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ASSESSMENT OF DIGITAL LEARNING TOOLS ON SENIOR SECONDARY II PHYSICS STUDENTS' ACHIEVEMENT IN GWAGWALADA COUNCIL AREA, FEDERAL CAPITAL TERRITORY, ABUJA, NIGERIA.

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Abstract

The study examined the effect of digital learning tools on the reflection and refraction of light waves as a teaching and learning delivery method, and students' achievement in the Gwagwalada Council Area of the Federal Capital Territory, Abuja, Nigeria. Two hypotheses were formulated and tested at a 0.05 significance level. A quasi-experimental design was used for the study. All public schools in the Gwagwalada Council Area, with sample of 104 Senior Secondary School Two (SSS 2) Physics Students, were enlisted. The Light Achievement Test (LAT), a 15-item multiple-choice test on the reflection and refraction of light waves, and the 15-item Digital Learning Tools Attitudinal Questionnaire (DLTAQ) were the research instruments used for data collection. Frequency count and percentages were used to analyse the respondents' biodata, while the two hypotheses were tested using a t-test at a 0.05% level of significance. Findings from the study, among others, revealed a significant difference in the post-test achievement scores of students taught reflection and refraction of light waves using digital learning tools compared to those taught using a conventional strategy. It was concluded that a properly equipped digital learning laboratory and qualified digital literacy physics teachers with adequate digital operating skills for effective physics lesson delivery have a significantly negative influence on students' understanding of light concepts and digital skills acquisition. Based on the findings of the study, it was recommended among others that digital learning software's such as (Amination, illustrator. Graphics) as well as DLT(s) resources such as well-equipped digital laboratories with power sources be made available in all public senior secondary schools in the FCT, Abuja, for effective physics delivery that will in turn enhanced better and higher students' achievement.

Keywords: *Digital learning tools, Animations in physics, graphics,* Students' achievement in the Gwagwalada council area

Introduction

The achievement of physics students in the field of study is becoming worrisome, especially in one of the branches of physics known as optics. Optics is generally the study

of light rays. Due to its abstract nature, most students find it difficult to comprehend, which leads to low achievement on end-of-term examinations in most public schools in the study area. This poor or low achievement could be a result of inadequate or a lack of trained, qualified physics teachers in the subject area, as well as digital learning tools, e-learning platforms, and power supply issues, which could help improve physics students' achievement in general and their understanding of light rays in particular. The development and introduction of digital learning tools in teaching/learning science education in general and physics subject in particular for a better enhancement of learners' achievement in the global perspective do not necessary need the presence of learners, this makes aims and objectives of teaching/learning successful without necessarily in the four-wall corner classroom setting, but all over the environment of the learner. Introducing Artificial Intelligence (AI) makes teaching and learning more engaging and accessible.

Digital learning involves using electronic gadgets, the internet, and multimedia sources to make learning more accessible, faster, and easier, and to reduce the time spent on particular content to be taught (Muthucamy & Thiyagu, 2011). Engaging in digital education is a substantial paradigm shift from conventional classroom teaching and learning to modern ICT-based learning strategies that are flexible and customised (Takema, 2020). In developed countries, the modes agencies and organisations use are driven by new digital education and the need to improve agencies' practices through ICT and related technologies. The dissemination of technological drifts explores growing variations in all plans of human knowledge, as digital distortion causes an extreme revolution in educational pedagogies and strategies. The education sector remains an important industry, incumbered with significant responsibility in developing any country (Takema, 2019).

Many ICT-induced changes in the running and management of secondary education, especially in private schools, are more significant in how staff interact with students and participate in the administration of their schools, as well as how students access school facilities and receive quality learning. As a result of the emerging trends in technology use, most private schools now incorporate the use of ICT to fulfil their core functions of teaching, research, and learning, as well as provide services (Takema, 2019). The development and use of telecommunication tools created huge possibilities to adopt information and communication devices for teaching and learning at different levels of education, with the potential of ICT in transforming teaching and learning processes and the adoption of ICT-enabled resources for teaching/learning and research is gaining wide attention, hence the unprecedented drive by secondary education to integrate the use of ICT in most educational activities (Takema, 2020).

Research by Famade and Takema (2022) showed that during the COVID-19 pandemic, the e-portal for learning purposes enabled some secondary schools to adopt a modern paradigm of technology-enabled content delivery, placing an emphasis on strategies that facilitate teacher collaboration and knowledge exchange between teachers and students to meet educational goals.

