SOUTH EASTERN JOURNAL OF RESEARCH AND SUSTAINABLE DEVELOPMENT (SEJRSD)

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## Editorial

The South Eastern Journal of Research and Sustainable Development (SEJRSD) is published twice a year online and hard copy. But recently, the journal policy was amended on 10th September, 2021 to be published **monthly**. Thus, the journal begins its monthly publication with volume 6 (1); 2021. It is designed to disseminate knowledge to teachers, teacher-trainees, researchers, curriculum specialists and other interested stakeholders. SEJRSD has continued to serve as an effective instrument for development and innovation in education and equips researchers whose purpose is in development and innovation in educational sector.

However, still on quality of articles published on this journal, the editorial board of this journal modified its policy to be **quarterly** publication as thus; **January – March, April – June, July – September, October – December.** This kicked off with January – March 2024 publication seen in volume 14 (2).

The Editor-in-Chief of this Journal is sincerely thankful to the editorial team especially to the numerous subscribers to this volume of the Journal and to all those who has contributed in one way or the other towards making this volume a reality.

## Note to Contributors

The South Eastern Journal of Research and Sustainable Development (SEJRSD) is published twice a year online and hard copy. But recently, the journal policy was amended. Thus, the journal hence forth publishes **quarterly** (**January – March, April – June, July – September, October – December**) in a year. The journal publishes peer-reviewed, well researched findings and opinion papers from educators, teachers and other stakeholders in any discipline. The editorial board of SEJRSD therefore requests for original and thoroughly researched empirical and theoretical papers on trending issues in any field.

**Note the following:**

- Any article submitted for assessment for publication should not exceed 12pages on A4 paper with 12points font size, Time New Roman Face and double line spaced
- The front page cover should include the title of the article, the author's name, affiliation and e-mail address, followed by the abstract of the study. The abstract should be precise, not exceeding 150 words
- Article must be written in clear and coherent sentences
- The article must be submitted online via the e-mail address: sejrsd@gmail.com
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- The 6th edition of APA (American Psychological Association) referencing style should be used. Avoid footnotes
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- All article submitted to SEJRSD for assessment are copyrighted to SEJRSD
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- A final corrected copy for an accepted article must be submitted online via the e-mail address: sejrsd@gmail.com in MS Word format, accompanied by ₦15,000.00 which is for online publication only.

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# EFFECTIVENESS OF PROBLEM-BASED AND THINK-PAIR-SHARE TEACHING METHODS IN ENHANCING SECONDARY SCHOOL STUDENTS' INTEREST IN ELECTROCHEMISTRY IN ENUGU EDUCATION ZONE

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## Abstract

*The study investigated the effectiveness of problem-based learning and think-pair-share methods on secondary school students' interest in electrochemistry in Enugu Education Zone. Three research questions guided the study while three null hypotheses were tested at 0.05 level of significance. Quasi-experimental design was adopted for the study. Specifically, the pretest, post-test, non-randomized experimental groups was used. The population of the study comprised seven thousand eight hundred and twenty-four (7,824) Senior Secondary School year two (SS 2) students offering Chemistry in the thirty-one (31) public secondary schools in Enugu Education Zone. A sample size of one hundred and twenty-six (126) SS2 Chemistry students, made up of seventy five (75) males and fifty one (51) females were involved in the study obtained using multi-stage sampling procedure. The instrument used for data collection was Chemistry Interest Scale (CIS). The coefficient of reliability was established through Cronbach Alpha Formula and internal consistencies of 0.81 was obtained, indicating that the instrument was reliable. The experimental group one ($E_1$) were taught using problem-based method, while the experimental group two ($E_2$) was taught using think-pair-share method. The treatments lasted for six weeks. Data collected were analyzed using mean, standard deviation and Analysis of Covariance. The results revealed that problem-based and think-pair-share methods are effective in enhancing students' interest in electrochemistry; problem-based method is more effective than think-pair-share method in enhancing interest in electrochemistry; the use of problem-based learning and think-pair-share as teaching methods were significant factors on the students' overall interest in electrochemistry and that gender was a significant factor on the overall students' interest in electrochemistry. Based on the findings of the study, the following recommendations were proffered among others that, chemistry teachers should adopt problem-based and think-pair-share teaching methods when teaching in order to enhance students' interest in chemistry. Also, students and chemistry teachers should be trained properly on the use of these two methods in teaching by teacher educator tertiary institutions.*

**Keyword**: Problem-based, think-pair-share teaching method, interest

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## Introduction

Science has contributed immensely to the development of the modern world and has been recognized as the bedrock on which modern day technological breakthrough is hanged. Nowadays, countries all over the world, especially the developing nations like Nigeria, are striving hard to develop technologically and scientifically. Since the world is turning scientific, proper functioning of lives depend greatly on science. Science education is needed to dispel ignorance, poor cultural practices and beliefs in the society. The major goal of science education is to develop scientifically literate individuals that are concerned with high competence for rational thoughts and actions. Science comprises the basic subjects such as Physics, Biology, Mathematics, Agriculture and Chemistry.

