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IMPACT OF NATURAL AND ARTIFICIAL INSTRUCTIONAL MATERIALS ON STUDENTS JUNIOR SECONDARY SCHOOL STUDENTS' ACHIEVEMENT IN BASIC SCIENCE AND TECHNOLOGY IN NORTH CENTRAL NIGERIA

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ABSTRACT

The study investigated the impact of natural and artificial instructional materials on junior secondary school students achievement in Basic Science and Technology in Plateau State, Nigeria. The research involved pre-test, post-test, non-equivalent, control group design, utilizing intact classes from four randomly selected schools. All the 208 JSS Basic Science and Technology students in the sample schools participated out of a population of 2,273 students in Bokkos, North Central Nigeria. Experimental and control groups were assigned to two schools each by the researcher using simple balloting technique. Three research questions and three hypotheses guided the study. The instrument for data collection was Basic Science and Technology Achievement Test (BSTAT). The instrument was validated by two experts in science education and test and measurement evaluation. The reliability of the instrument was established using cronbach alpha method and 0.81 was obtained Mean and standard deviation were used to answer the research question, while ANCOVA was employed for testing the hypotheses at 0.05 level of significance. The result revealed that students taught with natural and artificial instructional materials strategy outperformed those without. Gender did not significantly affect achievement in Basic Science and Technology. Based on the findings of the study, it was recommended among others that basic science and technology teachers should utilize natural and artificial instructional strategy in teaching which in turn enhance students' achievement in the subject.

Keywords: Achievement, Basic Science and Technology, Gender, Natural and Artificial Instructional Materials.

INTRODUCTION

Science and technology has become useful tool in national development. This is because it is applied on everyday living and in various disciplines. Science education as an instrument has become very obvious to be taught at all levels of education. Within the Nigerian education system, Basic Science and Technology is a prominent science subject taught at the Junior secondary school level. Renowned for its challenging nature, Basic Science and Technology has consistently been identified as one of the most difficult subjects in the school curriculum (Bello and Zakariyya 2018). Numerous studies, including those by Owoyemi (2018), Adegoke (2013), and Abdul-Raheem (2012), have consistently highlighted the persistent and widespread poor achievement of Nigerian students in secondary school Basic Science and Technology. Basic science and technology is a practically-based and teacher require instructional materials to make the teaching and learning

practically relevant. This has not been fruitful. For example Jimoh, (2017) revealed that the achievements of students in science subjects has not been impressive. This was attributed to poor instructional strategy.

Various factors contribute to poor achievement in Basic Science and Technology, including students' attitudes, teaching methods, teacher motivation, insufficient primary school science background, and the crucial role of natural and artificial instructional materials (Dawal,2023) The lack of these resources is considered a significant factor, as mastery of Basic Science and Technology concepts may be hindered without their use. Teaching Basic Science and Technology without proper instructional materials is likely to lead to subpar academic achievement, as emphasized by Onasanya and Omosewa (2011). These researchers highlighted that even professionally qualified science teachers, no matter how well-trained, face challenges in translating their expertise into effective teaching without access to adequate equipment and instructional materials.

Teaching Basic Science and Technology, being resource-intensive, poses challenges in obtaining sufficient natural and artificial materials for schools. These resources, as described by Bala (2018), encompassed both natural and artificial aids employed by teachers to facilitate learning in the classroom. They can be purchased, created by teachers, or even gathered with students' assistance. In the realm of Junior secondary school science education, natural and artificial instructional materials play a crucial role, serving as vital inputs. Thoughtfully planned resources not only combat disinterest and supplement book limitations but also engage students practically, fostering independent thinking and sourcing achievement (Owoyemi, 2018). The involvement of multiple senses and the teaching and learning process enhances learner participation. Proficiency in Basic Science and Technology is essential for teachers to effectively utilize natural and artificial instructional materials and assist students facing challenges in studying Basic Science and Technology. The current concern revolves around the potential impact of adequate instructional materials that would enhance students' achievement in Basic Science and Technology.

Another unresolved issue in basic science and technology education is that of gender. The concept of gender referred to the state of being male or female with respect to the socially-constructed roles and relationship. Gender issues and gender disparities have become educational concern globally Nfon, (2013). In teaching basic science and technology, every student should be taken into cognizance whether male or female.

