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EFFECT OF GENDER ON STUDENTS' ACHIEVEMENT AND RETENTION IN PHYSICS USING ACTIVITY-STUDENT-CENTERED, EXPERIMENT AND IMPROVISATION (ASEI) TEACHING APPROACH IN NASSARAWA EGGON, NASARAWA STATE, NIGERIA.

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Abstract

The study determined the effect of gender on students' achievement and retention in physics in Nasarawa Eggon Metropolis. It compared the male and female students' achievement and retention in Physics using ASEI teaching approach in Nassarawa Eggon, Nasarawa State, Nigeria. Quasi-experimental research design of pre-test, post-test control group design was employed. The study answered two research questions and tested two research null hypotheses. The sample size of 98 SS II students was drawn from the population of 1,938 using purposive random sampling from Government Secondary Schools in Nassarawa Eggon Inspectorate Area Office. Two instruments were developed and validated by experts and gave a reliability coefficient of 0.86 and 0.80. Analysis of data was done using mean, standard deviation and ANCOVA. The result of the analysis showed that, in ASEI teaching approach there is no significant difference between male and female students' performance in Physics. The study concludes that ASEI teaching approach is good for both male and female students in teaching Physics if properly employed by teachers. It is therefore, recommended that teachers should engage both male and female students in the learning process by making the teaching student-centred which would make the students active in the learning process. Policy makers should intensify effort to constraint review of curriculum in adding ASEI teaching approach to Physics Curriculum in both same sex Secondary Schools.

Keywords: Gender Stereotype, ASEI Teaching Approach, Physics Achievement, Student Retention.

Introduction

Physics is a foundational science subject that plays a pivotal role in technological advancement and national development. It equips students with critical thinking, problem-solving skills, and a deeper understanding of the physical world. Physics is the study of matter and its relation to energy. The tools of Physics can be used to explain, describe and understand everything in the world. Majority of the world's inventions, appliances, tools, and building construction are made possible through the application of the principles of Physics. The effect of Physics can be felt in all areas of human activity. In fact, whenever one is trying to take a step, trying to listen, catching a ball, sitting down, opening a door, whispering, or checking image in a mirror, he/she is unconsciously using the knowledge of Physics.

Many students whose ambition have been to specialize in professions such as Engineering, Medicine, Geology, Architecture, Surveying, Town planning, and other related fields of human endeavors normally change their careers because they are unable to secure even the lowest credits in Physics. Therefore, students who are unable to obtain the lowest credit in Physics cannot be given admission to study any of the above-mentioned courses in higher institutions of learning.

The West Africa Senior School Certificate Examination (WASSCE) results revealed that many candidates perform below average in Physics (WASSCE report 2019, 2021, 2022 & 2024). According to Iiker (2016), poor academic performance of learners is as a result of poor teaching methods. To him, improved teaching methods will help better learners' acquisition. Lecture and demonstration methods seem to been adopted as popular methods in teaching Physics in secondary schools. Moises (2024) states that traditional methods such as lecture-based teaching offer a structure format for content delivery but lack students' engagement and critical thinking development. He also identified weaknesses in these methods of teaching due to their ineffectiveness to yield desired results. The findings of the study on Strengthening Mathematics and Science Education (SMASE), a Nigeria baseline survey in 2006 revealed that majority of primary/secondary school teachers opted for demonstration, lecture and project methods of teaching in preference to group work activities; as many engage in chalk and talk method as they do not give room for students' active participation in the classroom activities.

Using hand-on activities like ASEI teaching approach, both high ability and low ability learners may be able to collaborate in terms of understanding, explaining and retaining the concept they have learnt in a Physics class. Therefore, researchers have suggested that conventional lecture courses should be transformed to offer a student-centred, active learning approach to improve student learning in science (Huin-Chun & Shelley, 2021). This suggests that the mastery of Physics concepts cannot be fully achieved without appropriate teaching methods.

