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Impact of Technology Enhanced Learning on Academic Performance of high School Students' in Physics in Anambra State, Nigeria

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Abstract: The study evaluated impact of technology enhanced learning on the academic performance of students in physics in Anambra State. The study guided by four research objectives employed a descriptive survey research design. Multistage sampling procedure was employed to obtain a sample of 200 senior secondary year two (SS2) students, from the 1586 physics SS2 students in Anambra State. A 20-item structured questionnaire, with 4-point Likert-like response options, developed by the researchers from literature review and years of teaching experience with ICT tools was employed to collect data. The instrument, validated by three curriculum experts, from Science Education, and Measurement and Evaluation Departments, all in Nnamdi Azikiwe University, Awka was subjected to pilot testing using Cronbach Alpha formula, a reliability co-efficient of 0.81 was obtained. Mean and Grand mean were employed in to answer the research objectives. The results obtained agreed that technology enhanced learning had significant impact on the academic performance of students in physics positively.

Keywords: Academic Performance, Physics, Technology Enhanced Learning (TEL)

1. Introduction

Science, a key for technological innovations in the 21st century, has been defined by Nwuba *et al* (2023) as the step-to-step study of nature acquired through the skills of observation, measurement and experimentation. Its importance to man cannot be overemphasized, which is probably why it is taught at the high school level as basic subjects such as mathematics, biology, chemistry, physics, geography and agriculture (Nwuba *et al.,* 2022). Physics a core science subject, taught in Nigerian secondary schools, has been identified as an essential tool for understanding how the universe works. Onuh & Okigbo (2020) defined physics as the study of the basic principles that govern the physical world around us. It is a branch of science concerned with the study of nature, properties of matter and energy (Anosike & Okigbo, 2020). As a subject, physics encompasses not only the behaviour of objects under the action of given forces but also the nature and origin of gravitational, electromagnetic, and nuclear force fields (Izuakor *et al.,* 2022). In the same vein, Erinosho (2013) opined that physics is a natural science aimed at describing the fundamental aspects of our universe as it explains the constituents of the universe, properties of these constituents, as well as the processes these constituents undergo.

As a subject taught in schools as well as one whose applications has made immense contributions to astronomy and other spheres of life, one can assert that the importance of physics cannot be overemphasized, as advances in physics often enable advances in new technologies. For example, Izuakor *et al* (2023) and Onuh & Okigbo (2020) in their respective studies in physics posited that advances in electromagnetism, solid state and nuclear physics has led to the development of new products, such as television, computers, domestic appliances, and nuclear weapons, which have drastically transformed modern-day society. The knowledge of physics attempts to help man understand the nature and structure of the universe through its various fields of acoustics, astronomy, astrophysics, atomic physics, biophysics, computation physics and cosmology (Nnaji & Okoli, 2019). Similarly, Ese *et al* (2019) noted that physics is an aspect of science whose immense contributions to many inventions, has sharpened the modern-day life and helped explain many of the phenomena being encountered in everyday life.

In spite of the importance of physics in technological development as well as the subject being a requirement for many specialized science and engineering courses in the universities, a large number of students still perform poorly in the subject in external examinations such as West African Secondary School certificate examinations (WASSCE) evidently shown by West African Examinations Council (WAEC) statistics from 2017-2022. Amuche *et al* (2014) and Ese *et al* (2019) reported that poor performance of students in physics examinations has been traced to a number of factors such as: shortage of physics textbooks in the library, inadequate laboratory facilities, insufficient time allocated for practical work, use of predominantly lecture method by physics teachers, use of too many technical terms or terminologies in physics lessons, poor motivation of teachers, poor funding, and poor attitude of students towards the study of physics. Similarly, Checkley (2010) stated that students view physics as predominantly 'difficult', 'abstract' and 'uninteresting' as a result of its interdisciplinary nature with other science subjects, such as biophysics and quantum chemistry, which makes it abstract and uninteresting.

To curtail this, Nwoye *et al* (2020) advocated for the use of innovative approaches in the learning of Physics, underlined in their principle of fostering in students' mastery of generic competencies including the ability to collaborate, creativity, communication, character education, literacy and critical thinking. Supporting the premise, Abdulkareem & Musa (2020) suggested that the physics curriculum should be designed using a student-centered learning approach that encourages students to engage actively, be independent and skilful in applying knowledge gained in educational domains. To this end, teachers as forebearers of progressive education, in the 21st century, are expected to create a favourable learning environment through application of ICT tools in the classroom to develop students' self-potential optimally.

Technology enhanced learning (TEL) refers to the application of any type of technology or ICT tools, such as laptops, tablets and virtual learning environments, in schools to promote learners' educational experience. It is the incorporation of Information, Communication, and Technology (ICT) tools as well as computer-based communication into daily classroom instructional process (Ghavifekr, & Rosdy, 2015). Technology-enhanced learning (TEL) simply entails using technologies to support learning whether local (i.e., on campus) or remote (at home or in the workplace). Hence, TEL is simply the application of variety of ICT tools such as animations, multimedia texts and other e-learning tools in the classroom to foster learning.