Purpose of the Study

The purpose of the study was to determine the effect of natural and artificial instructional materials on students' achievement in Basic Science and Technology.

Specifically this study sought to determine the following

1. Effect of natural and artificial instructional material on students' achievement in Basic Science and Technology.
2. Effect of gender on the use of natural and artificial instructional materials on male and female students' achievement in Basic Science and Technology.
3. Interaction effect of natural and artificial instructional materials and gender on students' achievement in Basic Science and Technology.

The study was conducted with JSS II Classes. The study covered the following topics in Basic Science and Technology: Simple machines, forces, power and thermal energy. These topics are always difficult to be taught by teaches

Research Questions

The following research questions guided the study:

1. What is the effect of natural and artificial instructional materials on students' mean achievement scores in Basic Science and Technology?
2. What is the effect of natural and artificial instructional materials on male and female students' mean achievement school in Basic Science and Technology?
3. What is the interaction effect of natural and artificial instructional materials and gender on students' mean achievement in Basic Science and Technology?

Hypotheses

The following null hypotheses were tested at 0.05% confidence level:

1. There is no significant difference in the mean achievement scores of students taught basic science and technology with natural and artificial instructional materials and those taught without natural and artificial instructional materials.
2. There is no significant difference in mean achievement scores of male and female student taught basic science and technology using natural and artificial instructional materials.
3. There is no significant interaction effect between natural and artificial instructional materials and gender on students' mean achievement scores in Basic Science and Technology.

Method

This study employed a quasi-experimental design involving pre-test, post-test, non-equivalent control groups, utilizing intact classes due to the impracticality of randomizing subjects within the study period. A sample of 208 students' were drawn from four secondary schools out of population of 2,273 students in Bokkos, Plateau State, Nigeria, selected through simple random sampling. All JSS 3 Basic Science and Technology students in the selected schools participated. Experimental and control groups were assigned to two schools each, determined by simple balloting to avoid disruption. Randomization of subjects was avoided to maintain school organization during the study.

The data collection instrument utilized in this study was the Basic Science and Technology Achievement Test (BSTAT), developed and validated by the researcher with input from two measurement and evaluation lecturers and two Basic Science and Technology experts at the University of Jos. Basic Science and Technology teachers from the selected schools, trained by the researcher served as research assistants. The instrument, comprising 50 multiple-choice items, underwent face and content validation, resulting in a reliability coefficient of 0.87 using cronbach alpha method. The experiment began with the administration of the BSTAT as a pre-test to both experimental and control groups. The control group received instruction using a natural and artificial instructional material, while the control group was taught the same topics without the instructional materials. The concepts thought were work, energy and power, kinetic theory and heat flow. The study spanned two months, concluding with the administration of the post-test by the researcher with the help of research assistants. Mean and standard deviation were employed to address research questions, while ANCOVA was utilized to test the null hypotheses at a significance level of 0.05.

Results

Research Question 1

What is the effect of Natural and artificial instructional materials on students' mean achievement scores in Basic Science and Technology?

Table 1: Adjusted Mean and Standard Deviation and Achievement Scores of Students Taught Basic Science and Technology using natural and artificial material and those Taught without Educational material

Groups	N	Mean (X)	SD	Mean Dif
Experimental	104	44.10	2.70	31.97
Control	104	12.13	3.22	

The result in Table 1 indicates that students taught with natural and artificial materials had a mean score of 44.10 with a standard deviation of 2.70, whereas those taught without Educational material had a mean score of 12.13 with a standard deviation of 3.22. The higher mean scores for students taught with natural and artificial indicated materials suggest that utilizing natural and artificial materials enhance students' achievement in Basic Science and Technology compared to teaching without such materials.

Research Question 2

What is the effect of natural and artificial instructional materials on male and female students' mean achievement scores in Basic Science and Technology?

Table 2: Mean Achievement Scores of Male and Female students Taught Basic Science and Technology with Natural and artificial instructional materials

Gender	N	Mean (X)	SD	Mean Dif.
Male	62	44.91	3.7	1.36
Female	42	43.55	2.25	

As indicated in Table 2, male students taught Basic Science and Technology with natural and artificial instructional materials achieved a mean score of 44.91 with a standard deviation of 3.7, while female students had a mean achievement scores of 43.55 with a standard deviation of 2.25. The difference is minimal, highlighting a slight variation between the mean achievement scores of male and female students.

