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Effect of Students Exposure to Satellite Observations on their Achievement in Space Science Physics Study in Public Secondary Schools in Nsukka Local Government Area

*[1]Ugwuanyi, S. E., [2,3]Mgbadike, C. D. and [4]Anie, N. O.

[1]Department of Science Education (Physics Option), University of Nigeria, Nsukka
[2]Department of Physics, School of Secondary Education Programme (Science Programmes), Federal College of Education (Special) Oyo.
[3]Department of Physics, Faculty of Physical Sciences, University of Nigeria, Nsukka.
[4]Physics Unit, Federal School of Surveying, Oyo, Oyo State

*Corresponding Author's Email: sabrophysics2@gmail.com

ABSTRACT
The pedagogy of physics needs to transform into a more experiential, holistic, integrated, inquiry-driven, discovery-oriented, and learner-centered approach. This method emphasizes enhancing the learning process through discussion, flexibility, and enjoyment, shifting the focus from traditional knowledge retention to the methodologies of knowledge acquisition. As a result, this transformation improves students' ability to apply knowledge to real-world challenges. In this context, space science observation emerges as a strong pedagogical alternative. It involves learning through active, firsthand engagement in significant experiences, often going beyond the confines of the classroom. Students often struggle to grasp abstract astronomical concepts due to a lack of direct sensory or experiential familiarity with phenomena such as the vastness of the universe or the dynamics of planetary motion. Therefore, space science education can seem disconnected from tangible reality, making assimilation difficult. Therefore, this research focused on effect of exposure to satellite observation on achievement in satellite studies among senior secondary school 3 physics in Nsukka Local Government Area. The study utilized a quasi-experimental research design sampling 4 secondary schools purposively in the area making up 2820 SSS3 students. One research question was posed and one null hypothesis was formulated at 0.05 level of Significance to guide the study. The researcher developed physics test on satellite topics in the SSS current physics curriculum with face and content validation. Reliability coefficient of o.85 was obtained using kuder-Richardson formular- 20. Data was analysed using mean and t-test. Pre-test and post-test results showed that physics students taught with space observation in their satellite study performed better than students taught without space observation using conventional teaching method and that gender had no influence in achievement of the students in the space science study.

Keywords:
Satellite,
Space observation.

INTRODUCTION

The significance of Physics in propelling the economic and technological progress of nations is profoundly evident, particularly within the realm of space science education where secondary school curricula involve both qualitative and quantitative approaches to satellite studies. However, as emphasized by Wenno (2015), the teaching and learning of this crucial subject encounter a myriad of challenges, especially at the secondary level. Physics is often perceived as intimidating, a perception that arises primarily from students' insufficient mathematical skills necessary for addressing physics-related inquiries (Widayanti et al, 2019; Ugwuanyi et al, 2025). Furthermore, Panou (2019) noted that students frequently neglect the qualitative dimensions when tackling satellite problems, overlooking essential insights that qualitative representations provide Dendup, Utha, &Pem (2021). Zangmo (2016) identified that students experience difficulties with substantial learning due to their inadequate understanding of fundamental concepts

