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EFFECTS OF PEER TUTORING STRATEGY ON SECONDARY SCHOOL STUDENTS' ACHIEVEMENT IN CHEMISTRY IN LAGOS ISLAND LOCAL GOVERNMENT AREA OF LAGOS STATE

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Abstract
The purpose of the study is to examine the effect of Peer-Tutoring strategy on students' achievement in Electrolysis. It also aimed at determining the effects of peer-tutoring on students' achievement in Electrolysis relative to their gender. All with a view of finding a solution to the poor performance of Secondary School Students in Chemistry. Quasi-experimental design was used in the study. The Students' Chemistry Achievement Test (SCAT) was used for both the pre-tests and post-tests. The SCAT was a 20-option multiple choice objective test covering Electrolysis concept. The instrument and lesson plans were validated before use. The research hypotheses were tested using t-test at 0.05 level of significance. The study revealed that peer-tutoring strategy significantly increased the students' achievement in Electrolysis concept compared with the conventional method of teaching. Overall, the study indicated that peer-tutoring strategy is a measure to reduce the poor performances of Secondary School Students in Chemistry. It was recommended that peer-tutoring strategy should be included in the Chemistry teacher curriculum in institutions of learning, as well as incorporated into Teachers' Continuous Professional Devel opment Programmes.
Keywords: Chemistry, Conventional Strategy, Peer-Tutoring Strategy, Students' Achievement.

Introduction Background of the Study

Human mind has always been very curious to make investigations and know about various phenomena occurring around him. This leads to collection of information through observations and experiments. From this observation and experiments, knowledge and database are acquired which is systematised in a way that mankind takes maximum benefit out of it. This knowledge base is known as Science which is further classified into different branches due to its enormous expansion and diversified fields. Science based subjects include; Physics, Chemistry, Biology, Basic Science, Geology, and so on. Chemistry is a branch of natural science that deals with the study of matter, its composition, structure, properties and the changes they undergo. Chemistry is seen as a subject that takes a central position in science and technology which is offered at the senior secondary levels in Nigeria. The Nigeria curriculum presents Chemistry as a practical subject where scientific concepts, principles and skills are developed through experimental investigations. The objectives of the curriculum are to facilitate a transition from secondary to tertiary level of education, show links with industry, everyday life and hazards and benefits, provide a course which is complete for individuals not proceeding to higher education while at the same time. Therefore, Chemistry is to develop both individuals and the society. It is multidisciplinary in nature as it provides students with many careers in the fields of industries,

research work, government agencies, etc.

However, to realize Chemistry aims and / objectives, the government has made efforts for introduction of new curriculum that suits the changing socio-cultural conditions of Nigeria, building laboratories and procurement of Chemistry equipment and organization of workshops for Chemistry teachers. Chemistry teachers are also sensitized to embark on the use of different modes of instruction such as cooperative learning, peer-tutoring, use of games and simulations and concept mapping (Njelita, 2015). Despite all these efforts, it is unfortunate that realization of Chemistry aims/objectives according to Moses (2012) is still a difficult task. The poor academic achievement in Chemistry could abort the ambitions and expectations of students and parents' guardians respectively, in offering some science-oriented courses in higher institutions of learning and other life endeavours. The cause of students' perennial poor achievement in Chemistry has been identified to be mainly due to the instructional approach adopted by most Chemistry teachers (Igboanugo and Njoku, 2015; Igboanugo 2013; Njoku and Ezinwa, 2014). The application of chemistry education would be very essential for more effective utilisation of these resources such as coal, tin, iron-ore, kaolin, columbite, etc.

Most Chemistry concepts at the senior secondary school curriculum are seen to be abstract and difficult to understand by the learners. West African Examination Council Chief Examiner's reports (2015 - 2022) have consistently highlighted some of the difficult concepts/topics the candidates performed poorly as: electrolysis, chemical equilibrium, mole, geometric isomerism, balancing chemical equations, IUPAC nomenclature, structure of organic compounds, collision theory, Gay Lussac's law, solubility, redox reaction. The report also goes further to enumerate candidates' weakness as poor language expressions, inability to adhere to instructions, poor interpretation of questions, inability to tackle numerical questions, poor definitions, omission/wrong units, inability to write balanced equations, use of formulae instead of names, poor drawing skills, inability to read and interpret graph, inability to draw sensible inference from recorded observations.