Research Question 3

What is the interaction effect of natural and artificial instructional material and gender on the students" mean achievement scores in Basic Science and Technology?

Table 3: Mean and Standard Deviation on Interaction Effect of Treatment and Gender of Students

Variables		Mean (X)	Standard Deviation
With instructional abstracts	**Males**	**44.91**	**3.7**
	Females	**43.55**	**2.25**
Without Educational material	**Male**	**14.85**	**1.87**
	Female	**10.65**	**2.81**

Table 3 illustrates the interaction effect of natural and artificial instructional materials and gender on students' achievement. Male students, when taught with instructional materials, achieved a mean score of 44.91 with a standard deviation of 3.7, while female students achieved a mean score of 43.55 with a standard deviation of 2.25. In the control group, male students achieved a mean score of 14.85 with a standard deviation of 1.87 while female students achieved a mean score of 10.65 with a standard deviation of 2.81. The results indicate marginal differences in achievement in Basic Science and Technology.

Hypothesis One

There is no significant difference in the mean achievement scores of JSS Three students taught Basic Science and Technology not Natural and artificial instructional materials and those taught without Natural and artificial instructional materials.

Table 4: ANCOVA Result Based on Treatment

Sources of Variation	Sum of Mean	Df	Mean square	F-cal	Sig. F	Decision square
Covariates	609.784	1	609.784	66.471	.000	
Pre-test	609.784	1	609.784	66.471	.000	
Main effect	16917.522	1	16917.522	1844.134	.000	
Treatment	16917.522	1	16917.522	1844.134	.000	Significant
Explained	17027.305	1	8763.653	955.302	.000	
Residual	614.638	67	9.174			
Total	18141.934	69	262.927			

Significant at p < 0.05

Table 5: Means Classification Analysis based on Treatment Grand Mean = 35.83.

S/N	Variable Category	Unadjusted Deviation	Eta	Adjusted for Independents Covariates	Beta
1	Natural and artificial instructional materials	**18.27**		**18.29**	
2	No instructional materials	**-13.70**	**.98**	**-13.72**	**.98**
3	Multiple RR				**.966**

4	Multiple R	**.983**

From Table,5 the grand mean is 35.83 for achievement. Those with instructional materials group have the adjusted mean score of 44.12 while those without instructional materials group has an adjusted mean 14.55. Based on the results, it could be seen that Natural and artificial instructional materials group has the higher adjusted score which implies that it is more effective.

Hypothesis Two

There is no significant mean difference in achievement scores of JSS 3 male and female students taught basic science and technology using Natural and artificial instructional materials.

Sources of Variation	Sum of Mean	Df	Mean square	F-cal	Sig. F
Covariates	609.784	1	609.784	2.349	.130
Pre-test	609.784	1	609.784	2.349	.130
Main effect	136.037	1	136.037	.524	.472
Treatment	136.037	1	136.037	.524	.472
Explained	745.821	1	372.910	1.436	.245
Residual	1739.6	1	239.644		
Total	1814.94	1	262.927		

* Significance at P < 0.05

In Table 6, the result obtained was not significant: hence hypothesis two was rejected. This means that at 0.05 level of significance, there was no significant difference in the achievement between males and females when taught with Natural and artificial instructional materials. It implies that it is better to use the Natural and artificial instructional materials in teaching both male and female students.

Hypothesis Three

There is no significant interaction effect between Natural and artificial instructional materials and gender on students mean achievement scores in Basic Science and Technology.

Table 7: ANCOVA Result on Interaction Between Treatment and Gender

Sources of Variation	Sum of Mean	Df	Mean square	F-cal	F- Critical Value
Covariates	609.784	1	609.784	95.421	.000
Pre-test	609.784	1	609.784	95.421	.000
Main effect	17078.709	1	8539.354	1336.270	.000
Treatment	16917.1522	1	16917.1522	2647.317	.000
Gender	161.187	1	161.187	25.223	.000
2-way interaction	38.072	1	38.072	5.958	.017
Treatment and Gender	38.072	1	38.072	5.958	.017
Explained	17726.564	4	4431.641	693.480	.00
Residual	415.379	65	6.390		

Total	1814.943	69	262.927

*Significant at $p < 0.05$

Table 7 shows that interaction between treatment and gender is not significant at 0.05 level of significance, thus implying that there was no significant interaction effect of treatment and gender on students' achievement in Basic Science and Technology when students were taught with natural and artificial instructional materials. The was not rejected; meaning that there was no significant effect of interaction between treatment and gender on students' achievement in Basic Science and Technology.

