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Research Paper

The Effects of Instructional Material on Students' Attitude and Academic Achievement in Physics in Senior Secondary Schools, Plateau State, Nigeria

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Abstract— the study determines the effect of instructional material on physics students' attitude and their academic achievement. The study pretests, post-tests the design and employed a quasi-experimental design. Three research questions and three hypotheses were formulated to guide the study. Physics achievement test as an instrument of data collection was used to collect data from a sample of sixty students in two selected secondary schools in Jos-North Local Government Area of Plateau State. In addition, attitude questionnaires were given to students in the various schools sampled. The data collected was analyzed using mean and standard deviation for the research questions and T-test for the hypothesis. The findings of the research reveal that instructional materials have a very great influence on the teaching and learning of physics in senior secondary school. The result also showed that there is a significant difference between male and female students taught with instructional materials. Based on the findings, recommendations were made as revealed by the study, that academic achievement and student attitude depend on the use of instructional material and the teacher's attitude to awaken the interest of the physics student. Also, the government should organize workshops and seminars for teachers on the use of instructional material to stimulate the interest of the student, and educational planners should implement it in the school curriculum among others.

Keywords— Instructional material; academic achievement; senior secondary schools, attitudes, students, gender, studying physics.

1. Introduction

Physics is a major branch of science that concerns itself with the study of properties of matter, energy, force, and motion, and their relationship with each other. Studying these processes is essential in our as we interact with nature, and evolve in today's technology-driven society. Thus, the Federal Ministry of Education in Nigeria, recognized physics as a crucial subject for effective living and advancement in this age of science and technology [6]. It is decisive in all science and technology-based courses because a credit pass is required for entry into these programs. This implies every student must acquire some basic physics concepts, principles, theories, and skills, for effective living in today's society, which are the most important objectives of teaching physics at the senior secondary school level. According to the National Policy on Education, objectives of physics education include: providing basic literacy in physics for functional living in society; acquiring essential scientific skills and attitudes as a preparation for the technological application of physics; stimulation and enhancement of creativity, among others. Physics is an activity-oriented subject and thus requires instructional materials during the teaching/learning process [10].

Science Education is one pressing issue in the Nigerian system of education. Low and poor grades in Physics signify an inferior academic performance, leading to deficient scores in external and internal examinations. This low-scale academic performance in physics factors in the absence of instructional material; inadequate skills needed for effective teaching; lack and/or inability to improvise or make available materials relative to the topics taught, and depending on the school type. This justifies the inadequacies and clarifies that mastery of concepts in physics cannot be fully achieved without the use of instructional materials, which, are tools essential for enhancing learning and facilitating teaching. Instructional materials promote teachers' efficiency and improve students' performance in the subjects learned in the classroom. They make learning appealing, more interesting, practical, and realistic. Instructional material fosters activities and engages, develops, and increases students' participation, and helps in retention.

1.1 Statement of the Problem

Physics is one of the bedrocks of science, and its study plays a substantial role in the development of a nation. Many students do not offer physics in secondary schools due to the

fear of turning out with low grades, and a majority of the few offering the subject does not perform well [11]. The availability of learning/teaching aid is for a better understanding of the subject and makes the subject attractive and interesting to students. The May/June West African Examinations Council (WAEC) and November/ December National Examination Council (NECO) have been recording low grades, not only in the overall students' performance but also in Physics subjects where the high rate of failures has been a dominant feature of the student's achievement in secondary schools in Nigeria.

Recently reported the breakdown of the May/June SSCE examination, reveals the poor accomplishment of Physics students in WAEC and NECO exams. There was an average failure rate of 72 %, 74 %, 74%, and 75 % in 2008, 2009, 2010, and 2011 respectively. Each time the results of examinations are released, the statistics characteristically reeled out by examination bodies such as the National Examination Council and the West African Examinations Council (WAEC), point out that students have not been performing up to the required standards despite high investments by the various levels of government, as well as parental efforts in the sector, though, some students successfully pull through [13].

1.2 **Aim and Objectives**

The purpose of this study is to investigate the effects of instructional materials on secondary school physics students' attitudes, and their academic achievement in Physics in Plateau State, Nigeria. Specifically, the study intends to:

i. Investigate the effects of instructional materials on physics student attitude in Plateau State.
ii. Determine the effect of instructional material on students' academic achievement in physics in Plateau state.
iii. Measure the effect of instructional material in Physics on gender achievement in Plateau State.