Peer Tutoring is an effective teaching strategy for all students. Most students find it interesting to interact with their peer group and they ask their queries without any hesitation and comfortable while learning along with their peer group. Peer tutoring is a teaching strategy that uses students as tutors. The student pairs might work on academic, social, behavioral, functional or even social skills. There are many different ways to pair students, such as by ability level, skills mastered, or age. Peer tutoring fosters learning by teaching. Experience reveals that students learn and acquire better understanding of concepts when they teach others. Other features of peer tutoring include that it; makes room for more individualized learning, encourages students to be free and open when interacting with peers, promotes student-student interaction which enhances learning. An evaluation study by Hartman (2010) reported that peer tutoring increased students' motivation to learn. It is widely accepted in literature that motivation has positive impact on academic achievement.

Vtgosky (1987) believed that children's learning takes place within their zone of proximal development. This zone consists of a range of tasks too difficult for the child to perform alone but possible to accomplish with the help of adults and more skilled peers. The use of peer tutoring across many disciplines such as Chemistry is increasing to help in engaging students for effective learning process. One common method for determining tutors and tutees, or groups, involves ranking students from the highest performing to the lowest performing student for the particular activity or subject. Pairs can be formed by cutting the list in half and then matching the top

performing student with the first lowest performing student, the second highest performing student with the second lowest performing student, and so forth (Fuchs, Fuchs, & Kazdan, 1999). If heterogeneous groups are desired, the number of students in each team should be determined. The list of students can then be numbered from one to the desired number of persons in a group and then repeated until the entire class is included. When selecting tutors, teachers should be cognizant of which students can be most helpful in the process. Teachers should be mindful of differing student personalities, needs, and preferences. Tutors and tutees or groups should be established accordingly. Since the conventional teaching methods persistently used by Chemistry teachers cannot improve the difficult Chemistry concepts which manifests in perennial poor students' achievement, the researcher therefore deemed it necessary to study the effects of Peer-Tutoring on students' achievement in electrolysis.

Statement of the Problem

Although many researches have been carried out to improve the persistent poor academic achievement in Chemistry but up to no avail. Many instructional approaches were proffered by psychologists like Brunner, Peaget, Gagne, Ausubel for improved achievement in Chemistry and other sciences. It was strongly believed that the instructional approaches adopted by Chemistry teachers in teaching Chemistry is to a large extent responsible for the observed consistent poor achievement in Chemistry. According to the WAEC Chief Examiner's Report (2015-2022) highlighted the candidates' weakness in Chemistry which says that candidates did not use appropriate terms, did not understand the demand of the questions, could not recognise redox reactions, correct formulae of compounds, have poor knowledge on electrolysis concept, inability to define concepts and did not exhibit good communication skills. The conventional teaching methods lack students' cooperation and interaction that may provide effective learning of electrolysis concepts in Chemistry. Hence, the need for Peer Tutoring Strategy on Senior Secondary School Students' Achievement in Chemistry.

Research Questions

The following research questions were posed:

1. Is there any improvement in the academic achievement of students taught Electrolysis concept in Chemistry using Peer- Tutoring Strategy compared with the conventional method of teaching?
2. Is there any difference between the academic achievement of male and female students taught Electrolysis concept in Chemistry using Peer-Tutoring Strategy compared with theconventional method of teaching?

Research Hypotheses

The study was guided by the following hypotheses tested at $P < 0.05$ level of significance.

Ho_1: There is no significant difference in the mean achievement scores of students taught Electrolysis concept using Peer- Tutoring Strategy and conventional method of teaching.

Ho_2: There is no significant difference in the mean achievement scores of male and female students taught electrolysis concept using Peer-Tutoring Strategy and conventional method of teaching.

Purpose of the Study

The purpose of the study was to determine:

i. The achievement level of student in Electrolysis concept in Senior Secondary School when

taught using Peer-Tutoring Strategy compared with the conventional method of teaching.

ii. The achievement level of male and female students in some electrolysis concept in Senior Secondary School when taught using Peer-Tutoring Strategy compared with the conventional method of teaching.

Research Design

The pretest-posttest quasi-experimental design was adopted for the study. The research design is appropriate because the intact classes and the rigid school timetable would not allow the teacher to fully randomize the subjects. However, the research subjects were assigned to experimental and control groups based on their intact classes. It is non-equivalent control group design involving two intact groups of one experimental and one control group. The intact groups used were Group 1 (conventional teaching method) and Group 2 (Peer Tutoring Strategy). These groups were made up of six different schools. That is three schools for the experimental group and three schools for the control group. The research design is shown in table 1.1.

