

GENDER DIFFERENCES ON ACHIEVEMENT AND ATTITUDE IN CONCEPT LIGHT WAVES IN SENIOR SECONDARY SCHOOL STUDENTS IN KAGARKO LOCAL GOVERNMENT, KADUNA STATE

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Abstract

This study examined the Gender Differences on Achievement and Attitude in Concept Light Waves in Senior Secondary School Students in Kagarko Local Government, Kaduna State. The study adopted pre-test and post-test quasi-experimental research design. The population of the study consists of 2,431 (1,143 boys and 1,288 girls) senior secondary school two (SSII) students from public schools during the 2020/2021 academic session in Kagarko local government area, Kaduna state. A sample size of 45 (26 Male and 19 Female) SSII Physics students were selected from the target population using simple random sampling technique. The students were exposed to light waves concept using Activity-Based Strategy. Two instruments, namely Physics Achievement Test (PAT) and Physics Attitude Scale (PAS) were used for data collection and had reliability coefficient of 0.82 and 0.74 respectively. Two research questions were raised with two corresponding hypotheses. These hypotheses were tested using ANCOVA at 0.05 level of significance. The results of the study revealed that male and female students exposed to Activity-Based Strategy did not differ in their achievement and attitude. The study concluded that the application of Activity-Based Strategy is gender-friendly. The study recommended the provision of in-service training and retraining for teachers on the use of Activity-Based Strategy for teaching Physics.

Keywords: Gender, Achievement and Attitude, Students, Light waves, Activity-Based Strategy

Introduction

Science and technology have become crucial factors for sustainable development worldwide. This is because Science and technology contribute significantly to the quality of life in diverse areas such as; healthcare, communication, agriculture, environmental protection, nutrition, transportation, and energy production. Science and Technology are the basic requirements for any technological development in any country. According to Adam, Kime and Wali (2022), a nation can be classified as developed through its scientific and technological development. Thus, the world has identified science and technology as an important tool for national development.

The knowledge of Physics is important in understanding contemporary science and technology, and the valuable role that Physics plays in the scientific development of a

nation is never in dispute (Areo, 2022). Physics is one of the subjects in the field of science. According to Wikipedia, Physics is the scientific study of matter, energy, and their interactions. It plays a key role in the future progress of mankind. The interest and concerns of Physics education form the basis of technology. Physics generates fundamental knowledge needed for technological advancement which will in turn spearhead the economic engineering of the world (Zhaoyao, 2012). The concept learned in Physics contributes immensely to the technological infrastructure needed to make scientific advances and discoveries (Kola, 2013).

Despite the importance and significant role played by Physics education towards the development of Nigeria, there are a number of observable problems plaguing the teaching and learning of the subject, especially at the secondary school level (Areo, 2022). These problems, as observed by WAEC Chief Examiners' report (2017) include negative attitudes of students towards Physics, gender difference, poor science background among others.

Problems in teaching Physics can be minimized by selecting a suitable teaching method. The conventional method is the complete verbal presentation of the subject matter. It is characterized by a one-way mode of communication. Learners are always passive and that is inappropriate for the acquisition of practical skills as required in practically oriented subjects like Physics and lead to poor academic achievement (Achuonye, 2014).

The studies on gender disparities have been done in both developed and developing countries. In some of the countries women in institutions of higher learning tend to concentrate in certain fields of study such as humanities, home economics and arts, though more women have now enrolled in other fields like business and public administration. The enrolment in the fields such as mathematics and science related fields is however still limited (Brajraj, Rakhee, Rekha & Singh, 2019).

Fasakin (2011), recognized attitude as a major factor in a subject choice, he also considered attitude as a mental and natural state of readiness, organized through experiences exerting a directive influence upon the individual's responses to all objects and situations with which it is related. Erdemir (2009) described the attitude as the tendency of individuals who organize thoughts, emotions, and behaviors toward psychological objects. The differences in the attitude of males and females toward Physics have been an issue in many countries. In response to this, many kinds of research have been carried out with mixed reports.