In another study, Iro-Idoro and Jimoh (2021) asserted that e-learning methods are of different types, and their classifications are based on various factors. It can be described in terms of connectivity and functionality. Connectivity emphasises that the learning process occurs via connectivity on the intranet, or the web of connectivity, implying that learning is delivered or received via the internet or the web. Based on Functionality, it enables the electronic storage of information for teaching instructions, prompt updates, and the easy retrieval and distribution of these to students, all of which are made possible over the internet with the use of a computer.

Access to digital learning tools such as tablets and educational software is increasingly recognised as a crucial factor influencing student performance. Research indicates that students with regular access to these technologies tend to show improved grades, higher test scores, and increased engagement in their learning processes (Smith & Dwyer, 2020).

Another study was conducted by Takema and Famade (2023) on facilitating achievements in basic science using computer-assisted instruction in the Federal Capital Territory of Abuja, Nigeria. Findings from the study revealed that computer-assisted instructional strategy in science is intellectually stimulating and scientifically authentic, emphasising ways of acquiring knowledge rather than content. This is a shift from the traditional strategy. The authors opined that the strategy of teaching science is designed to foster inquiry and manipulative skills in students while discouraging rote learning.

According to Jones (2021), tablets facilitate interactive learning experiences and provide a platform for educational software to offer personalised learning experiences tailored to individual student needs. Moreover, digital tools can enhance collaborative learning and enable students to access a vast range of resources beyond the conventional classroom, leading to a deeper understanding and retention of the concepts taught to them. However, Takema (2015) asserted that the effectiveness of these digital tools depends mainly on the quality of the content, the integration of technology into the curriculum, and teachers' ability to adapt their teaching strategies to use these tools effectively in teaching and learning processes.

In another research, Taylor and Francis (2022), thought that the disparity in access to such technologies, often referred to as the "digital divide," can equally impair existing educational inequalities, where, learners from lower socioeconomic backgrounds may not have as much access to or familiarity with these digital tools, which can affect their performance relative to their peers who have regular access. Ensuring equal access and effective use of digital learning tools has thus become imperative for schools in Nigeria to enhance overall student achievement and engagement in the teaching and learning processes.

A study conducted by Brown and Green (2020) examined how digital tools could enhance collaboration and problem-solving skills among male and female students. The researchers conducted their study across ten schools, utilising software that supports real-time collaboration and problem-solving to investigate the impact of these tools on the performance of male and female students. Data collection involved direct classroom observations, digital logs of student interactions, and problem-solving tests administered

before and after the software introduction. Teachers were also interviewed to assess changes in instructional strategies and classroom dynamics. The study found no significant difference between male and female students who both performed excellently. The study also reveals that the use of collaborative digital tools not only increased student interaction but also led to higher scores on problem-solving tests. Students became more engaged in learning activities that required teamwork, and their ability to approach complex problems improved. Brown and Green noted that integrating such tools into everyday classroom activities encouraged a shift from teacher-centred to student-centred learning.

In another study, Thompson (2022) evaluated e-learning platforms to understand their differential impact on urban versus rural students in Kenya. This comprehensive study collected data from various schools, leveraging technology usage logs, academic performance records, and qualitative interviews with students and teachers. Thompson aimed to determine how disparities in access to digital tools influenced educational outcomes. Initial findings indicated a pronounced gap between urban and rural students, with urban students having better access to and thus benefiting more from digital learning environments. The study also explored internet connectivity, teacher readiness, and student attitudes towards e-learning. By employing advanced statistical methods, Thompson was able to illustrate the direct correlation between access to technology and student performance, with the high performance for students from the urban schools who had access to e-learning platform, which enhanced greatly their performance than the students from rural schools who could not have adequate access to e-learning platforms.

