	Mean squares	F	Sig level	Partial eta square
Corrected model	8067.672[a]	2	4033.836	551.917	0.000*	0.823
Intercept	5045.217	1	5045.217	690.296	0.000*	0.744
Pretest	292.855	1	292.855	40.069	0.000*	0.145
Treatment	7234.851	1	7234.851	989.886	0.000*	0.807
Error	1732.178	237	7.309			
Total	263690.000	240				
Corrected total	9799.850	239				

Note: a. R Squared = 0.823 (Adjusted R squared = 0.822) * P<0.05.

The Multiple Classifications Analysis (MCA) shown in Table 3 indicates the proportion of the variance explained by the experimental manipulation/treatment (5Es instructional strategy). The number in the first column represents the means of each group represented as a departure from the imperial average. In calculating these values, adjustment was not made for other factors or covariate. The numbers in the other column indicated the adapted average value in each group (again represented as departure from the imperial average), where the distinct factor was adjusted.

Table 3. Summary of multiple classification analysis of electrochemical reaction achievement by experimental and control groups.

Mean =32.53variable + category	N	Unadjusted deviation	Eta	Adjusted for independent Y covariates deviation	Beta
Treatment					
1	120	5.70	0.807	5.70	-0.891
2	120	-5.70	-	-5.70	
R^2	-	-	-	-	822
R	-	-	-	-	823

Finally, the multiple R at the bottom of Table 3 indicates the overall relationship between the criterion variable and the independent variable. R^2 (R squared) in the last column represented the proportion in electrochemical reaction achievement explained by the main effect of treatment and covariates. In this case, the variance derived from treatment is 82.3% (0.823). This meant that the independent variable (Treatment with 5Es instructional strategy) collectively explained up to 82.3% of the variance in the dependent variable.

The result in Table 3 showed that the treatment was potent in discriminating between students tutored electrochemical reactions with 5Es instructional strategy and those tutored electrochemical reactions without the 5E learning model. The experimental groups (tutored with 5Es instructional strategy) were found to be superior in electrochemical reaction achievement than the control group not tutored electrochemical reaction with 5 Es learning model.

4.1.2. Hypothesis Two

The hypothesis stated that "There exists no significant difference in the average achievement scores of, male and female chemistry learners in electrochemical reactions when they are exposed to 5Es instructional strategy and lecture method." The means score of the study can be used to give a brief explanation of the hypothesis whereas a 2x2 Analysis of Covariance was used to find out if the result was statistically significant. The descriptive statistics are presented in Table 4.

Table 4 indicates that the male learners in the group, tutored with the 5Es teaching model, achieved a slightly higher average score of 38.42 when compared to the female learners with an average score of 37.96. Similarly, the

male learners in the control group tutored electrochemical reaction without the 5Es teaching method also obtained a higher average score of 26.89 in comparison with the female learners with an average score of 26.78.

Looking at the combined value of both male and female learners tutored electrochemical reactions with the 5Es instructional strategy, the table shows a higher average score (38.22) in the experimental group compared to learners tutored electrochemical reactions without the 5E instructional strategy (average score = 26.83). Table 4 also presents the mean difference as significantly positive. This suggests that the teaching method was significant (F=969.649, p=.000; P<.05); gender was not statistically significant (F=0.693; p=0.406; P>0.05); influence of gender on treatment was nonsignificant (F=0.241; p= .624; P>0.05) and therefore the null hypothesis was retained.

Table 4. Descriptive statistics and summary of 2x2 analysis of covariance of the influence of gender on teaching methods on SS2 chemistry students' academic achievement in the electrochemical reaction.

Treatment		Gender	Mean	Std. deviation	N	
Experimental		Male	38.42	2.565	67	
		Female	37.96	3.168	53	
		Total	38.22	2.844	120	
Control		Male	26.89	3.035	55	
		Female	26.78	2.971	65	
		Total	26.83	2.988	120	
Total		Male	33.22	6.393	122	
		Female	31.81	6.361	118	
		Total	32.53	6.403	240	
Sources of variation	Sum of squares	df	Mean squares	F	Sig level	Partial ETA square
Corrected model	8074.506	4	2018.626	274.946	0.000*	0.824
Intercept	5037.775	1	5037.775	686.169	0.000*	0.745
Pretest	293.209	1	293.209	39.936	0.000*	0.145
Treatment	7119.058	1	7119.058	969.649	0.000*	0.805
Gender	5.087	1	5.087	0.693	0.406	0.003
Treatment X gender	1.767	1	1.767	0.241	0.624	0.001
Error	1725.344	235	7.342			
Total	263690.000	240				
Corrected total	9799.850	239				

Note: *P<0.05 (significant at p less than 0.05).

4.2. Discussion

The null hypothesis which speculated that the mean achievement scores of Chemistry students tutored with and without the 5Es instructional strategy in electrochemical reactions did not differ, and so was rejected. The implication is that, the 5Es instructional strategy is effective in teaching and learning. This may be because it made learners to be active in the classroom and as such brought about improved academic achievement. The 5E instructional strategy makes students to be involved in inquiry and critical thinking and thereby constructed their knowledge. The knowledge constructed by an individual brings about understanding unlike learning by rote memory that disappears in no distant time.