Chemistry is a branch of pure science, which deals with the composition, properties, reactions and uses of matter (Ababio, 2000). It is often referred to as the central science because its concept link together concepts of Physical, Mathematical, Biological, Medical, and Environmental sciences. Akudo (2020) asserted that, the knowledge of Chemistry helps us to observe some issues consciously and logically, and to check the accuracy of our assumptions about things in our physical and biological world. The major branches of Chemistry are Organic, Inorganic, Analytical, Physical, Biochemistry, Industrial, Polymer, Nuclear and Electrochemistry. This researcher is interested in one of the branches of Chemistry namely Electrochemistry.

Electrochemistry is a branch of Chemistry that studies the relationship between electricity and chemical changes. It is concerned with the transfer of electrons from one chemical species to another and the relationship between the electron transfer and the electrical currents that are generated or used during these processes (Okechukwu, 2019). Electrochemistry also deals with chemical changes produced by an electric current and with the production of electricity by chemical reactions.

Despite the importance placed on Chemistry, it is very disappointing to note that students' performance in the subject at both internal and external examinations has remained consistently poor (Nkot, 2022; Onwuma, 2017). Reports from various researchers show that mass failure in chemistry examination is real and the trend of students' performance has been on the decline (Nwajiuba, 2020, 2017; Nkama, 2019; Omaga, 2017). Therefore, using an alternative teaching method cannot be over-emphasized in redressing this situation and enabling students to perform better in chemistry. It is therefore more pertinent that we should continue to seek for methods and variables which would improve students' mastery of the subject and consider some strategies especially those that have to do with peer learning. Such student-oriented methods include; problem-based learning (PBL), think-pair-share approach, collaborative learning approach, inquiry-based science education among others. Two activity-oriented and learner-centered approaches to learning that may improve achievement of students in Chemistry learning are Problem-based learning and think-pair-share learning methods.

Problem-based learning is an instructional method that initiates students learning by creating a need to solve an authentic problem rooted in the students' prior knowledge and experiences. During the problem-solving process, students construct content knowledge and develop problem solving skills as well as self-directed learning skills while working towards a solution to the problem (Akcay and Doymus, 2018). The problem-based learning framework has 6 stepwise components (Sungur, 2006). They are; entry point, framing the problem, knowledge inventory, problem log, problem exit and problem debriefing. In each of these phases, the teacher served as a facilitator and guide. Students are guided to identify ill-structured problems related to the topics specified in the subject syllabus. In line with the framework, the students are engaged in self-directed learning, collect resources for themselves and their respective groups and take the necessary actions to solve the problems they had formulated. The teacher periodically steps in to engage them in brief discussion as and when it became necessary. In the final phase of each exercise, group members met in class to share their learning, exchange ideas, reflect, revisit the problem and go over it one more time. Another student-centered teaching method that could improve the academic achievement of students is the Think-pair-share.

Think-pair-share learning method is an instructional method that hold promises of improving achievement in learning. Think-Pair-Share (TPS) is a cooperative learning strategy that encourages students to work together to solve problems or answer questions on an assigned topic (Andrew and Alexandria, 2015). Think-pair-

share as the name goes involves the students in thinking about challenging academic tasks given by the teacher individually, pairing with other students to exchange ideas and sharing the idea with the larger class. These features of PBLM and TPS bear good and positive prospect for the students' interest in chemistry.

Students often learn and achieve better when they interact with those things that interest them. Interest is a motivational and psychological construct that is associated with those activities that gives one the pleasure or satisfaction needed. Interest in the pedagogical context, according to Aluko (2021) can be defined as the students' willingness to engage in an academic task. The problem of Chemistry teaching and learning is not with the subject as it were but with lack of interest in the subject. Learner's interest depends on the teaching approach used and the learning task accomplished. Chemistry may be interesting if more and new instructional approaches that help students to be actively involved in the learning process are adopted in teaching Chemistry concepts, especially the abstract ones. This is because such approaches can have a stimulating effect and sustain students' interest. Hence, there is need to adopt methods that will arouse students' interest in Chemistry through the teachers' use of effective instructional approaches. This could help to improve the interest of both gender (male and female students) in Chemistry.

