Irish Journal of Educational Practice
Adv. J. Man. Acc. Fin
Volume:7 Issue: 1,
January-February, 2024
ISSN: 2364 – 4219
Impact Factor: 6.93
Advance Scholars Publication
Published by International Institute of Advance Scholars Development
https://aspjournals.org/Journals/index.php/ijep

EFFECT OF PEER-TUTORING STRATEGY ON THE ACADEMIC ACHIEVEMENT OF SECONDARY SCHOOL STUDENTS IN ELECTRO CHEMISTRY IN IMO STATE

[1]Iheahurukawa Nnenna Joy and Prof. Anthonia N. Ugwu[2]

[1,2]Department of Science Education, Michael Okpara University of Agriculture, Umudike, Abia State

Keyword:
Peer-tutoring strategy
Academic achievement
Secondary school
Electro-chemistry
Quasi-experimental design

ABSTRACT: *The study examined the effect of peer-tutoring strategy on the academic achievement of secondary school electro-chemistry students in Imo State. The study was guided by two research questions and two null hypotheses. The design of the study was a pre-test -post-test quasi-experimental research design. The study was carried out in Imo State. The population of the study was all the 3,169 Senior Secondary Two (SS2) Chemistry Students in Imo State Government Secondary Schools in 2020/2021 academic session which includes 1,595 male and 1,574 female students. A sample size of 106 (57 males and 49 females) SSII students were involved in the study. The instrument used for this study was Chemistry Achievement Test (CAT) which was adapted from WAEC and NECO examinations that are related to the topic treated. Face validation of the instrument was established by three experts, two experts in Chemistry Education, and one expert in Measurement and Evaluation, Michael Okpara University of Agriculture, Umudike. The reliability of the instrument for the study was determined using Kuder Richardson 20 formula. The reliability coefficient obtained for the CAT was 0.72. The data collected through the administration of the instruments were analyzed using mean and standard deviation to answer research questions and Analysis of Covariance (ANCOVA) was used to test the null hypotheses at .05 level of significance. The study revealed that, students taught with peer tutoring strategy achieved more than students taught with lecture method, and there was no significant difference between the male and female students taught with peer tutoring instructional strategy. Based on the findings, it was recommended that Peer-tutoring strategy should be adoptedjj in teaching Chemistry lessons in the classroom than lecture method.*

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Introduction

Chemistry is one of the science subjects offered in senior secondary schools and it is of great importance to the world of science. Chemistry is the subject that studies the nature, interactions, transformation and the energy consequences of matter. Chemistry is a branch of science which makes people to understand the nature, compositions and usefulness of natural things and materials made by human beings (Omiko, 2014). Obodo (2015) defined chemistry as a branch of science that studies the properties of matter in terms of composition, structure, transformation, interaction and energy implications of chemical changes. Ababio (2016) sees chemistry as a branch of pure science which deals with the composition properties and uses of matter. Chemistry is concerned with the utilization of natural substances and the creation of artificial ones (Ojokuku, 2010). From the above definitions of chemistry, one can deduce that chemistry is interested in the study of compositions of substances. Chemistry is also interested in the changes that substances undergo either on their own or when they interact with one another. Chemistry also studies the energy content of substances as well as changes in the energy content and changes in the energies of substances undergoing transformation to other things or in their interaction with other substances. An interesting thing about Chemistry is that it is human activity that promotes human skills. These skills enable an individual to become self- reliant, wealth creator and entrepreneur in the society. Chemistry as one of the main science courses that aid the transformative development of nations has continually played very important roles in the production of many technologies ranging from the life -saving pharmaceuticals to computers and other information technologies. Chemistry is regarded as central science because of the central role it plays in the successful study of science- based courses, such as Medicine, Pharmacy, Biochemistry, Engineering, Agriculture and so many others. Okorie (2014) noted that chemistry and its impact on lives of individuals will continue to grow, and probably even at a faster rate in the 21st century, as a number of innovative secondary school chemistry curricula have emerged across the globe since the turn of the 21st century.