within the discipline (Dendup et al., 2021; Subasi et al, 2015.). Investigating the viewpoints of both Physics students and educators regarding the perceived complexities of the subject reveals that teachers often believe students hold biases against physics, labeling it as overly difficult, while students commonly regard the subject as excessively abstract (Mushinzimana et al, 2016; Majid, 2018). These obstacles, along with ineffective instructional methods, likely contribute to the notable underachievement of students in physics at both secondary and tertiary levels (Marušić & Hadžibegović, 2018; Koirala et al, 2020). Evidence indicates that the proficiency of Nigerian students in ordinary level Physics is generally inadequate. As a result, it is crucial to adopt teaching methodologies that foster critical thinking, comprehension, and enhanced student engagement in the learning process (Gimba et al, 2018; Akhter et al, 2019). Such methodologies possess the potential to significantly support the intellectual development of physics students as they navigate complex subject matter (Yildrim, 2016). The quest for innovative methods and practices aimed at improving the skills essential for high-quality physics education has led to the development of various instructional approaches designed to strengthen students' problem-solving capabilities (Kulegel & Topsakal, 2020). Nevertheless, the current literature provides limited insights into the effectiveness of these approaches in mitigating the challenges encountered by physics students in the study of space science. Therefore, the necessity for innovation and reform within the education system to foster advancements in science and technology cannot be understated, as education plays a pivotal role in societal development (Taherdoost, 2019; Dorji et al, 2022). Updating curriculum methodologies will facilitate a shift in learners' focus, broadening their knowledge horizons and equipping students with contemporary information aligned with societal needs as time evolves (Orlanda-Ventayen & Ventayen, 2017). Highly skilled individuals with a deep understanding of science and technology are essential for boosting the economy in the 21st century! Nigeria, as one of the developing nations striving for growth, must embrace and adapt the latest technological advances to enhance its developmental processes (Adekoya et al, 2024). Equipping the youth with the knowledge and skills to effectively utilize satellite technology is vital. With the exciting vision of developing and launching its own satellite, there's no better time to integrate the concept of satellite development into the Nigerian curriculum. This will ensure students are informed, motivated, and ready to take on future careers in space and satellite development! The curriculum for senior secondary school has been expanded to include satellite development, covering fascinating topics like orbital mechanics, satellite launch procedures, satellite subsystems, the space environment, and space laws and regulations. While previous studies suggest that learning outcomes can vary based on context, there's a pressing need for more resources, such as equipment and observatories, to inspire students to pursue careers in space physics. This study is going to play a crucial role in assessing students' strengths and weaknesses in tackling satellite-related challenges. It will explore how satellite observation can significantly enhance students' achievements in Physics, particularly in their problem-solving skills related to satellite studies.

Statement of the Problem

Students achieve poorly in science related subjects including Physics in secondary school external examinations in Nigeria. This observation was confirmed by WAEC Chief Examiners report of 2019 to 2023, in addition to the uncertainty surrounding the understanding condition of satellite by Nigerian senior secondary school students 3. Senior secondary school 3(SSS3) serves as a final year in secondary education in Nigeria, and students were required to learn about satellite development without much exposure to the foundational concepts in the lower class. This situation led researchers to believe that SSS3 students might struggle with the material, potentially fostering negative attitudes towards the subject and lowering their motivation. Therefore, as an educator, it was deemed important to know if the understanding of the topic can be improved by satellite observation in a better form than using conventional teaching method. The insights gained from this study are intended to provide feedback for those involved in curriculum development and implementation.

Purpose of the Study

The study aimed to explore how satellite observation impacts students' achievements in space science Physics at public secondary schools in Nsukka Local Government Area. Specifically, the research focused on two main objectives: to assess the impact of exposure to satellite observation on students' academic performance in space science Physics compared to those taught using traditional methods, and to examine how satellite observation influences the achievements of both male and female students in space Physics.

Research Questions

The following research questions were posed to guide the study.

i. What are the mean achievement scores of students taught satellite concepts using satellite observation and those taught using the conventional method?
ii. What are the mean achievement scores of male and female physics students taught satellite concepts using space observation?

Hypotheses

The following null hypotheses were formulated at 0.05 level of significance.

There is no significant difference between the mean achievement scores of secondary school students taught satellite concepts using satellite observation and those taught using the conventional method as measured by their mean posttest scores.

There is no significant difference between the mean achievement scores of male and female students taught satellite concepts using satellite observation as measured by their mean posttest scores.

MATERIALS AND METHODS

The investigator designed an exciting study using a pre-test and post-test approach with a non-randomized, non-equivalent control group. One group utilized observation techniques while the other group practiced a traditional teaching method. Additionally, gender served as a moderating variable with two categories: male and female. The focus of the research was on the performance of Year 3 students in the satellite topic. Below, you'll find an outline of the research design.