No nation can aspire to achieve its full developmental potentials unless all its people, men and women, boys and girls are full participants in the process. However, the attitude and values of Nigerian society on females have apparently influenced their (female) performance in Physical Sciences at all levels of education (Adam, Kime & Wali, 2022)

Gender is one of such factors mentioned in the literature to have considerable effects on students' academic performances, especially in science subjects. One of the millennium development goals (MDGs) is gender equality. In most societies, the roles of women are not adequately recognized thus preventing women from participating in, and benefitting from development efforts. They added that some subjects such as science and mathematics are branded masculine, while others like home economics and secretarial studies are branded feminine (Amedu, 2015).

Gin (2011) observed that in the contemporary context, men and women classification is a world where patriarchal values predominate, it is a world where there are general sets of beliefs that women are inferior to men and therefore, the power relations attached to their ideas, and beliefs, give men more power, more opportunities and more conscientious over and above women in the society.

The findings of Areo (2022) showed that there was no significant influence of gender on students' achievement in Physics. It implies that female students were found to be as good as their male counterparts in achievement in Physics. Also, attitude of students towards Physics was not determined by gender. Ibrahim, Sabitu and Magaji (2016), found that there were no significant differences in the performance of male and female students in Biology, Chemistry and Physics.

Omebe and Akani (2015), study revealed that there was no gender bias in terms of achievement in Physics students' taught with instructional resources. In a similar vein Josiah (2013), found that there was no significant difference in the achievement between male and female students exposed to practical Physics approach.

Research by Katcha and Wushishi (2015), study showed that attitude change of Biology students exposed to the adequately equipped laboratory is not gender-related. Muchai's (2016), study showed that the practical approach improved male and female students' attitude toward Physics and resulted in higher students' enrolment in Physics at Kenya Certificate of secondary school Education. In agreement, Apochi, Umoru, and Onah (2018) study found that students exposed to Advance Organizer on students' interest in Biology developed a more positive interest in Biology than those taught using the conventional method. Also, indicated that there was no significant difference in students' interests based on gender.

Contrary to other findings, Yakubu (2021), study showed that there was significant difference exists between the performance of male and female students in favour of male students in Physics. In agreement with Adam, Kime and Wali (2022), findings revealed that significant gender difference between male and female students' academic performance in Physics in favour of males' students. In the same vein Brajraj, Rakhee, Rekha and Singh, (2019), study showed that there is a significant level of attitudinal differences towards science subjects between male and female students at secondary school level and that might be influencing the enrolment at higher level of studies in science streams.

Problem Statement

The teaching and learning of Physics in most classrooms face a lot of problems on gender differences. Most of the teachers use the conventional teaching method that comprises talk and chalk, note taking and memorization. They do not make use of Activity-Based Strategy, where the learners play an active role in the learning process in respective of their gender. This inability of the Physics teachers in the use of Activity-Based Strategy might be the cause of gender differences on achievement and attitude of students' in the subject at both teachers' made examinations and external examinations. Thus, this study is aimed to determine the mean achievement and attitude of male and female students taught Light waves concept in Physics using the Activity-Based Strategy in Senior Secondary School in Kagarko Local Government Area, Kaduna State.

Objectives of the study

The main objectives of this study was to determine the Gender Differences on Achievement and Attitude of Physics Students in Senior Secondary School Kagarko Local Government, Kaduna State. The specific objectives are to;

- I. Determine the mean achievement scores between male and female students taught light waves concept using Activity–Based Strategy in senior secondary school in Kagarko local government area.
- II. Determine the mean attitude rating scores between male and female students taught light waves concept using Activity–Based Strategy in senior secondary school in Kagarko local government area.

Research Questions

This following research questions guided the study:

What is the mean difference in achievement scores between male and female students taught light waves concepts using Activity–Based Strategy in senior secondary school in Kagarko local government area?

What is the mean difference in attitude rating scores between male and female students taught light waves concept using Activity–Based Strategy in senior secondary school in Kagarko local government area?

Hypotheses

The following null hypotheses were raised and tested at 0.05 level of significance.