1.3 Theoretical Framework

Our study centers on the constructivist theory. Educational psychologists such as Dewey, Brunner, Piaget, and Vygotsky, protagonists of the theory, stress that learners construct knowledge individually (and socially) to achieve meaning while they learn. Constructivism, also regarded as a cognitive paradigm, views learning as an active, contextualized process of knowledge construction, rather than knowledge acquisition which is based only on personal experiences in the environment. However, this study is anchored on [4] social constructivism.

This theory was propounded by [4], it focused on the real classroom practices and the utilization of instructional materials which involves the teacher (instructor) who is the facilitator of the learning process, and the learner/s, who is the main center of interest. As stated by [4], creativity and invention are the processes of arriving at new knowledge from the basis of a learner's prior experience; that is from the known to the unknown. In this theory, the learner applies already acquired knowledge to achieve new knowledge from the teacher. The theory views knowledge as something which emanates from the learner and [4] maintains that new knowledge may be found from that which one knows without changing its structure. The student uses previously learned experience and information to construct new ideas or knowledge, and the learners participate in learning activities that determine their academic achievement.

Social constructivists identify and recognize extensive and tangible interaction with instructional aids, materials, and resources, and inspire 'hands-on activities' above all, alongside 'minds-on activities'. Constructivists acknowledge knowledge as a construction of a learner through his or her engagement with the factors in their dynamic environment. Jerome Brunner focused on instructional materials which offer a vast collection of such opportunities. Visualization strategies by displaying a pictorial representation of lessons, accelerate and simplify learning, by providing information in multiple ways so that students can construct knowledge. This improves learning by developing strong models which are rich in multiple perspectives on physics concepts; examine how students process information using multiple representations to develop their understanding with graphical illustrations, animations, and simulations presented in instructional media.

The research is subdivided into seven (7) sections:
Section 1 contains the introduction of the research and what it intends to achieve through the statement of the problem, aims and objectives of the study, as well as the theoretical framework which guided the research.
Section 2 contains the related work of [5] and [8].
Section 3 contains the methodology used in conducting our research, which comprises: the population of the study; the validity and reliability of the instrument.
Section 4 describes and reflects the results and discussion.
Section 5 covers the conclusion of the research, and states future scopes and perspectives relative to the study.
Section 6 contains recommendations and suggestions formulated by the researchers after conducting the study.
The final section 7 is the references for the study.

2. Related Work

As started earlier, physics is resource intensive just like other sciences. The utilization of instructional materials (tools) in teaching and learning physics, are categorically summarized into types by [5], which include: Audio, visual, and audio-visual aids. The relevance of these aids and learning/teaching resources in physics cannot be overemphasized. It helps to promote learning from verbalization (lecturing) to practical, and the combination of both; it assists the students understand easily by bringing into clarity and recognition the sensations which are needed for learning to take place, by giving the learners a realistic hands-on participation, which enables an absolute and total acquisition of knowledge. Learners partake more in learning when all their sense organs are involved. With instructional materials, they not only listen, watch the teacher's gesticulations, and ask and answer questions, but become a part of their knowledge formation by applying the sense of touch, together with other senses. A theory referred

to as Instructional theory which originates from the United States of America in the late 1970s was also reviewed. It tries to identify what instruction or teaching should look like. Paulo Fraire's work appears to critique instructional approaches which adhere to knowledge on the acquisition stance, and his work acquisition has garnered abroad influence over a generation of American educationists with his critique of various models of education and analysis of the teacher-student relationship [8].

The empirical studies looked at works done by other researchers in Nigeria, Ethiopia, and America. From the review, it is evident that there is a dearth of information as regards studies on instructional materials. It was also reviewed that, there are principles a physics teacher needs to observe in the selection and usage of instruction materials: principles like instructional guidelines, preparation and preview guideline, and number of learners, among others. The review further highlighted a few problems associated with using instructional material, such as funds, time, socioeconomic and environmental factors, teachers' knowledge, and technical know-how. The maintenance and management of the materials was also addressed. Conclusively, professional teachers in scientific fields of education, especially physics, must be aware of the design and directions which the production and use of instructional material should take. The effectiveness and efficiency of instructional materials depend largely on their relevance to the physical and cultural background of the learner, and to what extent the acquired knowledge can be applied. Instructional material makes learning physics concepts become real and not imaginary, and the absence of this material is resultant in the students' perception of physics as a difficult subject to learn. This study will bridge a gap in the effect of instructional materials on physics students' attitudes and academic achievement in Plateau State.

3. Methodology

3.1 Population of the Study

The population of our study comprises all senior secondary school students offering physics **in two selected senior secondary schools** in Plateau State, **which sum up to a total of 60 students. The students consist only of male and female gender, with an average age of 12-19 years. T**his population was chosen because the researcher believes that small population size will propagate easy collection of data.