Gender related difference in Chemistry interest and achievement has been an issue of concern to educationist. Researchers like Onwuma (2017); Uche and Maduako

(2018) and Okpala and Okigbo (2021a) found that boys achieve higher than girls in Chemistry. Kparogi and Njama (2019) and Kamba and Nosa (2020) found that females achieve higher than males. However, Remireku (2018), Ojediran and Fatoba (2019) observed no gender difference in the achievement of boys and girls while, Neborisa and Anakwenze (2020) found that the mode of instruction is one of the causes of gender related differences in students' interest in Chemistry. In view of this controversy and inconclusive male/female influence on students' interest in Chemistry, the present study seeks to determine the relative effectiveness of problem-based learning approach and think-pair-share approach in improving the interest of students in electrochemistry.

**Statement of the Problem**

Poor performance of students in chemistry both in internal and external examination is becoming more alarming by the day and this cannot be unconnected with the inability of students to solve problems related to electrochemistry. It is unfortunate that students nowadays cannot walk boldly and confidently into chemistry examination without carrying unwanted materials from which to copy in order to pass the examination. Much of this problem stem from the fact that the method of instructional delivery in a conventional classroom at best leaves the student in confusion and perplexity about chemistry concepts especially solving electrochemistry problems. Without a student friendly and student-centered instructional approach, students will continue to lag behind in ability to solve electrochemistry problems and consequently perform poorly in chemistry

examination. This tends to cripple the nation's pursuit towards the development of science and indigenous technology hence it spells doom for the nation's industrial and technological development. It is on this premise that this study sought to find out the effectiveness of problem-based and think-pair-share teaching methods in enhancing students' interest of senior secondary two (SS2) chemistry students

**Research Questions**

The following research questions guided the study;

1. What are the mean interest rating scores of students taught electrochemistry using PBLM and TPSM?
2. What are the mean interest rating scores of male students taught electrochemistry using PBLM and those taught using TPSM?
3. What are the mean interest rating scores of female students taught electrochemistry using PBLM and that of those taught using TPSM?

**Hypotheses**

The following null hypotheses were tested at 0.05 level of significance;

1. There is no significant difference in the effectiveness of PBLM and TPSM on mean interest rating scores students taught electrochemistry.
2. There is no significant difference in the effectiveness of PBLM and TPSM on mean interest rating scores of male students in electrochemistry.
3. There is no significant difference in the effectiveness of PBLM and TPSM on mean interest scores of female students in electrochemistry.

## Method

The study adopted a quasi-experimental research design. Specifically, the pretest, post-test, non-randomized experimental groups was used. The students' pretest scores serve as covariates with post-test scores to minimize the error that may occur from using this design. The is because the study determined the relative effectiveness of two independent variable (teaching methods).

The design is represented schematically as follows:

| **Group** | **Pre-test** | **Treatment** | **Post-test** |
|---|---|---|---|
| $E_1$ | $0_1$ | $X_1$ | $0_1$ |
| $E_2$ | $0_2$ | $X_2$ | $0_2$ |

**Figure 1**: Design of the Experiment

Where;

$E_1$= Experimental group

$E_2$= Experimental group

$0_1$= Pre-test

$0_2$= Post-test

$X_1$= Treatment with Problem-based learning method (PBLM)

$X_2$= Treatment with Think-Pair-Share method (TPSM)

-----=Non-randomized groups (equality of the groups not assured)

The research was conducted in Enugu Education Zone of Enugu State. Enugu Education Zone is one of the six (6) education zones in Enugu State and it covers three Local Government Areas (LGAs) namely: Enugu East, Enugu North and Isi-uzo. The three LGAs have similar culture, tradition and dialect.

The population of the study consisted of 7,824 senior secondary two (SS2) students offering Chemistry in the 31 government owned secondary schools in the Enugu Education Zone of Enugu State, Nigeria.

