International Journal of Innovative Social & Science Education Research 5(2):9-15, April-June,. 2017

© SEAHI PUBLICATIONS, 2017 **www.seahipaj.org** **ISSN: 2360-8978**

Gender Differences in Electricity Interest and Achievement Scores: A case of Problem Based Learning (PBL) Approach

OMAGA, J. O.
Department of Science Education,
Abubakar Tafawa Balewa University,
Bauchi State, Nigeria

ABSTRACT
The study examined the effect of Problem Based Learning Approach on senior secondary school students' interest and achievement in physics in Bauchi State Nigeria. Two research questions and two null hypotheses guided the study. The study adopted a quasi-experimental research design, which was a non-randomized pre-test post-test research design. The population of the study comprised of 4,500 senior secondary one (SS I) students offering Physics in all the 15 senior secondary schools located within Bauchi metropolis. Purposive random sampling technique was used to select four intact science classes from two equivalent co-educational secondary schools that were distantly located from each other within Bauchi metropolis. The instruments used for the data collection were Physics Achievement Test (PAT) and Electricity Interest Inventory (EII). The internal consistency of the instruments was established using Cronbach Alpha for the EII and its internal consistency was gotten as 0.61 and the internal consistency of the PAT was gotten as 0.76 using the Test Retest method to establish the reliability. Data collected for the study was analysed using ANCOVA and the results showed that there was no significant difference between the mean achievement scores of male and female students when taught electricity using PBL approach. Thus, gender is not a significant factor. From the findings of the study, it was recommended among that the use of PBL approach should be adopted as a learning approach and incorporated into the curriculum as a pedagogical approach for active learning among students and regular sensitization workshops should be organized to train and re-train physics teachers on the use of PBL approach in teaching physics.
Keywords: Problem based learning, Achievement, Interest, Physics, and Electricity.

INTRODUCTION

Physics can be said to be an important element in the education of chemists, engineers and computer scientists as well as practitioners of the other physical and biomedical sciences (Martinás & Tremmel, 2014). Physics generates the fundamental knowledge needed for the future technological advances that will continue to drive the economic engines of the world as it is a viable tool for national development. Despite the relevance of physics to national development in terms of technological advancements, research findings indicates that students' have been exhibiting dwindling interest and achievement in physics is poor.

The reason for the lack of interest in physics and low achievement in physics examination can be attributed to the abstract nature of the subject as noted by Adeyemo (2010) who opined that physics is perceived by students to be difficult because of its abstract nature. Erinosho (2013) also states that students generally regard physics as conceptually difficult, abstract, uninteresting, and an elite discipline only suitable for exceptionally talented and gifted students compared with other science subjects.

The physics curriculum at the secondary school level as specified in the curriculum given by Federal Ministry of Education (2008) is broken down into mechanics, heat, waves, motion, light, electricity and

atomic physics. Among the various aspects of physics contained in the curriculum, electricity is one aspect of physics that WAEC Chief Examiner reported that students find difficult. According to the West Africa Examination Council (WAEC) (2010-2015) Chief Examiners' Report, it was observed that students avoid questions on electricity while the few students that attempted questions on electricity achieved poorly. The report further states that every year questions on electricity (both objectives, practical and essay) are given and students achievement on those questions has been consistently poor.

Electricity is one aspect of physics that have been identified by students as difficult and abstract in nature due to its mathematical content (Tumba & Wada as cited in Okoronka and Wada (2014). Cañada, Melo, Costillo, and Mellado (2011) state that electricity is one of the topics students find difficult and abstract. This is because it has being recognized as a concept that students find difficult to learn and understand. Cildir and Sen (2006) state that students do not associate some electricity concepts to scientific realities and they have a great number of misconceptions at physics lessons, particularly about electricity concepts. Ukoh (2010) states that the reasons responsible for poor achievement of students in physics include inefficient teaching methods adopted by physics teachers in the field, poor manipulation of science process skills, learners variable such as gender stereotype in physics and lack of confidence by physics students in their approach to tackling physics problems.