The revised edition of the Senior Secondary School Chemistry Curriculum, according to National Policy of Education (FRN, 2013), the objectives of chemistry curriculum at the senior secondary school level are thus:

i. to develop interest in the subject of chemistry,
ii. to acquire basic theoretical and practical knowledge and skill,
iii. to develop interest in science, technology and mathematics,
iv. to acquire basic STM knowledge and skills,

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v. to develop reasonable level of competence in ICT application that will engendern entrepreneurial skills,

vi. to apply skills to meet societal needs of creating employment and wealth,

vii. to be positioned to take advantage of the numerous career opportunities offered by chemistry,

viii. to be adequately prepared for further studies in chemistry.In addition to the above objectives, the curriculum will facilitate a smooth transition in the use of scientific concepts and techniques acquired in the new Basic Science and Technology curriculum with chemistry, provide student with basic knowledge in chemical concepts and principles through efficient selection of concept and sequencing, show chemistry and its inter-relationship with other subjects, show chemistry and its link with the industry, everyday life activities, hazards and provide a course which is complete for students not proceeding to higher education while at the same time provide a reasonably adequate foundation for a post-secondary school chemistry course (FRN, 2013).

These objectives have to be achieved for a successful chemistry education and science education in general. In educational institutions success is measured by academic achievement or how well a student meets standards set out by the institution itself as career completion grows even fabulous in the working world. The importance of student's academic achievement in schools has attracted the attention of teachers, researchers, policy makers, administrators and parents (Bells, 2010). Thus academic achievement also refers to students' success in meeting short or long term objectives in education by completing high school or earning a college degree.

The result and outcome of education shows the extent to which students or institutions have achieved their educational goals and objectives. Therefore, achievement in school is evaluated in a number of ways for regular grading. The purpose of testing achievement is to help the teacher and the students evaluate and estimate the degree of success attained in learning a given concept. It is also useful in testing the retention of information and skill, it is also appropriate in determining the efficiency of instruction. Effective learning and sound academic achievement contributes to national development. Academic achievement is of great importance to parents, teachers and students. Therefore, academic achievement of a student represents intellectual endavours and thus, more or less, mirrors the intellectual capacity of a person.

Unfortunately, studies revealed that academic achievement of students in chemistry at Senior Secondary School Certificate Examination (SSCE) has consistently been very poor and unimpressive (Njoku, 2015). Science educators have been lamenting over the poor achievement of students in the subject in our senior secondary schools for the past decades (Mari, 2012; Njoku, 2012). For instance, students' percentage pass with credit and above in external examination like West African Senior

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School Certificate Exam (WASSCE) in the years 2016, 2017, 2018, 2019 were 21%, 29%, 19.84% and 33.93% respectively (WAEC Annual Reports form 2016 – 2019).

Meanwhile, Nnamdi (2014) reported that students' poor performance in chemistry in West African Secondary School Certificate Examination (WASSCE) was because of some difficult concepts in chemistry. Some of these concept perceived to be difficult in chemistry are Electrochemistry, Periodic Table, Ionic Equilibrium, Rate of Chemical Reactions, Chemical Bonding, Mole Concept and Thermodynamics. This study will focus on electrochemistry as a difficult concept in chemistry. The reason for using electrochemistry in this study is due to the rate of failure from past WAEC exams in the WAEC Chief Examiner's Reports (2016-2019).

In the course of teaching and learning Chemistry, electrochemistry cannot be overlooked because it is an important aspect of Chemistry and a topic in the curriculum of the Nigerian Secondary School Chemistry Curriculum. According to Alafara (2016), Electrochemistry is a branch of Chemistry that deals with the chemical transformation produced by the passage of electricity and with the production of electricity by means of a chemical transformation. Electrochemistry also provides an insight into the large numbers of processes such as corrosion of metals, refining of metals and with the interaction of ions in solution with one another and with solvent. Obamanu and Onuoha (2012) investigated Secondary School student's conceptual difficulties in electrochemistry Students performed poorly in this concept at public examination at the secondary school level (WAEC 2018; Ojokuku & Amadi, 2010).