Hence, ASEI is a teaching approach which places emphasis on fostering children's ability in solving problems. This approach of teaching is purely child centered and places the teacher less involving. In ASEI teaching, students are grouped into small numbers so that each of them can participate effectively in the learning process. Each of these groups is allowed to select their leaders (chairman and secretary) that will oversee their various group contributions. After which the teacher issues out the necessary materials and instructions to each of the groups. Students in this way use their previous/pre-requisite knowledge also in tackling the given instruction while the teacher watches and observe their findings. Leaders of the groups present their points and afterward the teacher summarizes and corrects where necessary (SMASSE Newsletter, 2006).

Hence, concepts in Physics are supposed to be presented to the learners in a way or approach that touches their sub-consciousness which can trigger quick recalling of the concept being taught or learnt regardless of gender.

Gender differences in academic achievement have been of great concern to researchers and education policy makers, both local and international. It is one of the current academic issues under deliberations all over the world (Addu-Raheem, 2012). Today, equality between boys and girls has become a major scourge plaguing the world, particularly in developing countries and also in sciences. In the society today, girls are look at as second-class citizens, which does not help nurture their careers in sciences (Abdu-Raheem, 2012).

The preponderance of male domination in science education has been traced to greater opportunities for boys than girls in science activities, teachers' bias towards elaborating more on boys' responses than girls' in classroom interactions and boys' superiority over girls in activities requiring manipulation (Okoli, 2012). Also, certain professions have traditionally been regarded as men's such as medicine, engineering, architecture among others and nursing, catering, typing, arts as women's professions. It implies that what are considered to be difficult and complex tasks

are allocated to boys, whereas girls are expected to handle the relatively easy and less demanding tasks. As a result of this way of thinking, the larger society has tended to see girls as the ‘’weaker sex’’. Consequently, an average Nigerian child goes to school with these fixed stereotypes (Amelink, Borrego & Douglas, 2009). Meanwhile, students’ academic achievement and retention in the teaching and learning processes might be influenced by gender.

According to Oludipe (2012) and Okeke (2015) teaching approaches are not gender sensitive. This is contrary to what Agu and Akpavan (2015) found when they revealed that male students achieve significantly higher than their female counterpart in Physics. According to them, Physics is usually perceived as a masculine subject since boys are portrayed as being brave and intelligent, decisive and adventurous, while the female are regarded as shy and timid. It’s very rare to see good number of girls who seat for Physics during O’ level examinations and most especially into higher institutions of learning. This study therefore, sought to determine the effect of ASEI Teaching Approach on Gender Stereotype on Students’ Achievement and Retention in Physics in Nassarawa Eggon Metropolis.

Statement of the Problem

Despite the critical role physics plays in national development and technological advancement, students’ achievement and retention in the subject, especially at the secondary school level, remain persistently low in Nigeria. Several studies have highlighted that these challenges are often influenced by both teaching methods and student-related factors such as gender. In Nasarawa State, and particularly in Nassarawa Eggon, gender disparity in science performance continues to be a concern, with male students often outperforming their female counterparts in physics. This situation raises questions about the effectiveness of current teaching strategies in addressing gender-based performance gaps.

Traditional teacher-centred approaches dominate physics instruction in many secondary schools, often leading to poor student engagement, limited practical understanding, and low knowledge retention. In contrast, the Activity-Based, Student-Centred, Experimentation, and Improvisation (ASEI) teaching approach has been recognized for its potential to foster deeper conceptual understanding and improve learning outcomes. However, there is limited empirical evidence on how this innovative method influences both male and female students differently in terms of achievement and retention in physics.

Given the importance of promoting gender equity in science education and the need for

effective instructional strategies, it becomes imperative to investigate the effect of gender on students' achievement and retention in physics using the ASEI approach in Nassarawa Eggon, Nasarawa State. This study sought to bridge the gap in knowledge by determining whether the ASEI approach can help mitigate gender disparities and enhance overall learning outcomes in physics education.