Agummuoh and Ifeanacho (2013) state that poor achievement of students in physics particularly on questions related to electricity can be attributed to many factors among which are teachers' teaching method such as the conventional method. The conventional method of teaching physics do not meet the requirement of the 21st century of teaching and learning as it does not promote deep and meaningful learning among students. This is noted by Anyafulude (2014) who states that by this method (conventional method) learners are encouraged to master course content through constant repetition of facts and drills. Though this method guarantees the completion of task on time, it encourages learners to memorize and regurgitate content of learning experiences instead of digesting and assimilating them. Hence, this method does not allow students to be actively involved in the learning process, thus making them to lose interest in the subject which leads to poor achievement in the subject. This is noted by Umahubi and Umoru as cited in Okafor and Ogunbodede (2016) that students' achievement in a subject depend largely on their interest in the subject. Thus, according to Igboanugo (2014), interest is an important variable in the learning process because one becomes eager to learn what one is interested in.

Interest plays a key role in influencing students' learning behaviour and intention to participate in future learning (Xiang, Chen, & Brene, 2005). Bakare as cited in Igboanugo (2014) states that interest is useful in predicting the success and satisfaction which an individual is likely to obtain from engaging in certain activities now and in the future. In the light of the problems stated above, the researcher adopted an active pedagogical approach for this study, which is the problem based learning (PBL) approach to find out if students' interest and achievement in physics could be improved upon. This is agreement with Agommuoh and Ifeanacho (2013) who state that physics could be well understood if students are taught with effective teaching strategies. Therefore, it is hopeful that when students are exposed to more active learning approach such as PBL, it will improve their interest and achievement in physics. The use of PBL as a creative and innovative learner centred approach to teach physics is to help improve the overall interest and achievement of students in physics. This is noted by Iji and Harbor-Peters as cited by Umeh and Okeke (2014) who say that the teaching of physics should be done in such a way and manner that all students in a class can achieve at a high level. Researches conducted by other researchers such as Ajai and Imoko (2015), Anyafulude (2014) and Mergendoller, Maxwell, and Bellisimo (2002) shows that PBL is a non-gender discriminatory instructional approach especially in terms of enhancing students' interest and achievement in their subjects of study. This is due to the fact that PBL help students to collaborate and gain from one another in the learning process

Statement of the Problem

The persistent poor achievement, dwindling interest of students and low enrolment of students in physics have been a major concern to physics educators, curriculum planners and researchers. Several factors have been said to be responsible for this trend, among which is the instructional approach used by physics

teachers in teaching physics such as the conventional method of teaching, inadequate science process skills, gender stereotype and lack of confidence by students in tackling physics problems, the abstract nature of physics, the mathematical nature of physics and the competitive nature of the subject et cetera. Electricity constitutes about 20% of the physics syllabus of West Africa Examination Council (WAEC) and it has been shown from reports by the chief examiner of physics that students avoid questions on electricity and those that attempted questions on electricity achieved poorly.

Research Questions

1. What are the mean achievement scores of senior secondary one students that were taught electricity using PBL approach based on their gender?
2. What is the interaction effect of gender and PBL on senior secondary one students' interest in electricity?

Research Hypotheses

1. There is no significant difference in the mean achievement scores of senior secondary one students taught electricity using PBL approach based on their gender.
2. There is no significant interaction effect of gender and PBL on senior secondary one students' interest in electricity.

METHODOLOGY

The research design adopted for the study is a quasi-experimental research design, which is a non-randomized pre-test post-test research design only. The study made use of two intact classes, this was done to avoid the disruption of the normal class schedule of the school. The study was carried out in Bauchi Metropolis of Bauchi State, Nigeria. Bauchi State is located in the North Eastern part of the Federal Republic of Nigeria with Bauchi as her capital. The state lies between longitude 9.84°E and latitudes 10.31°N with an elevation of 616m. She is bordered by seven states, which are Kano and Jigawa States to the North, Taraba and Plateau States to the South, Gombe and Yobe States to the East and Kaduna State to the West. She has 20 Local Government areas with a population of 2, 178, 683 million with total land area of 49, 119km^2 representing 5.3% of Nigeria's total land mass (Cometonigeria staff, 2011).