The sample will be chosen from SS2 physics class. The sample size (sixty (60) students) comprised respectively of eighteen males and twelve females selected from Agape Baptist high school, and twenty females and ten males from Aim Academy Faringada. The study sample was further divided into two: the experimental and control groups, each consisting of thirty students.

3.2 Validity and Reliability of Instrument

3.2.1 Validity

Validity is referred to the exactness and precision of deductions based on the research findings [9]. The validation of the instruments was undertaken to check the correctness of the data collection instruments, pre-testing of study instruments, before the actual study support criterion, and construction validation of the tools. Comments were made on clarity, language, applicability and significance of the items, format structure, and content of the research instrument to consider it acceptable. Suggestions were made on adding and rewarding questions established by Education Technology experts, and from the research measurement and evaluation unit of the University of Jos, Plateau State.

3.2.2 Reliability

The physics achievement test (PAT) is subject to trial testing. The pilot testing was carried out in GSS Naraguta and the obtained pretest scores were used to calculate the reliability of the instrument. The school is dismissed from the schools to be sampled for the study of the population. The trial testing is achieved by administering 20 copies of the PAT to the students, and the data obtained from their responses are used to estimate the reliability of the instrument. The reliability of the PAT was determined using the Cronbach Alpha method. It respectively revealed the level to which questions and statements in PAT are consistent in their measurement of students' performance, and their attitude towards physics when taught the concepts of Measurement. The average common internal consistency of the PAT was found to be 0.74 and 0.85 respectively. According to[3], these reliability estimates are reliable for research purposes

4. Results and Discussion

The research questions were answered using mean and standard deviations while Analysis of Covariance (T-test) was applied to test the hypotheses. All the hypotheses were tested at the P <0.05 level of significance.

4.1 Results

4.1.1 Population Size and Sampling

Table 1

S/N	Name of School	Population	Sample
1.	Agape Baptist High School	Student	30
2.	GSS Naraguta	Student	30
•	**Total**		**60**

4.1.2. Research Question I: What are the effects of instructional materials on physics students' attitude?

Table 2 Likert's Four-point Rating Scale of Student Attitude Towards Instructional Material

S/N	Items	SA	A	D	SD	Total	Mean
1	I feel confident when taught in physic using any instructional material	18 72	08 24	04 12	- -	30	3.6
2	I always get comfortable in physic class when taught with instructional material	15 60	09 36	02 04	04 04	30 104	3.46
3	I understand some	16	10	04	-	30	3.4

	concept better when taught using instructional material	64	30	08	-	102	
4	I don't get bored in physic lesson when taught with instructional materials	13 52	12 36	03 06	02 02	30 96	3.4
5	Instructional materials makes me to understand physics classes better	15 60	10 30	04 08	- -	30 98	3.26
6	I perform well in physics class because of instructional materials	20 80	10 30	04 08	-	30 108	3.6
7	Instructional material gives me a clear picture of some concept in physics	12 40	8 24	04 08	06 06	30 98	3.26
8	I want to be taught every concept of physics with instructional material	18 72	08 24	02 04	- -	30 100	3.33
9	Using of instructional material during physics class makes me want to study physics in higher level of education	12 60	11 33	03 06	04 04	30 103	3.43
10	I enjoy physics class when taught with instructional material	17 68	12 36	01 02	- -	30 106	3.6
11	I pay more attention when taught using instructional aids materials	15 60	09 27	05 10	01 01	30 98	3.26
12	Learning physics is simple with instructional materials	20 80	09 27	01 02	-	30 109	3.63
13	I prefer been taught using instructional material than an oral lesson method	12 48	09 27	01 02	-	30 99	3.3
14	I put more interest when taught some certain concept using instructional material	14 56	12 36	04 08	- -	30 100	3.33
15	I learn faster in physics class whenever my teacher uses instructional materials	14 56	11 33	05 10	- -	30 99	3.3
16	With instructional materials physics is the best subject	13 52	10 30	05 10	02 02	30 94	3.13
17	I easily understood physics whenever my teacher uses instructional materials	15 60	10 30	03 06	02 02	30 98	3.26
18	My physics teacher should always teach with instructional materials because it is interesting	14 56	12 36	04 08	- -	30 100	3.33
19	Learning physics with instructional materials gives me clear understanding of the abstract concept in physics	18 72	11 33	01 02	- -	30 107	3.56
20	Use of instructional materials by my physics teacher gives me pleasure in studying the subject	13 53	12 36	04 08	01 01	30 97	3.23
	Aggregate mean						**3.37**

Table 2 depicts all the 20 items used in finding out the attitude towards the use of instructional material in physics education, using the four likers scale and with an aggregate mean of 3.37. Based on the items above and the response gotten from the students, it thereby means that, instructional material has a huge positive impact in motivating students in physics class.