- H01: There is no significant difference in the mean achievement scores between male and female students taught light waves concepts using Activity-Based Strategy in senior secondary schools in Kagarko local government area.
- H02: There is no significant difference in mean attitude rating scores between male and female students taught light waves concepts using Activity-Based Strategy between male and female students in senior secondary schools in Kagarko local government area.

Methodology

Quasi-experimental design was adopted for this research. The design enable comparison between males and females' students' treatments on participants in a pre-test and post-test design. This design was used to examine the gender difference on students' achievement and attitudes toward physics when they are taught physics using Activity–Based Strategy for experimental group. The treatment comprised only one group which were subjected to Activity–Based Strategy. Quasi-experimental design is best for this study because the sample is non-randomized which means intact class were used.

Population of the Study

The target population of this study comprised of all the SS II Physics students in Public Senior Secondary Schools in Kagark Local Government Area of Kaduna state. There are twenty (20) public senior secondary schools in Kagark Local Government Area of

Kaduna State with a population of two thousand four hundred and thirty-one (2,431) SS II students categorized according to their sexes, male (1,143) and female (1,288) in Kagarko Local Government Area, (Kaduna State Annual School Census, 2020).

Sample Size and Sampling Technique

A sample size of forty-five (45) SS II Physics students formed the sample of the study; two (2) co-educational schools were selected using purposive sampling method. Simple random sampling method was used in selecting one (1) school from the two (2) sampled schools selected to represent experimental group by tossing a coin. One side of the coin was labeled GSS Kagarko and the other side was labeled GSS Jere, after the coin was tossed GSS Kagarko represent experimental group. The sample is represented in table 1 below:

Table 1: Sample of the Study

s/s	School	Group	Sample		Total
			Male	female	
1	GSS Kagarko	Experimental	26	19	45

Instrumentation

The instruments used before and after the commencement of teaching for students' attitude toward biology in experimental was adapted named as Physics Achievement Test (PAT), Physics Attitude Scale (PAS) and Lesson Plan.

Validation of Instrument

The instrument was subjected to both face and content validity. The validation of these instruments; Physics Achievement Test (PAT) and Physics Attitude Scale (PAS) was done by an expert in the Department of Science and Environmental Education, Faculty of Education, University of Abuja to check the face and content validity.

Reliability of the Instrument

The scores obtained from the trial testing were used to determine the internal consistency reliability co-efficient of the instruments. The internal consistency of PAT was determined using Kuder-Richardson formula (K-R 21), while the internal consistency reliability index of PAS was determined using Crombach Alpha.

Kuder-Richardson formular was used because the test item (PAT) were of multiple-choice types and were dichotomously scored. The internal consistency reliability coefficient of PAT was 0.82. The internal consistency of PAS was determined from the data collected, using Cronbach Alpha (α) was found to be 0.74.

Data Collection Procedure

Permission was sought and granted by the school authorities to use their school for the study. Thereafter, PAT and PAS were served to forty five (45) SSSII Physics students from the selected school. The results were then used to ascertain relative ability in achievement and attitude in Physics.

This period covered the treatment period which lasted for 6 weeks. The Physics students of the intact class of the male and female were taught using the Activity-Based Strategy. The topics were taught in the intact Physics class during the normal Physics period on the school timetable.

The post-test of PAT and PAS was administered to male and female Physics students at the end of the 8th week of the study.

Method of Data Analysis

The data collected from the study were analyzed using frequency count, mean score, and standard deviation to answer research questions, while a t-test statistic at 0.05 level of significance was used to analyze data for testing the null hypotheses. the analysis was computer-based, with the use of the Statistical Package for Social Science (SPSS).

Results

Demographic Data

The characteristic of the subjects that constituted the sample in respect of gender were presented in table 2 below:

Table 2: Distribution of Sample According to Gender

Gender	No. of Students	Percentage
Male	26	57.8
Female	19	42.2
Total	45	100

Table 2 indicates the distribution of students who participated in the study according to gender. Further analysis reveals that out of forty-five students, twenty-six students representing 57.8% were male students while nineteen students representing 42.2% were female students. It then means that majority of students in the entire sample are male.