DISCUSSION OF RESULTS

The study's findings indicated a significant impact of treatment on students' achievement in Basic Science and Technology, revealing that those taught with Natural and artificial instructional materials achieved significantly higher in the Basic Science and Technology achievement test compared to those taught without Natural and artificial instructional materials. The use of Natural and artificial instructional materials is observed to assist teachers and enhance students' intellectual abilities, fostering creativity and making learning more tangible. This aligns with prior research by Oladejo, Olosunde, Ojebisi, and Isola (2011), who emphasized the functions of instructional materials in extending learners' experiences and complementing verbal explanations. The current results also supported Bala (2018) perspective advocating for the practical teaching of science subjects. Okoboli's study, as cited in Owoyemi (2018), on gender differences in academic achievement further supported the preference for using instructional materials, showing significant differences favouring their use among male and female students in Biology and Mathematics. Also, this study did not find a significant interaction effect between treatment and gender on students' achievement in Basic Science and Technology.

CONCLUSION

Based on the study's data analysis, it is concluded that natural and artificial instructional materials serves as effective tools for facilitating learning, enhancing students' achievement in Basic Science and Technology. The research highlighted that Basic Science and Technology students taught with natural and artificial instructional materials outperformed those taught without. Importantly, there was no gender bias observed in students' achievement in Basic Science and Technology at the Senior Secondary School level.

RECOMMENDATIONS

Recommendations stemming from the study included

1. Organizing regular conferences, seminars, and workshops for Basic Science and Technology teachers to expand their knowledge on natural and artificial instructional materials and its effective utilization.
2. Basic Science and Technology teachers are to be encouraged to adopt the use of natural and artificial instructional materials to teach various Basic Science and Technology concepts.
3. Government at all levels should prioritize the regular supply of instructional materials to schools for effective teaching.

REFERENCES

Bala, S.S. (2018). Gender effect on performance and retention in basic science through computer assisted instruction among secondary school students in Kano Metroplis. In A.S. Ifemuyiwa (Ed) stem and economic growth. 59th annual conference proceedings of the science teachers' Association of Nigeria (118-127) Abuja: STAN place.

Bello, A.S. & Zakariyya, A.A. (2018) Strengthening science, technology, engineering and mathematics (STEM) education through the effects of metacognitive teaching strategy on achievement in calculus. In A.S. Ifemuyiwa (Ed) stem and economic growth. 59th annual conference proceedings of science teachers' association of Nigeria (82-90). Abuja: STAN PLACE

Dawal, B.S. (2023). Building creative minds and hands in integrated science education students through participatory learning approach in University Jos. *International Journal of Research in Science, Technology and Mathematics Education,* 9(2), (117-125).

Illiya, G.B. (2017). Effects of metacognitive skills package on junior secondary two students achievement in basic science and technology in Pankshin, Plateau State Nigeria, and Unpublished M.Ed. Thesis, University of Jos

Oladejo, M. A., Olosunde, G. R., Ojebisi, A. O., & Isola, M. O. (2011). Instructional materials and students academic achievement in Basic Science and Technology: Some policy implications. European *Journal of Humanities and Social Sciences,* 2(1), 113-126.

Omosewo, E, O. & Anasanya, S. A. (2011). Effect of improvised and standard instructional materials on secondary school teachers' academic performance in Basic Science and Technology in Ilorin, Nigeria. Singapore *Journal of Scientific Research*, 1(1), 68-76.

Omosewo, E. O. (2014). Relevance of Basic Science and Technology education programme of Nigerian higher educational institutions to the teaching of senior secondary school Basic Science and Technology. Horin *Journal of Education*, 14(1).

Owoyemi, T.E. (2018). Effects of collaborative and competitive learning strategies on senior secondary students' academic achievement in environmental-related concepts in chemistry. *Journal of science teachers association of Nigeria*, 53, 54-67.