In modern 21st century classroom, the integration of TEL tools is important for many reasons, not just because it is the new normal expected in education today, but because it can also improve learning. Supporting the premise, Ghavifekr & Rosdy (2015) asserted that ICT integration in education is important, because with the help of technology, teaching and learning is not only happening in the school environment, but also can happen even if teachers and students are not physically present. A technology- based teaching and learning offers various interesting ways which includes educational videos, stimulation, storage of data, the usage of databases, mind-mapping, guided discovery, brainstorming, music, World Wide Web (www) that will make the learning process more fulfilling and meaningful (Finger & Trinidad, 2002). Similarly, Roy (2019) noted that technology facilitates active engagement with the learning material, making the learning process interactive, and students passionate about learning as it engages them and gives them feedback on what they are learning. Thus, with comfort and ease experienced, in the 21st century, with usage of smartphones, tablets, computers, and more, children today are expected to thrive when interacting with technology, which may likely influence their academic performance in schools.

Academic performance is the outcome of any academic setting. It is the achievement recorded in an academic process often measured through examinations or continuous assessments (Christian-Ike *at al.,* 2024). In education, academic performance helps the teachers to fill in the gap needed for them to buttress more on as, it informs the teacher what the students know and what they do not know. As the endpoint of any academic activity, academic performance of students is influenced by many factors including the quality of instruction, educational resources, students-related variables, home environment, and socio-economic factors (Christian-Ike *et al.,* 2024; Nwuba *et al.,* 2024). Considering the premise, Anzaku (2021) noted that educational systems and institutions like STEM (Science, Technology, Engineering and Mathematics) aims to promote and support students' academic performance by provision of effective teaching and appropriate learning materials, supportive learning environments, and opportunities for student's growth and development in physics. In this light, the study seeks to establish the Impact of technology enhanced learning on academic performance of high school students in physics in Anambra state.

To this end, the following research questions guided the study:

1. Does the usage of animations influence academic performance of students in physics?
2. Does the usage of multimedia text influence academic performance of students in physics?
3. Does the usage of E-learning tools influence academic performance of students' in physics?
4. What factors mitigate against the usage of technology enhanced learning tools in teaching physics in secondary schools?

2. Method

The study employed a descriptive survey research design. Population of the study comprised of 1586 senior secondary school year (SS2) students in physics in Anambra State. 200 SS2 physics students, obtained using multistage sampling procedure, was used as the study sample size. A 20-item questionnaire developed by the researchers, from years of experience in teaching with TEL tools, with a 4-point Likert-like response options of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) was employed to collect data from respondents. Face and Content validation of the questionnaire was established by three curriculum professionals: Two from Physics (Science) Education and one other from Educational Measurement and Evaluation. The reliability of the instrument established using Cronbach Alpha, was that of internal consistency. This was done using 25 students in Enugu State, Nigeria. The value of the reliability co-efficient obtained was 0.81 which showed that the questionnaire was reliable. Data from respondents were analysed using mean and grand mean. In taking decision on an item and a research question, 2.5 served as a baseline. Any item with a mean or grand mean score of 2.50 and above was agreed on while any with mean score below 2.50, was not agreed upon.

3. Results and Discussion

Table 1. Students responses on the usage of animations on their academic performance in physics

S/N	ITEMS	Mean	Remark
1.	Animations make abstract physics concepts concrete	2.67	Agreed
2.	Cartoons make me understand Physics better	3.04	Agreed
3.	With animations, I pay attention during physics classes and actively participate in the lessons	2.99	Agreed
4.	Using animation during classes, makes me interested in physics.	2.80	Agreed
5.	Animations makes the class passive and at the end, I don't learn anything.	2.17	Disagreed
	Grand Mean	**2.73**	**Agreed**

From table 1, the respondents all agreed with the items except item 5. A grand mean of 2.73 obtained lies in the agreed category, showing that the use of animations influences student's academic performance in physics. The data in Table 1 reveals that the use of animations influenced student's academic achievement in physics. The findings concur with that of Ikeanumba & Adigwe (2019), Nwoye *et al* (2020) and Onuh & Okigbo, 2020 who reported, in their respective studies, that the use of animation in teaching improves skill and knowledge by presenting abstract concepts through visuals to provide learners a clear picture of the lesson.

Table 2. Students responses on the usage of multimedia on their academic performance in physics

S/N	ITEMS	Mean	Remark
1.	Power-point slides makes it easier to understand certain topics being explained by teachers	3.11	Agreed
2.	My school encourages the use of Educational TV shows	2.02	Disagreed
3.	Charts on some certain topics in physics help me understand the concepts better	3.07	Agreed
4.	Visual models help in explaining some theories in physics	3.04	Agreed
5.	Physics should not be taught using charts because it does not show the whole picture of the concepts to be learnt	1.98	Disagreed
	Grand Mean	**2.64**	**Agreed**