Statement of Problem

Academic achievement, as measured by examination results, is a primary goal of an educational system. Schools are established to impart knowledge and skills to those who attend them, and the ultimate aim or objective is to enhance students' academic achievement. Although public schools in the FCT have highly populated student bodies and a relatively high number of physics teachers across various fields of study, the standard of achievement in physics, particularly in the concept of light, has been low and worrisome. The low achievement of students in physics has been a primary source of concern to all educational stakeholders. Many researchers have reported on the factors that tend to affect physics students' achievement and have suggested ways to curb this poor achievement. Among the identified factors are teaching methods, inadequate instructional facilities, a lack of qualified teachers, digital learning tools, e-learning platforms, and students' attitude towards physics. Phobia among students in the physics subject in general may be due to a lack of a positive attitude to the subject and the abstract nature of the topic "light" in particular. Research globally has suggested that digital tools can enhance learning outcomes by providing rich, interactive, and personalised educational experiences. The introduction and effective use of these tools within public schools in Nigeria have not been comprehensively evaluated. Despite the growing integration of digital learning tools in the global educational landscape, significant gaps

remain in understanding their actual impact on student achievement across diverse settings. Moreover, disparities in access to technology between urban and rural areas, variations in teacher digital literacy, and the relevance of content to the curriculum raise questions about the equal benefits of digital education. Therefore, this study aims to critically assess how digital learning tools affect students' achievement in light concepts (reflection and refraction of light waves) in the Gwagwalada Council Area, Abuja, Nigeria.

Purpose of the study

The main purpose of this study is to investigate the effect of digital learning tools on senior secondary II physics students' achievements in light concepts (reflection and refraction of light waves) in the Gwagwalada Council Area, Federal Capital Territory, Abuja, Nigeria.

Research Hypotheses

To guide the study, the following hypotheses were formulated tested at the 0.05 level of significance ($P<0.05$)

H_{O1}: There is no significant difference in the mean achievement of senior secondary II physics students taught using digital learning tools and those taught with the conventional strategy in Gwagwalada Council Area, Federal Capital Territory, Abuja, Nigeria.

H_{O2}: There is no significant difference in the mean achievement of male and female senior secondary II physics students taught using digital learning tools and those taught with the conventional strategy in the Gwagwalada Council Area, Federal Capital Territory, Abuja, Nigeria.

Methodology

The study used a Quasi-experimental design. The target population of the study comprise 104 senior secondary two (SS II) physics students from the Gwagwalada council area. Four out of eight public senior secondary schools form the study sample. Four (4) intact classes from the Gwagwalada council area of the FCT were used for the study. A stratified random sampling technique was used to select twenty-six (26) SSS II physics students from each of the sampled schools, comprising a total of 104 students who were the respondents. The selection of the schools was done purposefully due to their homogeneous characteristics, as they share the same curriculum, facilities, and physics teachers. Light Achievement Test (LAT), a 15 multiple choice test on reflection and refraction of light waves one of the major topics in physics taught basically at the senior secondary two, in Nigeria, and the 15 item Digital Learning Tools Attitudinal Questionnaire (DLTAQ) research instruments developed by the researcher were used to collect data for this study. The DLTAQ consisted of 10-item questionnaires. Students were expected to answer all 15 LAT items in the questionnaire, which was intended to measure students' achievements, test their knowledge of reflection and refraction of light waves under ICT skills, and assess their attitudes towards light concepts using digital

learning tools. LAT was extracted from SSCE past questions, while the researcher developed DLTAQ. Both LAT and DLTAQ were subjected to content and face validity assessments by two experts in physics education and two in test and measurement, as approved by the Nigerian Educational Research and Development Council (NERDC), Abuja. The instruments were also given to four physics teachers who have taught physics for more than five years in senior secondary schools within the study area, which were not part of the selected schools for the study, in recognition of their valid contributions to the instruments. The experts rated the relevance of each item as an indicator of the construct, pointed out those aspects of the construct that were not covered adequately and also rated the clarity and conciseness of each item.

Physics teachers in all the sampled schools served as research assistants in administering both the LAT and DLTAQ instruments to the selected students. The LAT and DLTAQ were administered to 13 students from the government secondary school in Dupka Gwagwalada, which forms part of the study area's population but is not one of the sampled schools for the main study, in order to ascertain the reliability of the instruments using a pilot study. The instruments were collected on the same day, marked and scored using means and percentages. The level of difficulty of the light concept using digital learning tools was determined by the value of the means, as follows: means percentages less than 50% (< 50%) were classified as Simple, and means percentages equal to or above 50% (≥ 50%) were classified as Difficult. The influence of the independent variables, student-related (gender, students' achievement, and attitude) and school-related (digital learning tools for teaching and learning processes), on physics students' achievement was analysed using t-test statistics. The data obtained was analysed using the Pearson product-moment correlation Coefficient (PPMCC). A correlation coefficient of 0.94 was obtained, while the adapted attitudinal scale showed a reliability index value of 0.74, which was considered adequate for this study.