Objectives of this study

Specifically, the study aimed at finding out if the use of ASEI teaching approach to teach light waves could differ in achievement and retention on male and female students. Specifically, the objectives of this study were to find out;

i. The influence of gender on students' achievement when taught Physics using ASEI teaching approach.

ii. The influence of gender on students' retention when taught ASEI teaching approach.

Research Questions

The following research questions were raised to guide the study;

i. What are the mean achievement scores of male and female students who were taught light waves using ASEI teaching approach?

ii. What are the mean retention scores of male and female students who were taught light waves using ASEI teaching approach?

Statement of Hypotheses

The following null hypotheses guided the study and were tested at 0.05 level of significance.

H_{O1}: There is no significant difference in the mean achievement scores of male and female students when taught light waves using ASEI teaching approach.

H_{O2}: There is no significant difference in the mean retention scores of male and female students when taught light waves using ASEI teaching approach.

Methodology

Pre-test, post-test quasi-experimental research design was used for the study and two intact classes were chosen which comprised of male and female students and ASEI teaching approach was used in the teaching. At the end of the teaching, post-test was administered to both the male and female students and so also post-post-test was administered after two weeks of post-test to ascertain the extent of retention.

The instruments used in this study were the Light Waves Achievement Test (LWAT)

and Post-test in Light Waves (PTLW) which were developed by the researcher. The LWAT and PTLW were validated by three experts. The reliability of LWAT and PTLW were calculated using the Split-Half reliability and the Spearman Brown Formula and it was found to be 0.86 and 0.80 respectively. Prior to the commencement of the treatment, pre-test on LWAT was administered to the class. After the pre-test the scripts were collected and marked by the researcher and the result was kept for analysis. After four weeks, the post-test (POTLW) was administered and the scripts were also collected, marked and the result was recorded for analysis. Lastly, after two weeks of Post-test, the post-post-test was administered and the scripts were collected, marked and recorded for analysis.

The research questions were answered using descriptive statistics of mean and standard deviation, while Analysis of Covariance (ANCOVA) was employed to test the significant differences between the mean scores of male and female students at 0.05 levels of significance.

Results and Discussion

Research Question 1: What are the mean achievement scores of male and female students who were taught light waves using ASEI teaching approach?

Table 1: Means and Standard Deviations of LWAT of Male and Female Students in ASEI Teaching Approach

Gender	Type of Test	No of Students	Mean Score	Standard Deviation	Mean Gain
Male	Pre-test	28	9.45	2.739	18.02
	Post-test	28	27.47	4.407	
Female	Pre-test	22	9.31	3.736	17.15
	Post-test	22	26.46	5.325	

Table 1 shows the mean scores and standard deviation of male and female students taught using ASEI teaching approach. The table reveals that the male students had a mean score of 9.45 and 27.47 in the pre-test and post-test respectively with a mean gain of 18.02, while the female students had a mean score of 9.31 and 26.46 in the pre-test and post-test respectively with a mean gain of 17.15.

Hypothesis 2: There is no significant difference in the mean achievement scores of male and female students when taught light waves using ASEI teaching approach.

Table 2: Result of One-way ANCOVA on Male and Female Students Pre-test Achievement Scores Using ASEI Teaching Approach

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1147.662[a]	2	573.831	55.158	.000
Intercept	2444.990	1	2444.990	235.017	.000
Pre-test	1125.604	1	1125.604	108.195	.000
Gender	15.645	1	15.645	1.504	.223
Error	884.293	85	10.403		
Total	66292.000	88			
Corrected Total	2031.955	87			

Table 2 shows result on the influence of gender on students' achievement when taught ASEI teaching approach. The $F_{(185)} = 1.504$ and $p = 0.223 > \alpha = 0.05$, which implies that there is no significant difference between the male and female students taught Light waves with ASEI teaching approach. Since the p-value 0.223 is greater than alpha level 0.05, the null hypothesis is accepted

.**Research Question 2:** What are the mean retention scores of male and female students who were taught light waves using ASEI teaching approach?