The poor achievement and retention has also been partly attributed to ineffective and unproductive strategies used by practicing teachers (Oyelekan & Olorundare, 2019). Ezeliora (2013) also stated that students' poor academic achievement in chemistry may be as result of poor instructional strategies involving excessive teacher-talk' copying of note, rote-learning as encouraged by expository method of instruction. Osuala and Ogoamaka (2015) reported that 60% of Nigerian secondary school Chemistry teachers use the conventional method with occasional teacher dominated experiments which makes students passive learners. Conventional teaching method does not encourage meaningful student-teacher, students-students and students-material interaction. It hinders activities for developing scientific reasoning and skill processes. Ezeliora (2013) specifically noted that the conventional lecture method commonly used in teaching chemistry in Nigeria is boring and uninteresting. Nnaka, (2016), Nzewi, (2010), Okebukola, (2012) suggested a shift and going beyond the conventional approaches of teaching Science, Technology and Mathematics (STM) for better achievement in STM education in our primary and secondary schools. Shifting and going beyond the conventional teaching approaches according to Nnaka (2016), implies

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adopting the innovative approaches to teaching and learning STM. The appropriate teaching strategy if used by chemistry teachers can overcome lack of drive, timidity, self- imposed isolation, poor previous experience that hinders achievement in the students.

Chemistry should be taught in a way in which current ideas and innovations are introduced into it, especially in this modern age where children learn a lot by active performance. Chemistry lessons should be activity packed by the students because mere teaching may not bring about desired achievement and retention. Therefore, effective teaching and learning of chemistry may take place if peer tutoring instructional strategy is utilized.

Peer-tutoring is a system of instruction in which learners help each other and learn (themselves) by teaching, (Goodlad & Hirst, 2013). Key to this definition is the word peer, meaning someone with same or nearly equal status as the person being tutored, who as such is not a professional instructor. Hott (2012) defined peer tutoring as a flexible, peer mediated strategy that involves students serving as academic tutors and tutees. Typically a higher performing student is paired with a lower performing student to review critical academic or behavioral concepts. Peer tutoring basically refers to an instructional strategy that uses pairings of high performing students to tutor lower-performing students in class-wide setting or in a common venue outside of school under the supervision of a teacher.

Chemistry as an important subject required for sustainable development and nation building, should be taught using effective instructional approach capable of maintaining high achievement among students irrespective of sex for greater and better achievement. Students factor like gender need to be given maximum attention towards participation in the classroom to ascertain who participate better and also to identify those that needs extra attention so that they can be attended to in the course of the teaching and learning, in other words teachers should be well discerned in the case of gender.

Gender is an important factor in the teaching and learning process and in educational settings and has been focused upon because of their significance in the development of any nation. Etiubon and Udoh (2017) noted that gender could be a hindrance to high achievement of learners. Thus gender issues with academic achievement have become very important issue among researchers. According to Okeke (2017), gender refers to the social or cultural construct, characteristics, behavior and role which society ascribe to male and females. Gender is a social or cultural determinant that varies from place to place or culture to culture.

In recent time, gender related issues in science education have continued to receive serious attention judging by quanta of studies done to that effect. Mari (2019) indicated that there are lots of gender differences on students' performance in science. Peter (2014) investigated the effect of gender on student's

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achievement and reported that gender had no significant effect on students' achievement. There are different findings on gender issue, some in favour of males, others in favour of females and sometimes no gender difference are found. Isiyaku (2016) found no significant difference between male and female SS1 students performance in chemistry. Contrary to these findings Josiah (2012) ascertained that there exists a significant gender difference in favour of boys in computational problems while girls out performed boys in verbal problems. Mari (2012) and Nwachukwu (2018) claim relative poor and narrow participation of women in Science Technology and Mathematics. Nzewi (2010) discussed the nature of science and teaching strategies as factors that negatively influence female participation and achievement in Science and Technology.

Generally, there is ample evidence in literature that students' achievement is very poor. The poor achievement in Chemistry may be as a result of teachers' use of ineffective teacher-centered methods and inability to use some of the innovative learner-centered techniques for effective learning of Chemistry. This current classroom situation is characterized with the inability of students to actively participate in the teaching and learning process which affects effective learning of Chemistry concepts and low academic achievement. Therefore, the problem of this study is to find out the effect of peer-tutoring instructional strategy on secondary school Chemistry students' achievement in electro-chemistry in Imo State.