The findings of this study agree with the study carried out by Umahaba (2018) on the effect of the 5Es instructional strategy on students' learning outcome in some chemistry concepts among high school students. The findings of this study also agree with studies by Bahadir and Dikmen (2022); Bezen and Bayrak (2020) and Boakye and Nabie (2022). Their findings on the examination of the effectiveness of the 5-E learning instructional strategy on the academic achievement of science students found it to be a potent teaching method when enhanced students' achievement and learning outcome is paramount. This study collaborated with earlier studies by Umar et al. (2023) & Ramlawati et al. (2019) whose work found a noticeable difference in the academic performance of science pupils when tutored with the 5Es model of instruction. Students' performance was enhanced by the model on the influence of the 5Es teaching strategy.

The result of the hypothesis two analysis indicated that the male learners in the 5Es teaching strategy class had an average score of 38.42 while their female counterparts had an average score of 37.96. Table 4 examined if the result was likely to have an influence and indicated that the strategy was significant (F=969.649, p=.000; P <.05); gender was not significant (F=.693; p=.406; P>.05); influence of gender on teaching method on gender was not significant (F=.241; p=.624; P>.05). Thus, the hypothesis two was retained. This means that gender of chemistry students did not influence their academic achievement when taught with the 5Es teaching strategy and conventional method. It is assumed that it could be due to learning which affects the cognition function and not the gender. Both male and female students can construct their knowledge based on their prior knowledge as they interact with the environment. Knowledge is dependent on the age and developmental stage of the learner not the gender. That being the case, both male and female students were found benefited from the use of the 5Es instructional strategy.

Reports of the study by Tagbo (2014) agree with this research as the study indicated nonsignificant disparity in the average scores of male and female learners in chemistry after the conduct of the experiment, even though the males achieved a little better than the females . Umar et al. (2023) studied the influence of gender of students on their performance when tutored using the 5Es instructional strategy, and indicated that the results obtained for both male and female students were the same. This means that the gender of students did not affect their learning when they were tutored using the 5Es teaching method. It makes the model a good instructional material for all students irrespective of gender.

The findings of this study disagree with Omwirhiren (2015) on gender, who carried out a study to determine how academic achievement in chemistry is influenced by students' gender. The researcher reported that gender influenced the academic achievement of students. In the same vein, Mwanda, Odundo, Midigo, and Mwanda (2016) indicated that female's class performance was enhanced more than the males when the constructivist instructional strategy was employed. However, be it as it may all students had improved academic performance only that the females' performance was overwhelming.

5. LIMITATIONS

Due to the fixed nature of schools, the researchers were not able to assign subjects used in this study randomly to experimental and control groups. They were just named as experimental and control just because of the school they attended as intact classes were used. Secondly, only one topic in chemistry was used for the study. However, the aim of the use of the 5Es instructional strategy was to keep students active in the classroom during teaching. A host of other variables like attitude, family background, seating pattern, and motivation could have an influence on students' self-esteem before the employment of the 5Es model.

6. FUTURE IMPLICATIONS

From the findings of this research, it is suggested that, in the teaching of chemistry, the 5Es instructional strategy may be employed to increase students' achievement in chemistry. This study has indicated the relevance of students' active class engagement, critical and creativity skills during the lesson. Re-training of practicing teachers on the utilization of the 5Es instructional strategy should be carried out. A database that has information on how the different topics in chemistry can be tutored with the 5Es instructional strategy should be made available to teachers whenever the need arises. A study on the influence of psychological variables like self-esteem and motivation of students when a 5Es model is used in the classroom should be carried out. The impact of teachers' data and their usage of the 5Es instructional strategy on learners' performance may be conducted.

7. CONCLUSION

This study examined the impact of the 5Es instructional teaching method on chemistry learners' achievement in electro-chemical reactions, and the influence of chemistry students' gender on their achievement when tutored with and without the 5Es instructional strategy. Scholars tutored with 5Es teaching strategy were placed in the experimental group and learners tutored with the traditional method were placed in the control group. The active class engagement as they used inquiring and critical thinking skills during the lessons may have been the reason for the high academic performance of students tutored using 5Es instructional strategy. It was also indicated that students' gender played an insignificant role in their learning. This was evident in both the groups tutored with the 5Es instructional strategy and the traditional method. The study findings imply that the 5Es teaching approach is a good strategy for the teaching of chemistry irrespective of gender. This method can therefore be said to be appropriate for the teaching of male and female chemistry students. The study did not use randomized quasi experimental study because the schools were fixed and subjects were not moved from one school to another. Students' characteristics like interest, motivation, self-efficacy, age whether capable of influencing the results were not investigated.

8. RECOMMENDATIONS

A few recommendations could be made based on the findings of the study. First and foremost, in order to enhance students learning of different concepts in Chemistry, 5Es instructional strategy should be applied. Secondly, the Zonal Education Board, Federal Ministry of Education, and school administrators should carry out routine seminars and workshops, especially on the utilization of the 5Es teaching strategy. This will enable teachers to have a positive impact on their teaching techniques and also popularize the use of the strategy. Last, but not the least, the introduction of the 5Es instructional strategy should be implemented from the basic primary science to build the younger scientific minds into more creative, goal-oriented, problem-solving individuals.

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