Population of the Study

The population of the study comprised of all the senior secondary one (SS I) students offering Physics in all the senior secondary schools located within Bauchi metropolis. The population of the students is 4500 SS.I students in 15 Government secondary schools located within Bauchi metropolis (Source: Bauchi State Ministry of Education, 2015).

Sample and Sampling Technique

The sample for the study consists of 226 students drawn from two equivalent co-educational secondary schools that are distantly located from one another within Bauchi metropolis. It comprised of 108 female students and 118 male students. Purposive sampling technique was used to select two schools from the 15 schools. The researcher made use of intact classes in each of the two schools that were purposively selected. The schools were randomly assigned to experimental and control groups in a manner that each of the schools has equal and independent chance of been included in the study.

Instruments for Data collection

The instruments used for the data collection was Physics Achievement Test (PAT) and Electricity Interest Inventory (EII). PAT comprised of 30 multiple choice questions (MCQ) and EII comprised of 30 interest items on a four point rating scale which anchored on continuum of strongly agreed (SA = 4), agree (A = 3), disagree (D = 3) and strongly disagreed (SD = 1).

Validation of the Instruments

The two adapted instruments were given for face and content validation to two physics educators, two physics teachers and one expert in measurement and evaluation, making it a total of five validators. The lesson plans, research questions and hypotheses was also given to enable them carry out objective validation of the test questions and interest inventory.

Reliability of the Instruments

The internal consistency of the instruments was established using Cronbach Alpha (α) for the EII and its internal consistency was gotten as 0.61 while the internal consistency of the PAT was gotten as 0.76 using the Test Retest method to establish the reliability. The scores were calculated using the Pearson correlation coefficient.

Method of Data Analysis

Data collected was analysed using descriptive statistic of mean and standard deviation to answer the research questions. The research hypotheses were tested using inferential statistic of Analysis of Covariance (ANCOVA) at significance level of $P \leq 0.05$.

RESULTS AND DISCUSSIONS

Research Question 1

What is the mean achievement scores of senior secondary one students taught electricity using PBL approach based on their gender?

Table 1: Mean and Standard Deviation of Mean Achievement Scores of Male and Female Senior Secondary Students Taught Electricity using PBL Approach

Gender	N	Pre-test $\bar{x}$	SD	Post-test $\bar{x}$	SD
Male	36	23.03	7.48	53.31	7.55
Female	65	29.60	7.61	59.55	7.62
Mean difference		6.57		6.24	
Total	101				

Results in Table 1 shows that the male students had a pre-test mean achievement score of 23.03 with a standard deviation of 7.48 and a post-test mean achievement score of 53.31 with a standard deviation of 7.55. The female students taught electricity using PBL had a pre-test mean achievement of 29.60 with a standard deviation of 7.61 and a post-test mean achievement score of 59.55 with a standard deviation of 7.62. However, for each of the groups, the post-test achievement mean were greater than the pre-test achievement means with the female students having a higher mean achievement gain. This is an indication that the PBL approach slightly favoured the female students more than the male students with reference to electricity.

Research Question 2

What is the interaction effect of gender and PBL on senior secondary one students' interest in electricity?

Table 2: Mean and Standard Deviation of Respondents on the Interaction Effect of Teaching Approach and Gender on Students' Interest in Electricity.