Table 1.1. Research design

Group	No of Students	Pre-test	Research Condition	Post-test
1	102	Pre-test on Chemistry achievement test	Class taught using conventional method	Post-test on Chemistry achievement test
2	107	Pre-test on Chemistry achievement test	Class taught using Peer Tutoring	Post-test on Chemistry achievement test

Population of the Study

The population of this study were all Senior Secondary School 2 (SS2) Chemistry Students in Lagos state. The Choice of SS2 as population for the study is because of the selected concept (electrolysis) falls in the SS2 scheme of work.

Sample and Sampling Technique

Six coeducational schools were used in this study to ensure that male and female students were equally involved in the experiment since gender is an important variable of the study. The six schools used for the study were drawn using purposive and simple random sampling techniques.

Research Procedure

Seven weeks were used for the field work and it spans through:*First Week:* The Senior Secondary schools selected for the study were visited for familiarizationto seek for permission. *Second Week:* The pre-test was administered in the selected Senior Secondary schools. *Third-Sixth Week:* Were used for treatments for both control and experimental groups. *Seventh Week:* The post test was administered in the selected Senior Secondary schools.

Experimental Procedure

Two instructional approaches were used for the study. Peer Tutoring Strategy was used in teaching the experimental group while the conventional method of teaching was used in teaching the control group. Pre-tests was administered on the whole class of each school. The students in this class were distributed equally into three groups based on their performances. Each of these groups were a combination of high-class, middle class and lower class based on their pre-test scores. The teacher explained to the students in the experimental group the features and practice of Peer Tutoring Strategy. The students learned in their groups. In the control group, the teacher used only the conventional method of teaching. The experiment was carried out during normal school hours using the school time table for the classes. The experiment lasted for six weeks. On the last day of the experiment, a post-test was administered to the subjects using the validated SCAT, marked and recorded by the researchers. The SCAT used in the post-test was the same in content with the SCAT used in the pre-test but differed in sequence of items.

Instructional Guides

The Instructional Guides used for the study were for Peer Tutoring (experimental group) and for the conventional method of teaching (control group). The lesson plans covered electrolysis in the secondary school scheme of work. The lesson plans were validated by two experts in the field of chemistry. The experts examined the extent to which the lesson plans conform to the theoretical basis of the various teaching strategies. Two experienced Chemistry secondary school teachers also validated the lesson plans with emphasis on content coverage, clarity of lesson objectives, adequacy of instructional materials; adequacy of student activities; the appropriateness of the evaluation items.

Research Instruments

Three research instruments were used for the study as stated below:

i) Students' Chemistry Achievement Test (SCAT)
ii) Teachers' Instructional Guide on Peer Tutoring Strategy (TIGPTS)
iii) Teachers' Instructional Guide on Conventional Method of Teaching (TIGCMT)

Validity of the Instrument

The SCAT used was face-validated by two experts who deleted few items from the questions that were deemed irrelevant, they also suggested areas of modifications and their comments were used to improve the quality and content validity of the instrument before administration.

Reliability of the Instruments

The SCAT used was pilot tested on SS3 students of Lagos Island Local Government Area. Scores generated from their responses was used to establish the internal consistency of test items, using the Cronbach's alpha reliability method. An internal consistency estimates of 0.858 was calculated for the peer tutoring while an estimate of 0.776 was calculated for conventional method of teaching**.**

Method of Data Collection

The twenty question items (SCAT) set on Electrolysis for both the experimental and control groups were used as pre-test and post-test respectively. The pre-test was carried out at the same time for both groups to determine their achievement. At the end of the two weeks instruction, the post-test i.e. the re-shuffled pre-test was administered to the two groups at the same time to determine the

effectiveness of the two methods used. The achievement scores from both tests were recorded.

Methods of Data Analysis

Independent and paired sample t-test statistics were used as statistical tools to test the research questions and hypotheses formulated at 0.05 level of significance.

Data Presentation and Analysis

Demographic Information of the Respondents

Table 1.2 Demographic Information of the Respondents

Group		**Conventional Method (control group) n=204**	**Peer-Tutoring Method (experimental group) n=214**	**Total (n=418)**	**Group**
Sex:	Male	100 (49.0%)	102 (47.7%)	202 (48.3%)	
	Female	104 (51.0%)	112 (52.3%)	216 (51.7%)	
Total		**204 (100%)**	**214 (100%)**	**418 (100%)**	
Ages:	15-17yrs	70 (34.3%)	065 (30.4%)	135 (32.3%)	
	18-20yrs	134 (65.7%)	149 (69.6%)	283 (67.7%)	
Total		**204 (100%)**	**214 (100%)**	**418 (100%)**	
Classes: SS2		204 (100%)	214 (100%)	418 (100%)	
Total		**204 (100%)**	**214 (100%)**	**418 (100%)**	