A pre-test and post-test treatment were used for data collection for the main study. The pre-test was the first treatment given to both the control group and the experimental group. The two groups were subjected to LAT as a pre-test. A sequential lesson plan was developed by the researcher, which was used by physics teachers from the selected schools, who served as research assistants in delivering instruction on the light concept to students in the selected schools for the study. The teaching for the two groups lasted for six weeks, after which the experimental group was exposed to digital learning tools to learn independently under their teachers' supervision and also at home. This was installed on the computer systems of those schools. Students were given codes to log in to the page developed for teaching and learning about the reflection and refraction of light waves. At the same time, the control group was exposed to the conventional teaching strategy, using the same duplicate content as the experimental group, provided by the researcher with the assistance of research assistants in the selected schools.

A post-test of the Language Aptitude Test (LAT) was administered to both groups eight weeks later. The experimental group was subjected to using a computer system that was installed with digital learning tools to take their test. In contrast, the control group

were tested using paper and a biro. The results from the two groups were collected and analysed. Frequencies and percentages were used to analyse the biodata of the respondents. Hypothesis 1 was tested using inferential statistics of an independent t-test, while a paired sample t-test was used to test hypothesis 2 at a 0.05 significance level.

Results

H_{O1}: There is no significant difference in the mean achievement of senior secondary II physics students taught using digital learning tools and those taught with the conventional strategy in Gwagwalada Council Area, Federal Capital Territory, Abuja, Nigeria.

Table 1: Inferential Statistics of Independent T-test Showing Differences in Mean Post-test Scores of Experimental and Control Groups

Groups	N	Mean	SD	*df*	α	t-cal	t-crit	p-value	Decision
Control	48	6.54	2.02						
				104	0.05	5.08	1.94	.000	Sig.
Experimental	56	9.15	4.23						

The results in Table 1 reveal that the t-cal value of 5.08 exceeds the t-crit value of 1.94 at the 0.05 level of significance. Thus, hypothesis one, which states that there is no significant difference in the mean achievement of senior secondary II physics students taught using digital learning tools and those taught with the conventional strategy in Gwagwalada Council Area, Federal Capital Territory, Abuja, Nigeria, was rejected. This implies a significant difference in the mean achievement scores between the experimental and control groups of senior secondary II physics students taught using digital learning tools.

H_{O2}: There is no significant difference in the mean achievement of male and female senior secondary II physics students taught using digital learning tools and those taught with the conventional strategy in the Gwagwalada Council Area, Federal Capital Territory, Abuja, Nigeria.

Table 2: Inferential Statistics of Independent T-test Showing Differences in Male and Female Students' Scores Taught Using Digital Learning Tools.

Groups	N	Mean	SD	*df*	α	t-cal	t-crit	p-value	Decision
Male	72	10.42	8.38						
				104	0.05	1.86	1.98	.324	Not Sig.
Female	32	6.48	2.03						

Results from Table 2 showed that the t-cal value of 1.86 is less than the t-crit value of 1.98, with a P-value of .324 at a 0.05 level of significance. The result indicates that there

is no significant difference in the mean achievement scores of male and female senior secondary II physics students taught using digital learning tools. Thus, hypothesis two is retained. This implies that the male and female senior secondary II physics students subjected to the use of digital learning tools during lesson delivery were effective. Thus, there is no gender effect.

Figure 1: Demography of Participants
A total of 104 senior secondary II physics students from the four selected public schools for this study from Gwagwalada Council Area of the Federal Capital Territory, Abuja, participated in the survey, out of which 72 (69%) were male and 32 (31%) were female, as depicted in Fig. 1