The sample for this study comprises of 126 SS2 chemistry students made up of 75 males and 51 females. The Purposive sampling technique was used to select four schools out of the 20 coeducational schools from the area of study. Random sampling using balloting was used to select two (2) schools out of the four. From these two schools, intact classes comprising 66 and 60 students made up of 75 males and 51 females offering chemistry were selected respectively. The two schools were randomly assigned experimental group one (E1) and experimental group two (E2) respectively. The experimental group one was taught using problem-based method (PBLM) while the experimental group two was taught using think-pair-share method (TPSM). The instruments used for the study was Chemistry Interest Scale (CIS). CIS consists of 20-item with structured responses that sought to measure the students' interest in Chemistry. This instrument is a 4-point scale of Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD). The maximum score for CIS is 80 ($4 \times 20$), while the minimum score for CIS is 20 ($1 \times 20$)

The reliability of the instruments was carried out with a trial testing on a sample of forty (40) senior secondary two (SS2) chemistry students in a school outside the study area which were not part of the main study. The data obtained was analysed using the Cronbach Alpha Formula, which gave a reliability index of 0.81, indicating a high reliability of the instrument. Instructional packages used for treatment during the problem-based method and the think-pair-share method treatments were designed by the researcher. Before treatment for each group commenced a pretest was administered to each group and at the end of the treatment a posttest was also administered. Data collected were analysed using the mean and standard deviation to answer the research questions while the hypotheses were tested at .05 level of significance using Analysis of Covariance (ANCOVA).

**Results**

**Research Question 1:** What are the mean interest rating scores of students taught electrochemistry using PBLM and TPSM?

**Table 1: Mean interest scores of students taught electrochemistry using problem-based learning method (PBLM) and think-pair-share method (TPSM)**

| Treatment Group | Pre-Interest | | Post Interest | | | No of Students |
|---|---|---|---|---|---|---|
| | Mean | Standard Deviation | Mean | Standard Deviation | Mean gain score | |
| PBLM | 48.81 | 5.72 | 60.68 | 6.54 | 11.87 | 66 |
| TPSM | 47.95 | 6.11 | 56.10 | 5.13 | 8.15 | 60 |

Table 1 shows that students taught using problem-based method had mean interest score of 48.81 and standard deviation of 5.72 while those taught using think-pair-share method had mean interest score of 47.95 and standard deviation of 6.11 in the pretest. In the post test, students taught using problem-based method had mean interest score of 60.68 and standard deviation of 6.54 while those taught using think-pair-share method had mean interest score of 56.10 and standard deviation of 5.13.

The students mean gain score for the problem-based group was 11.87 while the students mean gain scores for the think-pair-share method was 8.15. Therefore, that the problem-based method was more effective in enhancing students' interest electrochemistry.

Table 1 also shows that in the pretest, scores in think-pair-share teaching method group deviated higher from the mean score with the standard deviation of 6.11

while the scores in problem-based learning method group deviated from the mean score with standard deviation of 5.72.

In the post test, scores in problem-based learning teaching method group deviated higher from the mean score with standard deviation of 6.54 while the think-pair-share teaching method group deviated with standard deviation of 5.13. The high mean interest scores in the post test for the problem-based learning teaching method and think-pair-share teaching method is suggestive of the fact that the two teaching methods were effective in enhancing students' interest electrochemistry.

**Research Question 2:** What are the mean interest rating scores of male students taught electrochemistry using PBLM and those taught using TPSM?

**Table 2: Mean interest scores of male students taught electrochemistry using problem-based learning method (PBLM) and think-pair-share method (TPSM)**

| Treatment Group | Gender | Pre-Interest | | Post Interest | | | No of Students |
|---|---|---|---|---|---|---|---|
| | | Mean | Standard Deviation | Mean | Standard Deviation | Mean gain score | |
| PBLM | Male | 51.82 | 4.47 | 64.51 | 5.35 | 12.69 | 39 |
| TPSM | Male | 51.80 | 4.24 | 59.13 | 3.56 | 7.33 | 36 |

Table 2 shows that in the pre interest, male students taught using problem-based method had mean interest score 51.82 and standard deviation of 4.47 while those taught using think-pair-share teaching method had mean interest score of 51.80 and

standard deviation of 4.24. In the post interest, male students taught using problem-based method had mean interest score of 64.51 and standard deviation 5.35 while those taught using think-pair-share teaching method had a mean interest score of 59.13 and standard deviation of 3.56. The male students mean gain score for the problem-based learning teaching group was 12.69 while the mean gain scores for the think-pair-share teaching method was 7.33. Therefore, after treatment males gained higher mean score in problem-based group than the think-pair-share teaching method group. Therefore, the problem-based method was more effective among males in enhancing students' interest in electrochemistry than think-pair-share teaching method.

**Research Question 3:** What are the mean interest rating scores of female students taught electrochemistry using PBLM and that of those taught using TPSM?