The following research questions were posed and answered as follows:

Research Question 1: What is the mean difference in achievement scores between male and female students taught light waves concepts using Activity–Based Strategy in senior secondary school in Kagarko local government area?

Table 3: Mean Achievement Scores of male and female students in the Experimental Group of Pre-test and Post-test (PAT)

Gender		Pre-test	Post-test	Mean Gain
Male	Mean	24.70	34.55	9.95
	Std. Deviation	0.86	0.79	
	N	26	26	
Female	Mean	24.88	36.62	11.74
	Std. Deviation	0.89	0.91	
	N	19	19	
Mean difference				1.79

The result in table 2 shows the mean achievement scores of male and female students in the experimental group. From the table, it was observed that the mean achievement scores of the male students in the experimental Pre-PAT was 24.70 with a standard deviation of 0.86, while that of female counterparts was 24.88 with a standard deviation of 0.89. This shows that, at the beginning of the study, the male and female students were almost at the same level in their knowledge of Physics. The male mean achievement scores for Post-

PAT was 34.55 with a standard deviation of 0.79, while that of their female counterparts is 36.62 with a standard deviation of 0.91. The result revealed that the female students exposed to Activity-Based Strategy had a positive effect on their achievement in Physics than their male counterparts exposed to Activity-Based Strategy. The difference in the mean gain achievement of male and female students in the group is 1.79 in favor of the female students.

Research Question 2: What is the mean difference in attitude rating scores between male and female students taught light waves concept using Activity-Based Strategy in senior secondary school in Kagarko local government area?

Table 4: Mean Scores and Standard Deviation on Attitude of Experimental Groups Due to Gender Pre-test and Post-test (PAS)

Gender		Pre-test	Post-test	Mean Gain
Male	Mean	1.46	2.67	1.21
	Std. Deviation	0.06	0.07	
	N	26	26	
Female	Mean	1.50	2.83	1.33
	Std. Deviation	0.09	0.08	
	N	19	19	
Mean difference				0.12

Table 4, shows the mean achievement attitude rating scores of male and female students taught with Activity-Based Strategy. From the table, it could be observed that the mean achievement attitude rating scores of the male students in the Pre-PAS was 1.46 with a standard deviation of 0.07 and that of their female counterparts was 1.50 with a standard deviation of 0.09. This implies that both male and female subjects for the study have nearly the same level of attitude toward Physics at the beginning of the study. The Post-PAS of male mean attitude rating was 2.67 with a standard deviation of 0.07, while that of their female counterparts was 2.83 with a standard deviation of 0.08. The difference in the mean gain attitude of male and female students is 0.12 in favor of the female.

Test of Hypotheses

The following null hypotheses were posed and answered as follows:

H₀₁: There is no significant difference in the mean achievement scores between male and female students taught light waves concepts using Activity-Based Strategy in senior secondary school in Kagarko local government area.

Table 5: T-Test Mean Achievement Scores of Male and Female Students in the Experimental Group

Gender	N	X	SD	t-value	df	P (2-tailed)	Decision
Male	26	42.46	5.46	1.63	43	0.111	Accepted
Female	19	44.95	4.44				

From Table 5, it is observed that gender as a main effect is not a significant factor in students' achievement in Physics. The p-value is greater than 0.05 level of significance (p-value = 0.111 > 0.05). This is greater than the already set alpha value of 0.05 level of significance at 2 and 43 df (degrees of freedom). The implication of this is that the null

hypothesis of no significant difference in the mean achievement scores of male and female students is accepted. This means that the difference in the mean achievement scores of male and female students in the Pre-PAT and Post-PAT is not statistically significant.

H0₂: There is no significant difference in mean attitude rating scores between male and female students taught light waves concepts using Activity-Based Strategy between male and female students in senior secondary school in Kagarko local government area.