The following research questions and hypotheses guided the study:

1. What are the mean achievement scores of students taught electro- chemistry using peer-tutoring and lecture method?
2. What are the mean achievement scores of male and female students taught electro-chemistry using peer-tutoring strategy?

Ho1: There is no significant difference between the mean achievement scores of students taught electro- chemistry using peer-tutoring and lecture method.

Ho2: There is no significant difference between the mean achievement scores of male and female students taught electro-chemistry using peer-tutoring strategy.

Method

This study adopted quasi-experimental research design. Specifically, a pre-test post- test non-equivalent group design was used for the study. The population of the study was 3,169 Senior Secondary Two (SS2) Chemistry Students in Imo State Government Secondary Schools in 2020/2021 academic session which includes 1,595 male and 1,574 female students (Imo State Secondary Education Management Board, 2019). A sample of 106 (57 males and 49 females) SSII students gotten from three schools in the zone was involved in the study. The instrument used for this study was Chemistry Achievement Test (CAT) which was drawn from WAEC and NECO question. Two experts in chemistry Education and one in

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Measurement and Evaluation in Michael Okpara University of Agriculture, Umudike validated the instrument. A reliability coefficient of 0.72 was obtained using Kuder Richardson 20. Mean and standard deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used in testing the hypotheses at an alpha level of 0.05. The null hypothesis is rejected when p-value is less than the 0.05 alpha and was not rejected when p-value is greater than the 0.05 alpha.

Results

The results are presented in the tables below.

Table 1: Mean Achievement Scores of Students Taught Electro- Chemistry Using Peer-Tutoring and Lecture Method

Teaching Method	N	Pre-test Mean	SD	Post-test Mean	SD	Mean gain
Peer-tutoring	58	39.91	6.32	75.34	8.68	35.43
Lecture Method	48	40.34	6.35	47.27	6.88	6.93

N= 152

Result in Table 1 indicated that the peer-tutoring group had a mean pre-test Score of 39.91, and standard deviation of 6.32, a mean post-test score of 75.34 and standard deviation of 8.68, and also a mean gain score of 35.43. The lecture method had a mean pre-test score of 40.34 and a standard deviation of 6.35, a mean post-test score of 47.27 and a standard deviation of 6.88, and also a mean gain score of 6.93. The higher mean gain score of students taught with peer-tutoring Strategy (35.43) over lecture method group (6.93) indicated that the students taught with peer tutoring strategy achieved more than students taught with lecture method. Thus, peer-tutoring strategy has higher effect on students' achievement in Chemistry.

Table 2: Analysis of Covariance (ANCOVA) for the Mean Achievement Score of Students taught Electro Chemistry with Peer-Tutoring, Scaffolding and Lecture Methods

Source of variation	Sum of Squares	Df	Mean Square	F	p-value	Decision
Corrected Model	10959.803[a]	1	5479.902	70.461	.000	
Intercept	9519.316	1	9519.316	122.400	.000	
Pretest	2967.443	1	2967.443	38.156	.000	
Group	9984.920	1	9984.920	128.387	.000	S
Error	11587.957	149	77.772			

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Total	410926.000	152
Corrected Total	4101.911	151

a. R Squared = .686 (Adjusted R Squared = .471), S = Significant

Result of data analysis in Table 2 showed that the probability value associated with the calculated value of F (128.387) for the mean achievement scores of Chemistry students taught using peer-tutoring strategy and lecture method is 0.000. Since this value (0.000) is less than the 0.05 alpha when tested at 0.05 level of significance, the null hypothesis is rejected. Hence, there was a significant difference among the mean achievement scores of students taught electro-chemistry with peer-tutoring and lecture methods.