Table 1: Research Design Outline

Group	Pre-test	Treatment	Post-test
Control	O_1	X_1	O_2
Experimental	O_1	X_2	O_2

Targeting SSIII physics students, we focused on year 3 learners from the Nsukka Local Government Area in Enugu State, Nigeria. The choice of SSIII students was perfect since the satellite topic is part of their curriculum. The researcher used multi-stage sampling methods, considering teaching resources and gender balance, to select two co-educational institutions. For this remarkable study, the researcher employed one primary research instrument: an achievement test. This test featured two sections, A and B. Section B contained 40 multiple-choice questions, while Section A gathered the respondents' bio-data. Each question had four options (A-D), with one being the correct answer. Both the pre-test and post-test included the same questions, albeit in different fonts and order, ensuring genuine data that accurately reflects the participants' real learning and changes in knowledge, free from memory effects. The researcher developed detailed lesson plans for both the control group and the experimental group, outlining how the satellite topic would be taught and delivered. In both groups, these plans guided the lesson delivery process. The experimental group utilized observation methods, while the control group relied on traditional teaching approaches, making the observation instrument specifically tailored for this purpose.

RESULTS AND DISCUSSION

This section presents the results and analysis of data. The presentation is based on the two research questions and two null hypotheses of the study.

Research Question 1: What are the mean achievement scores of students taught satellite concepts using satellite observation and those taught using conventional method?

Table 2: Mean Pretest and Posttest Achievement Scores of Students Taught using Satellite Observation and Conventional Method

Method	N	Pretest mean	Posttest mean	Gain inMean	SD pretest	SD Posttest
Satellite Observation	1410	31.79	76.89	45.10	11.55	11.69
Conventional Method	1410	31.81	54.43	22.62	12.39	10.01

Table 2 reveals some exciting findings. The group that learned about satellite concepts through satellite observation achieved an impressive mean score gain of 45.10, while those taught using traditional methods had a mean gain of only 22.62. This means that students who engaged with satellite concepts through observation experienced a significantly higher improvement in their scores compared to their peers who used the conventional approach. Plus, using satellite observation boosted the diversity of scores among the students, while the traditional method limited that variation.

Table 3: Mean Pretest and Posttest Achievement Scores of Male and Female Students Taught using Satellite observation

Method	Gender	N	Pretest mean	Posttest mean	Gain in mean	SD pretest	SD posttest
Satellite Observation	Male	1300	31.56	75.67	44.11	12.70	7.04
	Female	1520	32.00	76.20	44.20	10.55	13.80

Table 3 reveals that female students taught satellite concepts using the satellite observation method achieved an impressive mean gain score of 44.20, while their male counterparts recorded a score of 44.11. Interestingly, the use of satellite observation enhances the variability in scores among female students, whereas it reduces the variability for male students.

Hypothesis 1: The is no significant difference between the mean achievement scores of secondary school students taught satellite concepts using satellite observation and those taught using conventional method.

Table 4: Exciting Analysis of Covariance Revealing the Differences in Achievement Between Students Who Learned Satellite Concepts Through Satellite Observation and Those Who Used the Traditional Method

Source	SS	Df	Mean Square	F	P-value	Decision
Corrected Model	9643.763[a]	4	2410.941	24.032	.000	
Intercept	46343.196	1	46343.196	461.940	.000	
Pretest	910.721	1	910.721	9.078	.003	S
Gender	1096.850	1	1096.850	10.933	.07	NS
Method	6650.190	1	6650.190	66.288	.000	
Method * Gender	511.375	1	511.375	5.097	.025	S
Error	18158.473	2815	100.323			
Total	507720.000	2820				
Corrected Total	27802.237	2819				

Table 4 reveals these findings. At a significance level of 0.05, there is a significant main effect of the treatment on students' achievement scores, particularly in post-achievement results, with an impressive F(1,2819) = 66.288 and P-value of 0.000.

Hypothesis 2: This is looking into whether male and female students have similar mean achievement scores when learning about satellite concepts through satellite observation. Check out Table 4 for some exciting data related to hypothesis 2.

Table 4 illustrates an exciting finding at the 0.05 level of significance! There's a significant main effect of the treatment on the achievement scores of both male and female students regarding their post-achievement results, F (1,2819) = 10.933, P = 0.07, which is greater than 0.05. As a result, we do not reject the null hypothesis. This means that there isn't a significant difference between the mean achievement scores of male and female students who were taught satellite concepts using satellite observation.