Source: Field Survey, 2023; analyzed with SPSS 26.0

The table 1.2 above, shows the demographic information of the respondents participated in the study. Out of 418 students, 204 of them categorized as conventional (control group) while 214 of them categorized as Peer-Tutoring (experimental group). It revealed that for the Male students' category, 100 (49.0%) of them were from conventional group while 102 (47.7%) of them from Peer-Tutoring group. In the Female students' category, 104 (51.0%) of them were from conventional group while 112 (52.3%) of them from Peer-Tutoring group.

Table 1.3 Significant difference in the Pre and Post-Test Conventional method teaching and Peer-Tutoring Method (Paired Samples Statistics)

		Mean	N	Std. Deviation	T	
Pre-Test Method	Conventional	5.9216	102	2.44012	-19.076	P-value=0.000 < 0.05
Post-Test Method	Conventional	11.4314	102	1.93718		

Pre-Test Method	Peer-Tutoring	7.7757	107	2.87576	-18.908	P-value=0.000 < 0.05
Post-Test Method	Peer-Tutoring	13.9439	107	2.35056		

Source: Field Survey, 2023; analyzed with SPSS 26.0

Table 1.3 above shows the significant difference between Pre and Post-test Conventional method and Peer-Tutoring Method of Teaching. It shows that ***Post-test Conventional method*** had a higher mean value of 11.431 with STD deviation of 1.937 than that of ***Pre-test Conventional method*** with the mean value of 5.921 with STD deviation of 2.440 under the T-statistics of -19.076 and Probability value =< 0.05 significant level. Therefore, result indicated that there is significant difference in the Pre- test and Post-test mean achievement scores of students taught electrolysis concept using conventionalmethod of teaching.

Also, In the Peer-Tutoring Method, it revealed that ***Post-test Peer-Tutoring Method*** had a higher mean value of 13.943 with STD deviation of 2.350 than that of Pre-test ***Peer-Tutoring method*** with the mean value of 7.775 with STD deviation of 2.875 under the T-statistics of -18.908 and Probability value = 0.000 < 0.05 significant level. Result also implied that there is significant difference in the Pre-test and Post-test mean achievement scores of students taught electrolysis concept using Peer- Tutoring method.

Hypothesis One

H_0:1 There will be no significant difference in the mean achievement scores of students taught electrolysis concept using Peer- Tutoring Strategy and conventional method of teaching.

Table 1.4 Significant difference Between Peer-Tutoring and Conventional method of Teaching (Independent Samples Test)

Variables	N	Mean	Std. Deviation	T	Sig. (2-tailed)
Peer-Tutoring Teaching Method	214	10.8598	4.05235	5.862	P-value=.000< 0.05
Conventional Teaching method	204	8.6765	3.52936		

Source: Field Survey, 2023; analyzed with SPSS 26.0

Table 1.4 above shows the significant difference between Peer- Tutoring Strategy and Conventional teaching method. For the ***Peer- Tutoring Teaching Method*** had a mean value of 10.859 with STD deviation of 4.052 than that of ***Conventional teaching method*** with the mean value of 8.676 with STD deviation of 3.529 under the T-statistics of 5.862 and Probability value = 0.000 < 0.05 significant level. Therefore, the tested hypothesis that says "*There will be no significant differencin the mean achievement scores of students taught electrolysis concept using Peer- Tutoring Strategy and conventional method of teaching*" will be rejected while the alternative is accepted.

Hypothesis Two H_0:2 There is no significant difference in the mean achievement scores of male and female students taught electrolysis concept using Peer-Tutoring Strategy and conventional method of teaching.

Table 1.5 Significant difference in the Male and Female Test on Peer-Tutoring method andConventional Method of Teaching (Independent Samples Test)

Variables	N	Mean	Std. Deviation	T	Sig. (2-tailed)
Male Students Peer-Tutoring Method	102	11.4216	3.93621	1.948	P-value=.053 > 0.05
Female Students Peer-Tutoring method	112	10.3482	4.10605		
Male Students Conventional Method	114	8.6667	3.74323	5.703	P-value=0.000 < 0.05
Female Students Conventional method	52	5.4423	2.37976		