**Table 3: Mean interest scores of female students taught electrochemistry using problem-based learning method (PBLM) and think-pair-share method (TPSM)**

| Treatment Group | Gender | Pre-Interest | | Post Interest | | | No of Students |
|---|---|---|---|---|---|---|---|
| | | Mean | Standard Deviation | Mean | Standard Deviation | Mean gain score | |
| PBLM | Female | 44.48 | 4.44 | 55.14 | 3.34 | 10.66 | 27 |
| TPSM | Female | 42.16 | 3.18 | 51.54 | 3.48 | 9.38 | 24 |

Table 3 shows that in the pre interest, female students taught using problem-based learning teaching method had mean score of 44.48 and standard deviation of 4.44 while those taught using think-pair-share teaching method had mean score of 42.16 and standard deviation of 3.18. In the post interest, female students taught using problem-based method had mean score of 55.14 and standard deviation of 3.34 while those taught using think-pair-share teaching method had a mean score of 51.54 and standard deviation of 3.48. The female students mean gain score for the problem-based group was 10.66 while the gain mean scores for the think-pair-share method was 9.38. Therefore, after treatment females gained higher mean interest score in problem-based group than the think-pair-share method group. Therefore, problem-based method is more effective among females in enhancing students' interest electrochemistry than think-pair-share method.

**Hypotheses 1:** There is no significant difference in the effectiveness of PBLM and TPSM on mean interest rating scores students taught electrochemistry.

**Table 4: Two-way Analysis of covariance of students' post interest due to Treatment and Gender.**

**Tests of Between-Subjects Effects**

Dependent Variable: Post-test Interest

| **Source** | **Type III Sum of Squares** | **Df** | **Mean Square** | **F** | **Sig.** |
|---|---|---|---|---|---|
| Corrected Model | 3659.564[a] | 4 | 914.891 | 82.865 | .0001 |
| Intercept | 790.690 | 1 | 790.690 | 71.615 | .0001 |
| Pre Interest | 769.479 | 1 | 769.479 | 69.694 | .0001 |
| Teaching Method | 426.959 | 1 | 426.959 | 38.671 | .0001 |
| Gender | 171.935 | 1 | 171.935 | 15.573 | .0001 |
| Teaching Method * Gender | 73.596 | 1 | 73.596 | 6.666 | .011 |
| Error | 1335.936 | 121 | 11.041 | | |
| Total | 436199.000 | 126 | | | |
| Corrected Total | 4995.500 | 125 | | | |

a. R Squared = .733 (Adjusted R Squared = .724)

Table 4 shows that the difference in mean interest scores between the groups taught using the different teaching methods in the covariates is significant since the worked F ratio of 38.671 is significant at P< 0.001. The difference in the mean interest scores between the treatment groups is therefore significant at P< 0.05. Therefore, it can be concluded that the research hypothesis 5 is rejected. The difference in the mean interest scores of students taught electrochemistry using

problem-based learning and think-pair-share teaching method is significant and not by chance.

**Hypotheses 2:**There is no significant difference in the effectiveness of PBLM and TPSM on mean interest rating scores of male students in electrochemistry.

**Table 5: One-way Analysis of covariance of students' post interest due to Treatment for males only.**

**Tests of Between-Subjects Effects**

Dependent Variable: Post-test Interest

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 1019.834[a] | 2 | 509.917 | 34.806 | .0001 |
| Intercept | 508.087 | 1 | 508.087 | 34.681 | .0001 |
| Pre Interest | 479.217 | 1 | 479.217 | 32.710 | .0001 |
| Teaching Method | 538.851 | 1 | 538.851 | 36.781 | .0001 |
| Error | 1054.833 | 72 | 14.650 | | |
| Total | 289755.000 | 75 | | | |
| Corrected Total | 2074.667 | 74 | | | |

a. R Squared = .492 (Adjusted R Squared = .477)

Table 5 shows that the difference in mean interest scores between the groups taught using the different teaching methods in the covariates is significant since the worked F ratio of 35.781 is significant at P< 0.001. The difference in the mean interest scores between the treatment groups is therefore significant at P< 0.05. Therefore, it can be concluded that the research hypothesis 6 is rejected. The

difference in the mean interest scores of male students taught electrochemistry using problem-based learning and that of those taught with think-pair-share teaching method is significant and not by chance.

**Hypotheses 3:** There is no significant difference in the effectiveness of PBLM and TPSM on mean interest scores of female students in electrochemistry.