Table 6: T-Test Mean Attitude Scores of Male and Female Students in the Experimental Group

Gender	N	X	SD	t-value	df	P (2-tailed)	Decision
Male	26	3.35	0.51	1.02	43	0.312	Accepted
Female	19	3.53	0.63				

From Table 6, it is observed that gender is not a significant factor in the attitude of students in Physics. The p-value is greater than 0.05 level of significance (p-value = 0.312 > 0.05). This is greater than the already set alpha value of 0.05 level of significance at 2 and 43 df (degrees of freedom). The implication of this is that the null hypothesis of no significant difference in the mean attitude rating of male and female students is accepted. This means that the mean attitude scores of male and female students in the Pre-PAS and Post-PAS, though not equal are not statistically significant.

Discussion

The result shown in table 3, reveals that female students recorded higher mean achievement scores than the male, in the experimental Pre-PAT and Post-PAT. This mean difference was not statistically significant as revealed in the t-test statistic result in table 5. This implies that gender does not have a significant effect on students' achievement in Physics when exposed to Activity-Based Strategy. This finding contradicts Adam, Kime and Wali (2022) and Yakubu (2021) who study revealed that significant difference exists between the academic performance of male and female students in Physics in favour of male students. These findings agreed with Areo (2022) who found no significant influence of gender on students' achievement in Physics. This finding also lends support to other researchers such as, Ibrahim, Sabitu and Magaji (2016) revealed that there was no significant difference in performance of male and female students in Biology, Chemistry and Physics. It means that Activity-Based Strategy is gender-friendly; it can be used to reduce the problem of gender issues in science.

Table 4, revealed that female students have a higher mean attitude rating in the Pre-PAS and Post-PAS than their male counterparts. The mean difference is, however, not statistically significant as revealed in table 6, at 0.05 level of significance. This implies that the use of Activity-Based Strategy as instructional material helped both the female and male subjects to develop a positive attitude toward Physics. In other words, gender did not influence the Activity-Based Strategy approach in Physics. Use of Activity-Based Strategy is practical oriented. The finding of this study contradicts Brajraj, Rakhee, Rekha and Sigh (2019) who revealed that there is significance level of attitudinal differences toward science subjects between male and female students. The finding of this study is in line with Areo (2022) who discovered that attitude of students toward Physics was not

determined by gender. These findings also lend support to other studies such as Katcha and Wushishi (2015), Apochi, Umoru, and Onah (2018), who found that there is no significant difference in students' attitudes and interests based on gender when exposed to adequately equipped laboratory and advance organizer strategy. Also, Muchai's (2016) study showed that a practical approach leads to improved male and female students' attitudes toward Physics. The male and female students were exposed to the same method which give them equal opportunity to participate actively, this helped to boost their attitude irrespective of gender.

Conclusion

Based on the result obtained, the researcher draws conclusion that the use of Activity-Based Strategy promoting gender achievement and attitude in Physics concepts. Gender had no significant influence over students' achievement and attitude in Physics. This implies that the relative superiority of Activity-Based Strategy in fostering achievement and attitude was uniform for both male and female students.

Recommendations

The following recommendations are made based on the findings of this research:

- I. Physics teachers: Physics teachers should be encouraged to incorporate Activity-Based Strategy of teaching since the method provides equal opportunity for both male and female students' achievement and positive attitude toward Physics concepts.
- II. Government/education administrator: Government/education administrators should also organize public lectures, seminars, and workshops, incorporating of Science Teachers Association of Nigeria (STAN) on Activity-Based Strategy in schools, as a way of marketing the new concept;
- III. Government: Government should through appropriate agencies, sponsor further research into the possible application of Activity-Based Strategy in other aspects of science and technology.