Source: Field Survey, 2023; analyzed with SPSS 26.0

Table 1.5 above shows the significant difference between Male and Female Peer-Tutoring method and Conventional Method of Teaching. It revealed that though ***Male Students Peer-Tutoring method*** had higher mean value of 11.421 with STD deviation of 3.936 than that of ***Female Students Peer-Tutoringmethod*** with the mean value of 10.348 with STD deviation of 4.106 but under the low T-statistics of 1.948 and Probability value = 0.053 > 0.05 significant level. Thus, the tested hypothesis that says "There is no significant difference in the mean achievement scores of male and female students taught electrolysis concept using Peer-Tutoring Strategy method of teaching" was accepted.

ile in the Conventional Method. It revealed that ***Male Students Conventional method*** had higher mean value of 8.666 with STD deviation of 3.743 than that of ***Female Students Conventional method*** with the mean value of 5.442 with STD deviation of 2.379 under the T-statistics of 5.703 and Probability value = 0.000 < 0.05 significant level. Thus, the tested hypothesis that says "There is no significant difference in the mean achievement scores of male and female students taught electrolysis concept using Conventional method of teaching" was rejected while the alternative is accepted.

Discussion of Findings

The findings of this study clearly revealed that Peer Tutoring has a significant effect on students' achievement in electrolysis concept. Table 1.1, shows the demographic information of the respondents participated in the study. In table 1.2, the result indicated that there is significant

difference in the Pre-test and Post-test mean achievement scores of students taught electrolysis concept using conventional method of teaching and also result implied that there is significant difference in the Pre-test and Post-test mean achievement scores of students taught electrolysis concept using Peer-Tutoring method. The difference in mean achievement was in favour of the Peer Tutoring group. This is in line with that of Hartman (2010) who reported that peer tutoring increased students' motivation to learn.

In table 1.3, there is a non-significant difference in the mean achievement scores between male and female students taught using peer tutoring strategy. This finding shows that peer tutoring has the capacity to close up the gender disparity in achievement observed in Chemistry classrooms. This is in line with Olatunji and Mbanefo (2019) who reported a non - significant difference in the achievement and retention of males and females exposed to peer instruction in Basic science. However, the result is in contrast with the finding of Eze, Egbo and Omeje (2018) who found a significant difference in favour of female students when taught kinetic theory and gas laws using programmed instruction and also Aniodoh and Eze (2014) shows a significant gender difference in favour of males when taught chemical equilibrium using programmed instruction.

Summary

The purpose of this research work is to determine the effect of peer-tutoring on students' achievement in Electrolysis concept. It was also carried out to determine the effect of peer-tutoringon students' achievement in Electrolysis and concept in relative to gender. The study wasconducted in Lagos Island local government area of Lagos State. This is done to find a solution tothe perennial poor performance of students in senior secondary school Chemistry.

The quasi-experimental design and Students' Chemistry Achievement Test (SCAT) were used for both pre-tests and post-tests in the study. The SCAT was a 20-option multiple choice objective test covering Electrolysis concept. The instrument and lesson plans were validated before use. The results of the study indicated that peer-tutoring strategy was more effective in teaching Electrolysis concepts compared with the conventional method of teaching.

Conclusion

The major findings of this study revealed a significant effect of treatment on the achievement of experimental and control groups in favour of students exposed to peer tutoring strategy. The statistical data analysis of the result indicated that there is significant difference in the Pre-test and Post-test mean achievement scores of students taught electrolysis concept using conventional method of teaching. And also result implied that there is significant difference in the Pre-test and Post-test mean achievement scores of students taught electrolysis concept using Peer-Tutoring method. The post test scores of the experimental groups provided evidence that the academic performance of students in Chemistry subject increased positively. It is evident that Peer-Tutoring is a good way of teaching because it promotes cohesion, understanding and also help teachers to monitor the progress of not just the class but individual student.

Recommendations

The following recommendations are possible solutions to the persistent poor performance of students in senior secondary school in Chemistry.

1. Peer-tutoring should be incorporated into the Chemistry teacher education curriculum in tertiary institutions of learning. The essence is to make the teaching approach popular among the would-be teachers, who would apply them in teaching difficult Chemistry concepts when they get to the field.
2. Relevant agencies like Science Teachers' Association of Nigeria (STAN) should

initiate programmes to build the capacities of science teachers on the effective use of this method in the teaching and learning of science. Professional Associations like the STAN should popularize the effective use of peer- tutoring strategy in teaching difficult Chemistry concepts through seminars, workshops, conferences, and publications.

3. Ministries of education and school authorities should sponsor teachers to attend conferences, seminars and workshops to update their knowledge on current pedagogies inscience classrooms.

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