Hypothesis One: There is no significant comparison of the physics mean achievement scores of students taught using instructional material with those taught without using instructional material.

4.1.3 Research Question II: What are the effects of instructional materials on physics students' attitude?

Table 3 Frequency and the Percentage Scores on Level of Achievement of Students' in Physics Experimental Group

Raw Score	Level	N	Percentage (%)
70-100	High Achievement	21	70
50-69	Average Achievement	06	20
00-49	Low Achievement	03	10
	Total	**30**	**100**

Table 4 Control Group

Raw Score	Level	N	Percentage (%)
70-100	High Achievement	06	20
50-69	Average Achievement	09	30
00-49	Low Achievement	15	50
•	**Total**	**30**	**100**

4. 1.4 Research Question III: To what extent does the instructional material have an effect on gender achievement in physics?

Note: N= number of student, SD_1 =standard deviation for pre-test, SD_2 =standard deviation for post-test, $\overline{X}$= mean and df = difference.

Mean ($\overline{X}$) and Standard Deviation (SD) Scores of Male and Female Students' Achievement in Physics

Table 5

Gender	N	Mean	S.D
Male	18	67.78	12.12
Female	12	59.58	10.19
Mean difference		**8.20**	

The analysis in Table 5 shows that all the 20 items use in finding out the attitude towards the instructional material in physics, using the four Likert scale and with an aggregate mean of 8.20. Based on the items above and the respond gotten from the students it therefore means that instructional material has a great positive impact in motivating the students in physics class.

Table 6 T-test of Significant Difference of Mean Scores for Students Taught with Instructional Materials and those Taught Without Instructional Material

Groups	N	Mean	S.D	Df	t-cal	t-tab	P	Decision
Experimental	30	69.75	15.00	58.00	3.79	2.00	0.05	Reject H_0
Control	30	49.75	18.17					
Mean difference		**20.00**						

The analysis in Table 6 shows that there is significant mean difference in physics achievement score between the experimental and control group at 0.05 level of significance; since the T-test result for the calculated T-value of 3.79 is greater than the Table value of 2.00, and their mean difference was 20. This means, the null hypothesis which states that there are no significant differences between the achievements mean score of students taught with instructional material and those taught without instructional material is rejected and its alternative accepted. Thus, it implies that physics students taught with instructional materials performs better than those taught with no instructional materials.

Hypothesis Two: There is no significant difference between the post-test mean achievement scores of male and female students who were taught using instructional material.

Table 7 T-test of Significant Difference in Mean Scores of Male and Female Student's Performance in Physics

Gender	N	Mean	S.D	Df	t-cal	t-tab	P	Decision
Male	18	67.78	12.12	58.00	3.79	2.00	0.05	Reject H_0
Female	12	59.58	10.19					
Mean difference		**8.22**						

The analysis in Table 7 shows a significant mean difference in physics achievement score between male and female students at 0.05 level of significance; given that the T- test result for the calculated T-value of 3.79 is greater than the Table value of 2.00 and their mean difference was observed to be 8.22. This means, the null hypothesis which states that there is no significance difference between the mean achievement scores of male and female students in physics is rejected and its alternative accepted. This indicates that, there is comparable difference between the mean of male and female students' achievement in physics.

4.2 Discussion

The study embarks on determining the effect of instructional materials on physics students' attitude, and on their academic performance in senior secondary school II (SS2) in Plateau State. The result show significant and sizable difference in physics achievement score between students taught with instructional material and those taught without instructional material at 0.05 level of significance, since the T- test result for the calculated T-value of 3.79 is greater than the Table value of 2.00 and their mean difference was observed to be 20. This means the null hypothesis, which states that there are no significant differences between the achievements mean score of students taught with instructional material and those taught without instructional material is rejected and it alternative accepted. This show that physics students taught with the aid of instructional materials achieve better than those taught without instructional materials. It therefore implies that the use of instructional material has a positive effect in understanding the concept of measurement of weight. The use of instructional material in teaching and learning of physics influences the affective, cognitive, and psychomotor achievement of physics students when evaluating or using instructional material. This finding is in accordance with the discovery made by [12], who indicated that there is significant difference between the physics achievement scores of students taught with instructional materials and those taught without instructional materials with those in the experimental group achieving higher than those in the control group.