References

- Adam, M., Kime, M. M & Wali, H. M. (2022). Gender difference in performance in four science subjects in Borno State Colleges of Education. *Journal of Education and Practice*: www.carijournals.org ISSN 2520-467X (Online);6 (4), 1 - 11.
- Achuonye, K. (2014). Predominant Teaching Strategies in Schools: Implication for Mathematics, Science, and Technology Curriculum Implementation. *Being a Paper Presented at the 14th Annual Conference of the Curriculum Organization of Nigeria, Calabar, University of Calabar.*
- Amedu, O. I. (2015). The Effect of Gender on the Achievement of Students in Biology using the Jigsaw Method. *Journal of Education and Practice*. www.iiste.org, ISSN 2222-288X, 6(17), 176-180.
- Apochi, M. A., Umoru, S. E., & Onah, D. O. (2018). Effect of advance organizers on Senior Secondary Students' Interest in Biology in Makurdi Metropolis. *ATBU*,

Journal of Science, Technology & Education (JOSTE); ISSN: 2277-001, 6(3), 18-26.

- Areo, O.O. (2022). Influence of gender on students' achievement and attitude towards physics in secondary schools in Ondo State, Nigeria. *International Journal of Research in Education and Sustainable Development*, www.ijaar.org | ISSN: 2782-7666; 6(2), 1-9.
- Brajraj S., Rakhee, C.1, Rekha, Y.& Singh, K. (2019). A study on gender difference in attitude towards science. *International Journal of Education (IJE)*, <http://iaeme.com/Home/issue/IJE?> 1(2), 38-46.
- Erdemir, N. (2009). The Change and Development of Attitude of Science Teacher Candidates towards Branches Kastamonu Education Journal, 17(1), 161-170.
- Fasakin, P. J. (2011). *Effects of Everyday Phenomena on Students' Achievement, Attitude, and Practical Skills in Physics*. A master's Dissertation Submitted to the Department of Teacher Education, University of Ibadan, Ibadan, Nigeria.
- Gin, E. K. (2011). Gender and Politics in Nigeria: Lessons and Challenges for the Nigerian Woman for the Actualization of Vision 20: 2020. *The Belt Journal of Education* 2(2), 67-96. <https://en.m.wikipedia.org/wiki/physics>. Retrieved 13th June, 2024.
- Ibrahim, S.T., Sabitu, A & Magaji, Y. M. (2016). Comparative analysis of gender performances in biology, chemistry and physics among pre-degree students of Federal University, Dutsinma. *International Journal of Educational Benchmark (Ijeb)*, eISSN: 2489-0170 pISSN:2489-4162 University of Uyo, 5(1), 108-118.
- Josiah, M. M. (2013). Effects of Practical Physics Knowledge on Students' Academic Achievement: A Study of Pankshin Local Government Area of Plateau State, Nigeria. *World Educators forum/Effects of Practical Physics Knowledge on Students' Academic.pdf*, <http://www.globalacademicgroup.com/journals/worldeducators>, 2(1), 1-9.
- Katcha, M. A., & Wushishi, D. I. (2015). Effects of laboratory equipment on secondary school students' performance and attitude change to biology learning in Federal Capital Territory, Abuja, Nigeria. *Journal of Education Research and Behavioral Sciences*, ISSN23158735, <http://www.apexjournal.org>. 4(9),250-256.
- Kola, A. (2013). Importance of Science Education to National Development. *Latin-American Journal Physics Education*, 1(7), 223-229.
- Muchai, A. N. (2016). *Effects of practical work on students' achievements in physics at secondary school level in Murang a East Sub-County, Kenya*. An Unpublished Ph.D. Thesis Kenyatta University Kenya.
- Omebe, C. A., & Akani O. (2015). Effect of instructional resources on student's achievement in physics and chemistry in secondary schools in Ebonyi State, Nigeria. *European Journal of Training and Development Studies,UK* www.eajournals.org. 2(2), 56-65

WAEC (2018): Senior Secondary Certificate Examination. Chief Examiners Report, Reports, Lagos office, Nigeria.

Yakubu, P. A. (2021). Gender and assessment of physics students' academic performance in senior secondary school SSIII (SS3) Olamaboro Local Government Area of Kogi State, Nigeria. *AJSTME*. ISSN: 2251-0141, 6(2); 1-9.

Zhaoyao, M. (2012). *Physics Education for the 21st Century: Avoiding a crisis physics education*, 37(1), 18- 24.