Discussion

One of the primary objectives of this study was to evaluate whether instructional satellite observation leads to improved academic performance in space science compared to traditional teaching methods. The results indicated that students who were taught using instructional satellite observation achieved higher academic outcomes in space science than those who received conventional instruction. The mean score of students taught with satellite observations was greater than that of their peers taught by conventional means. This conclusion was further supported by data in Table 4, which demonstrated that the teaching approach significantly impacted the academic success of students learning space science. The null hypothesis, which stated there would be no statistically significant difference in the mean academic achievement scores of students taught with instructional satellite observation versus those taught using lecture methods, was rejected. Consequently, the findings suggest that the group using instructional satellite observation performed better than the group receiving traditional instruction. Previous research by Folade et al (2016) supports this finding, as it showed that instructional satellite observation enhances space science students' academic achievement more effectively than conventional methods. The observed difference may be attributed to the interactive qualities of satellite observation, which encourage active student engagement in the learning process. Additional studies conducted by Barlett et al., (2018); Panou et al. (2019); Dewitt &Bultitude (2020);, also support this conclusion. Marusic and Hadzibegovic (2017) found that instructional observation technique facilitate better learning outcomes for students, while Marusic and Hadzibegovic (2017); Kulegel and Topsakal (2020) reported a significant difference favoring the experimental group when taught with instructional satellite observational technique. Straub and Whalen (2014) noted a notable difference in the performance of students learning space science through instructional satellite observation compared to those taught through conventional methods, with the former group achieving greater results. It is noteworthy that the increased mean achievement in the experimental group reflects heightened interest among these students. Table 3 confirmed a statistically significant difference in the mean academic achievement scores of students taught through instructional satellite observation compared to their counterparts receiving traditional instruction. The performance of students taught with satellite observations was superior to that of those taught by

conventional methods. This outcome aligns with the research of Falode et al., (2016), who found that students showed improved performance when utilizing innovative instructional methods, such as satellite observation. In contrast, Dendup et al., (2021) reported that instructional satellite observation did not enhance student interest, though they acknowledged that it did improve academic performance.

Excitingly, this study uncovers a fascinating gender difference in academic achievement among students when comparing those taught with instructional satellite observation to those using traditional methods. The results show that male and female students differed significantly in their average score gains. Specifically, female students outperformed their male counterparts in Space science when they were taught with instructional satellite observation. Interestingly, while researchers have documented significant gender differences in science achievement across various educational systems, there remains conflicting evidence on this topic (Dewitt & Bultitude, 2020); Dare and Roehrig (2016). This contrasts with experimental research, which showed that, although female students excelled more in achievement in both experimental and control groups when learning Algebra, the differences in achievement were not significant. Furthermore, a study indicated that female students also exhibited higher levels of interest. In a different approach, Widayanti et al., (2019) examined how inquiry and laboratory teaching strategies in geometry affected achievement and interest in students and found no significant differences between male and female students' mean scores, which contrasts with the findings of this study.

CONCLUSION

The investigation into the effects of instructional satellite observation on students' achievement in space science reveals some exciting conclusions. The use of instructional satellite observation for teaching senior secondary school students proved to be far more effective than the traditional methods. This is clearly shown by the impressive results of the experimental group that utilized satellite observation, outperforming the control group that followed the conventional approach. Moreover, it's thrilling to note that gender played a significant role in student achievement. Female students who were taught using instructional satellite observation excelled beyond their male peers. The satellite observation technique not only boosted their achievement but also significantly increased their interest in the subject compared to the male students. Therefore, the following thrilling recommendations are shared:

i. We should absolutely incorporate instructional satellite observation into the physics curriculum at all public secondary schools. This approach will definitely spark students' enthusiasm for the subject.
ii. Since many current teachers aren't yet familiar with the amazing benefits of instructional satellite observation, it's crucial to organize conferences, seminars, and workshops through relevant professional bodies to help educate them on this innovative method.
iii. The ministry of education and other government organizations should play an active role in supporting these professional bodies by providing sufficient funding, ensuring that workshops and seminars turn into real action rather than just ideas on paper. It's essential for curriculum planners to embrace and highlight satellite observation as an exciting alternative to traditional lecture methods.

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