Method of Teaching	Gender	N	Pre-test $\bar{x}$	SD	Post-test $\bar{x}$	SD
PBL Approach	Male	36	2.48	0.51	2.89	0.52
	Female	65	2.65	0.43	2.87	0.54
Mean difference			0.17		0.02	
Conventional Approach	Male	82	2.50	0.36	2.73	0.36
	Female	43	2.57	0.32	2.72	0.35
Mean difference			0.07		0.01	

Results in Table 2 show the interaction effect of gender and teaching approach on students' interest in electricity. Results show that the male students taught electricity using PBL approach had a pre-test interest mean score of 2.48 with a standard deviation of 0.51 and a post-test mean interest score of 2.89 with a standard deviation of 0.52. The female students taught electricity using PBL approach had a pre-test interest mean of 2.65 with a standard deviation of 0.43 and a post-test interest mean of 2.87 with a standard deviation of 0.54. Table 6 also shows that male students taught electricity using conventional approach had a pre-test mean interest rating of 2.50 with a standard deviation of 0.36 and a post-test mean interest rating of 2.72 with a standard deviation of 0.35. The female students taught electricity using conventional approach had a pre-test mean interest rating of 2.57 with a standard deviation of 0.32 and a post-test mean interest rating of 2.72 with a standard deviation of 0.35.

In both cases, the post-test mean interest ratings were greater than the pre-test mean interest rating with the male students having a higher mean interest ratings in both PBL and conventional approaches. The effect size was also considered as indicated by the corresponding partial eta squared value which is 0.00. This value indicates how much of the variance in the dependent variable is explained by the independent variable. Converting the partial eta squared value to a percentage by multiplying by 100, it gives 0.00 percent.

Hypotheses 1

There is no significant difference in the mean achievement scores of senior secondary one students that learnt electricity using PBL approach based on their gender.

Table 3: Analysis of Covariance (ANCOVA) Result of the mean achievement scores of senior secondary one students that learnt electricity using PBL approach based on their gender.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	7160.981[a]	4	1790.245	36.238	.000
Intercept	30319.355	1	30319.355	613.728	.000
Pre-test Achi.	2062.803	1	2062.803	41.755	.000
Treatment	3254.440	1	3254.440	65.877	.000
Gender	7.149	1	7.149	.145	.704
Treatment * Gender	799.726	1	799.726	16.188	.000
Error	10917.837	221	49.402		
Total	648363.000	226			
Corrected Total	18078.819	225			

The result in Table 3 shows that with respect to mean achievement scores of male and female students that learnt electricity using PBL approach, $F(1, 221) = 0.145$, $P > 0.05$. Therefore, the null hypothesis which state that there is no significant difference in the mean achievement scores of senior secondary one students taught electricity using PBL approach based on their gender was not rejected. Inference drawn therefore is that, the difference in the mean achievement scores of male and female students in electricity is not statistically significant.

Hypotheses 2

There is no significant interaction effect of gender and PBL on senior secondary one students' interest in electricity.

Table 4: Analysis of Covariance (ANCOVA) Result of the interaction effect of gender and PBL on senior secondary one students' interest in electricity

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1.271[a]	4	.318	1.593	0.177	0.028
Intercept	42.634	1	42.634	213.790	0.000	0.492
Pre-test Int.	6.933E-005	1	6.933E-005	.000	0.985	0.000
Treatment	1.216	1	1.216	6.098	0.014	0.027
Gender	.012	1	.012	.060	0.807	0.000
Treatment * Gender	.001	1	.001	.005	0.943	0.000
Error	44.071	221	.199			
Total	1808.233	226				
Corrected Total	45.342	225				

The result in Table 4 shows that with respect to the interaction effect of gender and PBL on students mean interest ratings in electricity, F (1, 221) = 0.005, P > 0.05. Therefore, the null hypothesis which states that there is no significant interaction effect of gender and PBL on senior secondary one students' interest in electricity is not rejected.

The effect size was also considered as indicated by the corresponding partial eta squared value which is 0.00. This value indicates how much of the variance in the dependent variable is explained by the independent variable. Converting the partial eta squared value to a percentage by multiplying by 100, it gives 0.00 percent which means that the interaction effect of gender and PBL on SSI students' interest in electricity is not statistically significant.

CONCLUSIONS

Based on the findings of the study, the researcher drew the following conclusions:

There was no significant difference between the mean achievement scores of male and female students when taught electricity using PBL approach. Gender is not a significant factor.

The interaction effect of gender and PBL on senior secondary one students' interest in electricity is not statistically significant.