From table 2, the respondents agreed that Power-point slides makes it easier to understand certain topics in topics, Charts on some certain topics in physics help them understand the concepts better and Visual models help in explaining some theories in physics. The respondents however disagreed with the other two items. The table had a grand mean of 2.64 which is in the agreed category, revealing that the use of multimedia text influences student's academic performance in Physics. The data in Table 2 reveals that the use of multimedia text influenced student's academic achievement in physics. The findings are in line with Sweller (1989) and Primamukti & Farozin (2018), who found that students taught with multimedia tools showed improved knowledge, and comprehension skills in learning

Table 3. Students responses on the usage of E-learning tools on their academic performance in physics

S/N	ITEMS	Mean	Remark
1.	E-learning encourages interaction between teacher and student through social media panels	3.31	Agreed
2.	With E-Learning, I can be taught anywhere in the world	3.72	Agreed
3.	E-learning tools allow me to build quality study habits	3.19	Agreed
4.	E-learning tools encourage me to learn independently	3.57	Agreed
5.	E-learning tools allows easy access to learning resources like YouTube, Udemy, Coursera, etc	3.54	Agreed
	Grand Mean	**3.47**	**Agreed**

Date from table 3 revealed that the respondents all agreed with the items in the research questions, with a grand mean of 3.47 which is in the agreed category. The table shows that the use of E-learning tools encourage teacher and student interaction, improves study habits and influence the students' academic performance

The data in Table 3 reveals that the use of E-learning tools influenced student's academic achievement in physics. The respondents (students) concurred that use of E-learning tools (online learning platforms) such as Google Classrooms, Youtube, Udemy, Coursera, etc enhanced their understanding and retention of physics concepts as these platforms not only encourage interaction between teacher and students without physical interaction, but also encourages one to learn independently, build quality study habits as well as learn from anywhere in the world. These findings align with that of Ghavifekr & Rosdy (2015), Raja & Nagasubraman (2018) & Roy (2019) who reported, in their respective studies that E-learning tools positively influence students' learning outcomes.

Table 4. What factors mitigate against the use of technology enhanced learning tools in teaching physics in schools?

S/N	ITEMS	Mean	Remark
1.	My teacher does not use any of the technology because he/she does not have the knowledge of them	2.54	Agreed
2.	Lack of resources for teaching	3.23	Agreed
3.	There is unstable electricity in my school	3.40	Agreed
4.	Adequate time is not allotted for application for E-Learning tools during classes	3.23	Agreed
5.	My parents do not understand the importance of ICT tools in learning physics	3.54	Agreed
	Grand Mean	**2.98**	**Agreed**

Table 4 showed that the respondents all agreed with the items except for item 5. The table revealed a grand mean of 2.98 showing that factors ranging from lack of ICT tools, content knowledge of ICT tools, unavailability of electricity and time allotment to usage of ICT tools should be addressed by government and school managements to facilitate the use of TEL tools in the classroom.

Data in Table 4 revealed that unavailability of E-learning resources for teaching, insufficient time allotted for application for E-Learning tools during classes, unstable electricity supply in most schools and lack of technological know-how by teachers are factors that mitigate against the use of technology enhanced learning tools in teaching physics in secondary schools. The findings are in alignment with Ghavifekr & Rosdy (2018) and Raja and Nagasubraman (2018) who reported that time, lack of resources, availability of ICT resources, and technology knowhow are the key factors mitigating against application of TEL tools in the classroom.

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5. Conclusion

Although the outbreak of the COVID-19 pandemic wrecked activities, including education, all over the world, causing a lot of deaths and loss of livelihood, it also brought about the rapid interest in technology enhanced learning in efforts to facilitate the learning process throughout the globe. The study, in this light, investigated the impact of TEL on academic performance of students in physics. The findings of the study established that the use of animation, multi-media texts and E-learning tools significantly influenced the academic performance of students in physics as they make the concept of physics presented in such a way that fosters rapid assimilation. The study also revealed among others that factors such as lack of ICT tools, content knowledge of ICT tools, unavailability of electricity and time allotment to usage of ICT mitigate against the use of Technology enhanced learning tools in physics classes.

In line with the findings, it was recommended among others that:

1 Adequate ICT equipment for the propagation of Technology Enhanced Learning in physics classes should be provided by education stakeholders.

2 Principals and teachers of schools should sensitize people on the positive impact of technology enhanced learning in the teaching and learning process of physics.

3 Education stakeholders should furnish schools with amenities like laptops, desktops, generators, whiteboards, and adequate power supply to foster usage of technology in physics class.

6. Limitations and Further Research

The major limitations of the study are outlined as follows:

1 Only one level of students (SS2 physics students) was used to conduct the study

2 Only government owned secondary schools, in the state, were used in the study, limiting the generalization of the study.

Considering the limitations, suggestions for further studies were made as follows:

1. Research should be done on influence of usage of Artificial Intelligence in Physics in Anambra state. This would really be beneficial as Artificial Intelligence is rapidly taking over every sector of our economy.
2. Perceived impact on other methods of learning would also be of high importance as this would enable other researchers evaluate other methods of teaching and learning of physics.

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Does this article screen for similarity?

Yes

Conflict of Interest

The authors have no conflicts of interest to declare. There is also no financial interest to report. The author certifies that the submission is original work and is not under review at any other publication.

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