Last of all, our research also set out, to find the extent in which gender affects the mean achievement scores of physics students in the classroom setting. The findings revealed that there is difference between the mean achievement scores of male and female students, since the T-test result for the calculated T-value of 2.83 is greater than the Table value of 2.00 and their mean difference was observed to be 8.22. This means the null hypothesis which states that there is no significance difference between the mean achievement scores of male and female students in physics was rejected and its alternative was thereby accepted. Hence, there is significant interaction-effect of gender on students' performance in physics which was in favour of male students on how their achievements in physics surpass that of their counterpart. This finding is in agreement with the finding made by [7], which propose that science, technology and their related disciplines are male reserved, while Art and Humanities are female reserved. This belief tends to foster a natural positive attitude in boys, and incline them towards science and technical subjects, while girls show more leaning to Art and Humanities. [2], also found that male students were academically exceptional that their female counterpart. But the finding is in disagreement with the discovery made by

[14], who opined that feminine students perform better in classroom instructional activities than the opposite gendered; and in addition, the works of [1], in their comparison, emphasizes no significant difference between the performance of boys and girls, but was rather observed that, boys perform better than girls if a female teacher directed the instructional activities and vice-versa.

5. Conclusion and Future Scope

From the findings, it could be concluded that the use of instructional materials in teaching physics positively affects students' rapid grasping and understanding of the concepts of measurement, and the experimental group performed better than those in the control group. It is however pertinent to note that, the use of instructional materials is essential in developing physics ideas, and enhances the retention of acquired knowledge. The findings indicated that instructional material influences the affective, cognitive, and psychomotor performance of physics students. It helps to make learning and teaching of physics effective and fun-filled, by providing the students of physics a firsthand experience through participation. It could also be concluded that instructional materials motivate physics students in physics class and serve as a driving force in their excellent academic achievement and performance, and it can be predicted from our deductions that learners can be able to undertake their learning acquisition by themselves with adequate and proper usage of instructional materials. Last, of all, the result shows a significant difference in the educational performance of male and female students in physics.

Recommendations

Because of the research, the following suggestions were formulated:

1. Educational administrators and policymakers, teachers, and students should confer and incline connectively, to the use of instructional materials in the learning/teaching process of physics in senior secondary schools, appreciate, be aware, and be conscious of the enormous benefits associated with it.
2. Government and Ministries of education, together with educational agencies including those in the private educational sector should ensure the provision of instructional materials in secondary schools to enhance effective teaching and learning, and designate it compulsory in the curriculum.
3. Enough time should be allocated for physics lessons in schools to effectuate the efficient use of instructional materials in teaching physics.
4. Seminars and workshops on the application and usage of instructional materials should be organized for physics teachers to enhance and update their skills and knowledge to improve in the classroom.
5. Teachers and students should be encouraged into improvising instructional materials to make up for the shortfall in supply.
6. The government through the Ministry of Education should make available adequate qualified teachers, equip physics laboratories, secure these facilities, and ensure regular supervision of schools using these instructional materials. There is a need for competent physics teachers to handle instructional materials and the use of adequate laboratories in relating abstract ideas and theoretical approaches to practical views.

Suggestions for Further Study

Based on stringent factors that might have affected the findings of the study, the following research should be replicated in other regions for correlation of results and otherwise.

1. Effect of instructional materials on physics students' attitude and retention on the academic performance in some senior secondary schools.
2. The effects of using improvised or standardized instructional material in learning and teaching physics.
3. The use of a large class in administering instructional material in both Junior and Senior Secondary Schools.

Data Availability

Due to the want of space, the sources of the data used in carrying out this research from which conclusions are drawn is not available here but will be made available to any reader upon request via the corresponding authors email address.

The generalizations made with respect to this study are however subject to the following limitations:

1. In the process of the study, the researcher finds out that some of the secondary schools in Jos North Local Government Area of Plateau State lack adequate laboratory equipment which made it difficult for the researcher to teach the experimental group. The availability of laboratory equipment is very poor compared with the physics students' population in the schools, because students have to touch and feel this instructional materials in order to make learning more concrete, easier, clearer, more realistic and dynamic.
2. Since the same teacher was used for different groups, it could be assumed that he might not have been of equal attributes in terms of method, cognition, personality and affective functioning.
3. There was also the problem of absenteeism among the students. The fact that some students skipped classes may have influenced their performance.

Conflict of Interest

During the process of carrying out this research conflict of interest was not encountered by the researchers.

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Authors Contribution

Author-1 reviewed related literature and came up with the study, carrying out protocol development and acquiring ethical approval. Author-2 recruited the patient, carried out the data analysis and drafted the first manuscript. The manuscript was reviewed and edited by all the authors after whom they all approved the final version of the manuscript.

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