**Table 6: One-way Analysis of covariance of students' post interest due to Treatment for females only.**

**Tests of Between-Subjects Effects**

Dependent Variable: Post-test Interest

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 456.211[a] | 2 | 228.105 | 39.046 | .0001 |
| Intercept | 272.596 | 1 | 272.596 | 46.661 | .0001 |
| Pre Interest | 290.949 | 1 | 290.949 | 49.803 | .0001 |
| Teaching Method | 54.370 | 1 | 54.370 | 9.307 | .004 |
| Error | 280.416 | 48 | 5.842 | | |
| Total | 146444.000 | 51 | | | |
| Corrected Total | 736.627 | 50 | | | |

a. R Squared = .619 (Adjusted R Squared = .603)

In Table 6, it reveals that the difference in mean interest scores between the groups taught using the different teaching methods in the covariates is significant since the worked F ratio of 9.307 is significant at P< 0.004. The difference in the mean achievement scores between the treatment groups is therefore significant at P< 0.05. Therefore, it can be concluded that the research hypothesis 7 is rejected. The

difference in the mean interest scores of female students taught electrochemistry using problem-based learning and that of those taught with think-pair-share teaching method is significant and not by chance.

**Discussion**

Results on Table 4 shows that the teaching methods (PBLM and TPSM) enhanced students' interest in learning electrochemistry. Taking interest in Chemistry is a positive first step towards better performance in achievement tests. This idea agrees with Okeke (2019) who posits that capturing students' interest in Chemistry is a necessary precondition for improved students' achievement in Chemistry. This study has proved that the learner-centeredness of problem-based learning and think-pair-share can greatly improve the students' interest in learning electrochemistry which in turn will enhance students' achievement in Chemistry. The conventional teaching method has been described as uninteresting to the students and ineffective due to its teacher- centredness and relative lack of activity on the part of the students. This in consonance with Udousoro (2011) who maintains that student's poor performance and lack of interest in Chemistry could be traced to the Chemistry teachers' excessive use of the expository method of instruction.

However, results in Table 4 revealed that the male students showed more interest in electrochemistry than their female counterparts with mean interest score of 48.81 and 47.95 respectively. The gender differences in student's interest could be as a result of the steps involved during the treatment process, given that male students

had higher interest than their female counterparts, it could be traced to the fact that female students flourish more in speech, verbal abilities and presentation. They might have found it difficult to do practical activities unlike their male counterparts, female have greater writing capabilities and can memorize words with greater proficiency, while concrete and visual teaching are enjoyed by boys. These may have increased the interest of boys in learning electrochemistry using problem-based learning and think-pair-share teaching methods than their female counterparts. The finding is in line with that finding of Ajayi and Ogbeba (2017) that male student had higher mean interest score in chemistry than their female counterparts.

**Conclusion**

The study shows that teaching methods have significant effects on students' achievement in electrochemistry. Indeed, the result indicates that the two teaching methods were effective but problem-based learning method was outstanding and more effective than the think-pair-share method in engendering the aforementioned criteria measure. This means that in an effort to achieve set objectives of Chemistry education in Senior Secondary Schools, electrochemistry should be taught using more of the problem-based learning than think-pair-share. The influence of gender on achievement was significant and the male students demonstrated higher achievement and based on the mean scores of CAT. Now that it has been proved that the teaching methods adopted in teaching electrochemistry plays an important role in students' achievement. The use of problem-based learning and think-pair-

share teaching methods should be recommended in the Chemistry curriculum since both are efficacious and unisex in their effects.

**Recommendation**

The study seek to recommend among others that;

1. The use of problem-based learning in teaching has been found more effective on the achievement of students in electrochemistry, chemistry teachers should be encouraged to employ it in the teaching of the subject. By so doing, the achievement of students in electrochemistry could be improved.
2. The fact that higher mean achievement scores were recorded through the use of problem-based learning and think-pair-share calls for teachers to acquaint themselves through training with the distinctive characteristics of the teaching techniques involving problem-based learning and think-pair-share with a view to enhancing students' achievement for effective learning outcomes. This could be done through seminars, conferences and workshops organized by the Science Teachers' Association of Nigeria (STAN), Chemical Society of Nigeria (CSN) and the Curriculum Organization of Nigeria (CON).
3. Teacher training tertiary institutions should incorporate performance based instructional and playwriting techniques which can be learned from the simple to complex or from the known to unknown. This can be presented to the learner of the subject matter or the trainee teachers as the principles of preparing and assisting the learners to prepare quality problem solving ability. By so doing the students will learn willfully and better too.

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