Table 3: Mean Achievement Score of Male and Female Students Taught Electro Chemistry using peer-tutoring Strategy

Gender		Pre-test		Post-test		Mean gain
		Mean	SD	Mean	SD	
Male	30	44.34	6.66	72.12	8.49	27.78
Female	28	43.96	6.63	71.98	8.54	28.02
Mean difference		0.38		0.14		0.24

Result in Table 3: showed that in the peer-tutoring group, the male students had a mean pre-test score of 44.34 with a standard deviation of 6.66, a mean post test score of 72.12 with standard deviation of 8.49, and a mean gain score of 27.78. The females on the other hand had a mean pre-test score of 43.96 with a standard deviation of 6.63, a post-test score of 71.98 with a standard deviation of 8.54, and a mean gain score of 28,02. Also, the mean difference between the male and female pre-test scores is 0.38 in favour of the male students, while the mean difference between the male and female post test scores is 0.14 in favour of the male students. The mean difference between the male and female gain score is 0.24 in favour of the female students.

Table 4: Analysis of Covariance (ANCOVA) for the Mean Achievement Scores of Male and Female Students Taught Electro Chemistry using Peer-Tutoring Strategy

Source of variation	**Sum of Squares**	**Df**	**Mean Square**	**F**	**P-value**	**Decision**
Corrected Model	900.048[a]	1	900.048	15.381	.023	
Intercept	671.064	1	671.064	11.468	.033	
Pretest	592.023	1	592.023	10.117	.042	

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Gender	126.655	1	126.655	2.164	.526	NS
Error	3276.887	56	58.516			
Total	5566.677	58				
Corrected Total	5176.375	57				

. R Squared = .313 (Adjusted R Squared = .196) NS = Not Significant

The analysis in Table 4 revealed the F calculated value of (2.164) and P-value .526. Since this p-value is greater than the 0.05 alpha when tested at 0.05 level of significance, the null hypothesis which stated that there is no significant difference between the mean achievement scores of male and female students taught electro Chemistry using peer-tutoring is thereby upheld. It implies that there is no significant difference between the mean achievement scores of male and female students taught electro Chemistry using peer-tutoring.

Discussion of Findings

The results of the study show that peer-tutoring strategy has higher effect on students' achievement in Chemistry than lecture method. The corresponding hypothesis revealed that there was a significant difference between the mean achievement scores of students taught electro-chemistry with peer-tutoring and lecture method. Therefore, the two teaching strategies were significantly different in their effects on students' achievement in Chemistry. This implies that peer-tutoring Strategy was more effective than lecture method. The finding is in agreement with the findings of Eze & Dinneye (2022) who revealed that students taught peer tutoring achieved significantly higher than their counterparts taught with lecture method, and Ehiubo and Ugwu (2018) who showed that students taught using peer tutoring perform significantly better than those taught jigsaw strategy. Also, the findings of Ndirika and Ubani (2017) who revealed that there was statistically significant difference in the mean achievement scores of students exposed to peer tutoring and lecture method. The findings also indicate that the mean difference between the male and female pre-test scores is 0.38 in favour of the male students, while the mean difference between the male and female post test scores is 0.14 in favour of the male students. The mean difference between the male and female gain score is 0.24 in favour of the female students. The corresponding hypothesis affirmed that there is no significant difference between the mean achievement scores of male and female students taught Electro Chemistry using peer-tutoring. The finding is not in agreement with the finding of Ezenwosu & Nworgu (2013) who noted that male students achieved better result in science and show more positive attitude to the subject than female students. The finding is contrary to the finding of Osondu (2021) who showed that female students obtain slightly higher than male students in computer studies and that the difference between their mean achievement scores was significant. The

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differences in the previous and present studies may be as a result the study area.

Conclusion

The study examined the effect of peer-tutoring instructional strategy on the academic achievement of secondary school electro-chemistry students in Imo State. Based on the findings of the study, the researcher concluded that students taught with peer tutoring achieved more than students taught with lecture method. Thus, peer-tutoring strategy has relative effect on students' achievement in Chemistry. It was further concluded that there is no significant difference between the mean achievement scores of male and female students taught electro-chemistry using peer-tutoring. Thus, peer tutoring favours both male and female students.

Recommendations

Based on the findings and conclusions of the study, it was recommended that peer-tutoring strategy should be used more in teaching Chemistry lessons in the classroom irrespective pf gender. The use of peer-tutoring strategy in teaching and learning Chemistry will enable the students to develop inquiry skills needed for concept and knowledge construction which will help them to appreciate Chemistry better and improve on their achievements.

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