RECOMMENDATIONS

1. The use of PBL approach should be adopted as a learning approach and incorporated into the curriculum as a pedagogical approach for active learning among students.
2. Regular sensitization workshops should be organized to train and re-train physics teachers on the use of PBL approach in teaching physics.

REFERENCES

Adeyemo, S. A. (2010). Teaching and learning physics in Nigerian secondary schools: The curriculum transformation, issues, problems and prospects. International Journal of Educational Research and Technology, 1(1), 99-111.

Agummuoh, P. C., & Ifeanacho, A. O. (2013). Secondary school students' assessment of innovative teaching strategies in enhancing achievement in physics and mathematics. IOSR Journal of Research and Method in Education, 3(5), 6-11.

Ajai, J. T., & Imoko, B. I. (2015). Gender differences in mathematics achievement and retention scores: a case of PBL method. International Journal of Research in Education and Science (IJRES), 1(1), 45-50.

Anyafulude, J. (2014). Effect of Problem based learning strategy on students' achievement in senior secondary schools chemistry in Enugu State. Journal of Research and Method in Education, 4(3), 27-31.

Cañada, F., Melo, V. L., Costillo, J., & Mellado, V. (2011). Pedagogical content knowledge of secondary school physics teachers on electric field Retrieved from http://www.researchgate.net/publication/269400981

Cildir, I., & Sen, A. I. (2006). Lise oğrencilerinin elektrik akimi konusun daki kavram yanilgilarinin kavram haritalariyla belir len mesi. Hacettepe –niveritesi, Eğitim Fakültesi Dergisi, 30, 92-101.

Cometonigeria staff. (2011). Bauchi State Retrieved from www.cometonigeria.com/region/north-east/bauchi-state/

Erinosho, S. Y. (2013). How do students perceive the difficulty of physics in secondary school? An exploratory study in Nigeria. International Journal for Cross-Disciplinary subjects in Education (IJCDSE), 3(3), 1510-1515.

Federal Ministry of Education. (2008). Senior secondary school curriculum for Physics. Lagos: NERDC printing press.

Igboanugo, B. I. (2014). Effect of cooperative learning on students' interest in senior secondary school difficult chemistry concepts. Paper presented at the 55th Annual Conference Proceedings of Science Teachers Association of Nigeria (STAN), Asaba.

Martinás, K., & Tremmel, B. (2014). Physics curriculum for the 21st century. Interdisciplinary Description of Complex Systems, 12(2), 176-186.

Mergendoller, J. R., Maxwell, N. L., & Bellisimo, Y. (2002). The effectiveness of Problem based instruction: A comparative study of instructional methods and students' characteristics. Interdisciplinary Journal of Problem Based Learning, 1(2), 49-69.

Okafor, N. P., & Ogunbodede, A. M. (2016). Enhancing secondary school girls' achievement in chemistry through motivation and reinforcement. International Journal of Research in Science, Technology and Mathematics Education, 4(1), 1-10.

Okoronka, U. A., & Wada, B. Z. (2014). Effects of analogy instructional strategy, cognitive style and gender on senior secondary school students' achievement in some physics concepts in Mubi Metropolis, Nigeria. American Journal of Educational Research, 2(9), 788-792.

Ukoh, E. E. (2010). Determining the effect of problem based learning instructional strategy on NCE pre-service teachers' achievement in physics and acquisition of science process skills. European Scientific Journal, 8(17), 102-113.

Umeh, U. B., & Okeke, N. F. (2014). Effect of exchange board strategy for teaching basic operations in primary school mathematics: Implication for Creativity in STEM Education. Paper presented at the 55th Annual Conference proceedings of Science Teachers Association of Nigeria (STAN), Delta.

West Africa Examination Council (WAEC). (2010-2015) Chief Examiners' Report on Physics. Retrieved from http://waeconline.org.ng/e-learning/.

Xiang, P., Chen, A., & Brene, A. (2005). Interactive impact of intrinsic motivators and extrinsic rewards on behaviour and motivation outcomes. Journal of Teaching in Physical Education, 24(3), 179-197.