Table 3: Means and Standard Deviations of POTLW on Male and Female Students in ASEI Teaching Approach

Gender	Type of Test	No of Students	Mean Score	Standard Deviation	Mean Gain
Male	post-test	28	27.47	4.407	-1.27
	post-post-test	28	26.20	4.528	
Female	post-test	22	26.46	5.325	-1.87
	post-post-test	22	24.59	5.604	

Table 4 shows the mean scores and standard deviation of male and female students taught using ASEI teaching approach. This table reveals that the male students had retention

mean score of 27.47 and 26.20 in the post-test and post-post-test with a mean gain of -1.27, while the female had a mean of 26.46 and 24.59 in the post-test and post-post-test respectively with a mean gain of -1.87.

Table 4: Result of One-way ANCOVA on Male and Female Students Post-test Retention Scores Using ASEI Teaching Approach

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1187.563[a]	2	593.781	48.232	.000
Intercept	71.582	1	71.582	5.815	.018
Pre-test	1130.969	1	1130.969	91.867	.000
Gender	15.825	1	15.825	1.285	.260
Error	1046.426	85	12.311		
Total	59405.000	88			
Corrected Total	2233.989	87			

Table 4.8 shows the ANCOVA results of male and female students using Activity-based teaching approach. The result reveals that the noted difference between the male and female students is not significant at 0.05 alpha levels, that is $F_{(187)} = 1.285$ and $p = 0.260 > \alpha = 0.05$. The null hypothesis is therefore accepted indicating that there is no significant difference in the mean retention scores of male and female students taught Activity-based teaching approach.

Discussion

Findings from this study shows that there is no significant difference between the male and female students taught light waves with ASEI teaching approach. From the hypothesis 1 therefore, implies that gender has no influence on achievement while using ASEI in teaching. Hypothesis 2 also shows that there is no gender influence on retention of students' knowledge with ASEI teaching approach. This finding supported the work of Oludipe, (2014) who indicated

that there is no difference in the achievement of male and female students in science education.

The finding also agreed with the works of Oludipe and Oludipe (2018) who find out that there was no significant interaction effect of gender and students' academic achievement. So also, the work is in line with the works of Adekoya and Olatoye (2011) and Oludipe (2012). But the work is contrary to what Agu and Akpavan (2015) revealed; that male students achieve significantly higher than their female counterpart in Physics. Similarly, the work did not agree with the work of Wakgari and Teklu (2013) that male students perform significantly better than the female students.

This finding theoretically supports the Bruner Theory of learning where children construct their own knowledge and do this by organizing and categorizing information using a coding system. Bruner's work also suggests that a learner even of a very young age is capable of learning any material so long as the instruction is organized appropriately. Here the role of the teacher should be to teach information by rote learning, but instead to facilitate the learning process. This means that a good teacher will design lessons that help students discover the relationship between bits of information. This theory emphasized that learning take place under already formulated ideas and understandings called previous knowledge. In a constructivist classroom, learning is constructed. Here the previous knowledge in turn formed the basis or serves as the raw materials for the new knowledge the learner will develop. This implies that effective teaching and better achievement/retention can be attained through the use of ASEI teaching strategy since the strategy involves the manipulation of materials in the teaching and learning process.

Conclusion

Based on the findings of this study, it is evident that effective adoption and implementation of aspects of the ASEI

teaching approach to teaching Physics leads to better learning outcomes and is effective for both male and female students. This shows that students achieved and retained better knowledge while taught with ASEI teaching approach in respective of gender

Recommendations

Based on the findings of this study, the researcher recommends the following:

1. ASEI teaching approach should be emphasized more by Physics teachers than the conventional approach. Physics teachers should teach students the skills for investigation and activities based rather than telling them all the facts in science.
2. Professional bodies like Science Teachers Association (STAN) should encourage the teachers of Physics to improvise the available local materials in teaching (ASEI teaching approach) rather than relied on the readymade one that are not always available.
3. At the pre service level, the use and implementation of Activity-based teaching strategy in the classrooms should be emphasized in the methodology courses being offered by the student-teachers

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