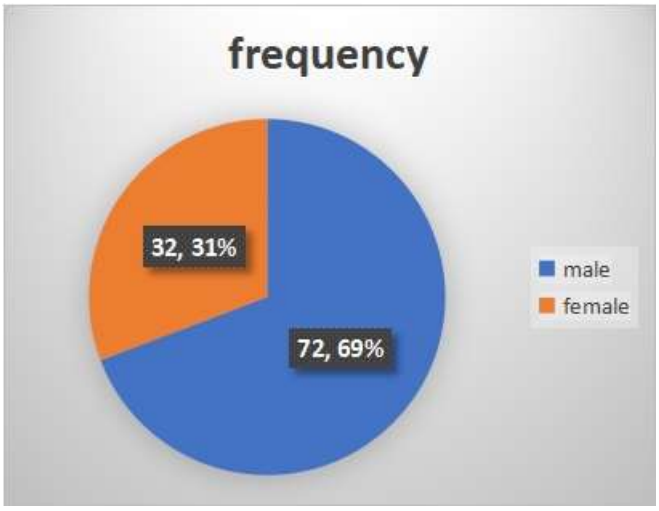

Fig. 1: Respondent Gender

Discussion of Findings
Teaching and learning science subjects, in general, and physics in particular, can be enhanced using digital learning tools. Research has shown that students' achievement in the light concept improved significantly when they were introduced to learning through the means of digital learning tools. Research also showed that while digital tools can engage students more deeply, they require significant training and support for both students and teachers to utilise the tools to meet their desired purpose effectively. A drastic shift was noticed towards more student-centred learning environments, resulting in their high achievement in reflection of light concepts. The low achievement of the control groups could be as a result of inability to access the digital learning tools which could in turn improved their achievement in light concepts, generally physics students' low achievement could be as a result of negative attitude towards the subject or light

content in particular, lack of qualified teachers with competent skills in digital learning tools,

The inability of Physis students to access these digital learning tools effectively for teaching and learning delivery results in low test scores. It is hoped that the adoption of the findings of this study in the classroom setting and the awareness of digital learning tools skills in physics lesson delivery will bring about the much-desired improvement in students' achievement in physics.

Findings from Table 1 showed that the t-cal value exceeded the t-crit value at the 0.05 level of significance. The results indicate a significant difference in the mean achievement scores between the experimental and control groups of senior secondary II physics students taught using digital learning tools, favouring the experimental group. The findings of this study align with those of Smith and Dwyer (2020), who held the view that students with regular access to these technologies tend to show improved grades, higher test scores, and increased engagement in their learning processes. The result from table 1 is also in agreement with that of Takema (2015) who asserted that the effectiveness of these digital tools depends mainly on the quality of the content, the integration of the technology into the curriculum, and the teachers' ability to adapt their teaching strategies to be able to use these tools in teaching/learning processes effectively.

The results from Table 2 showed that the t-cal value was less than the t-crit value at the 0.05 level of significance. The result indicates that there is no significant difference in the mean achievement scores of male and female senior secondary II physics students taught using digital learning tools. Thus, hypothesis two is retained. The finding of this study agrees with that of Brown and Green (2020) who were of the view that gender is not a detriment of students' achievement but the proper instructional packages for teaching/learning in schools, as the use of collaborative digital tools not only increased student interaction but also led to higher problem-solving test scores, where students became more engaged in learning activities that required teamwork. Their ability to approach complex problems improved. Brown and Green noted that the integration of such tools into everyday classroom activities encouraged a shift from teacher-centred to student-centred learning.

Conclusion

Digital Learning Tools for instructional teaching and learning delivery are fundamental to science subject teaching in general and physics in particular. Identifying some of the student and school variables would provide excellent guidance in remedying the serious educational gap in bringing digital learning skills into the classroom for students' acquisition. Considering the results from the findings of this study that gender, does not influence student' achievement of physics under the reflection and refraction of light waves in physics topic but; students' attitude, properly equipped digital learning laboratory, and qualified digital literacy physics teachers with adequate digital operating

skills for effective physics lesson delivery have significant influence on students' light concepts and digital skills acquisition.

Recommendations

Based on the above findings, it was recommended that:

1. Public senior secondary schools' digital tools laboratories should be adequately equipped and expanded by educational stakeholders to accommodate and enable teachers to adopt strategies that will equip students with the appropriate skills.

2. There should be training for physics teachers on acquiring digital learning skills, so that they can incorporate and implement a student-centred strategy that promotes active learning in science and physics.

3. Digital Learning software's such as (Amination, illustrator. Graphics) as well as DLT resources such as well-equipped digital laboratories with power sources be made available in all public senior secondary schools in the FCT, Abuja, for effective physics lesson delivery that will in turn enhanced better and higher students' achievement.

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