Educia Journal

ISSN: (2988-019X)
Vol. 1 No. 2, 2023
Page: 57-66

The Influence of Digital Tools on Student Engagement and Academic Outcomes Across Educational Levels

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Article Info

Article History:

Received March 4, 2023
Revised April 17, 2023
Accepted: May 6, 2023

Keywords:

Technology In Education, Student Engagement, Academic Performance.

Abstract

The present research investigates the effectiveness of technology utilization within the context of educational quality enhancement for students, with respect to students' motivation, achievement, and perceived educational outcomes. This developed a quantitative research design with respect to 500 students and 50 teachers from the primary, secondary, and tertiary institutions. Information was obtained using technology use questionnaires, students' performance reports, and teachers' feedback forms. The study showed that the more technology intensive a class or lesson is there is a high likelihood of having students' participation and high academic achievement. Students who interactively used technologies today including learning management systems, interactive whiteboards, etc. found out they had better academic performance and motivation. Controlling for teacher efficacy and methods in the use of technology was also found greatly to affect students' achievement. The quantitative data were analysed using descriptive and inferential measures such as the Pearson correlation and regression test to show how technology can enhance learning environment. These findings, therefore, join the emerging literature on technological integration and found positive impacts on various levels of education. This research underlines the importance of further professionalism as to teachers, and the use of proper technological means for improving the quality of education.

Introduction

Incorporation of technology in the delivery of education is one of the biggest revolutions that has affected teaching and learning processes and brought new possibilities to ensure improvement of quality of education worldwide. In the last few decades, the development of digital technologies has brought drastic changes in the established educational paradigm which offers the innovative techniques and approach for both learner and instructors (Ciarli, et al., 2023). Applying ICT in learning processes has become common from classrooms to learning management systems and hence has affected not only the teaching-learning process but also the performance of the learners (Turnbull et al., 2020). Modern educational systems' utilization of technology to enhance the quality of education is now of interest to policy makers, teachers, and scholars that are in a bid to look for opportunities and challenges in different educational environments.

Education quality is one of the worst-defined concepts that are usually linked to student learning achievements, teachers' performance, and materials available (Giovannella, 2023).

DOI: https://doi.org/10.71435/610408

With the global education systems seeking to deliver on the need for education in a world that is rapidly going digital, technology has been advanced as the solution that is capable of enriching learning experiences, raising learners' achievement levels, and producing skills that are relevant to the current and future workplace (Reis & Renzulli, 2023). Although there is a considerable body of evidence pointing to the importance of technology within education, exactly how technology influences the quality of education is still up for discussion (Gunasekeran et al., 2021).

Technology has the capacity to bridge educational gaps, especially in regions where access to quality education is limited due to resource constraints. Through the use of digital tools and platforms, students in remote or underfunded schools can access the same learning materials, participate in virtual classrooms, and engage with teachers and peers globally, thus reducing the disparities in educational opportunities (Ravi et al., 2021). Technology allows for personalized learning experiences, catering to the diverse needs and learning styles of students. By integrating adaptive learning technologies, educational systems can provide students with customized content and feedback, improving their overall learning outcomes (Khosravi et al., 2020).

In higher education, the role of technology has been particularly transformative. Online learning platforms and massive open online courses (MOOCs) have made education more flexible, allowing students to access quality courses from prestigious institutions without the constraints of time and location. The growing prevalence of digital tools such as virtual labs, simulations, and augmented reality has also enriched the learning experience, providing students with interactive and immersive opportunities to apply theoretical knowledge in real-world scenarios. These innovations have not only enhanced student engagement but have also contributed to improved academic performance by offering a more engaging and hands-on approach to learning.

Despite these advancements, the adoption of technology in education is not without challenges. Several factors influence the successful implementation of educational technology, including access to infrastructure, teacher preparedness, and the alignment of digital tools with curriculum goals. In many educational systems, the digital divide remains a significant barrier, with students in low-income areas or rural regions lacking the necessary devices or internet connectivity to fully participate in technology-enhanced learning (Cruz, 2021). Teachers' technological competencies and their ability to integrate technology effectively into their pedagogy are crucial for realizing the full potential of digital tools. Inadequate training and support for educators can lead to ineffective use of technology, limiting its impact on learning outcomes (Chukwuemeka & Samaila, 2020).

The relationship between technology and student performance is complex and influenced by multiple factors. While some studies have shown positive effects of technology use on academic achievement, others have raised concerns about the potential negative impact of excessive screen time or distractions from non-educational content. The challenge lies in ensuring that technology is used purposefully to enhance, rather than detract from, the educational experience. The rapid pace of technological change presents a challenge for educational systems, which must continuously adapt to keep up with emerging technologies and their potential applications in teaching and learning.

A growing body of research has examined the impact of various technological tools on educational outcomes, yet much of the existing literature focuses on specific technologies or isolated case studies. Studies have explored the effectiveness of learning management systems (LMS), interactive whiteboards, and gamification in improving student engagement and academic performance (Yamani et al., 2022). Less attention has been given to understanding

DOI: https://doi.org/10.71435/610408

the broader impact of technology across different educational levels and contexts. While many studies have highlighted the positive influence of technology on learning, the mechanisms through which technology affects educational quality remain insufficiently explored.

This study aims to bridge these gaps by conducting a comprehensive analysis of the role of technology in improving the quality of education. Through empirical data collection and analysis, the research will assess the impact of various technological tools on student performance, engagement, and overall educational outcomes. By examining the interplay between technology use and educational quality, this study seeks to provide valuable insights for educators, policymakers, and technology developers to optimize the use of digital tools in education. Moreover, it aims to contribute to the growing body of literature on educational technology by offering evidence-based recommendations for the effective integration of technology into educational practices.

As educational systems continue to evolve in the digital age, understanding the role of technology in improving the quality of education is critical to ensuring that future generations are equipped with the skills and knowledge necessary to succeed in an increasingly interconnected world. This study will contribute to the ongoing discourse on how best to harness the power of technology to enhance learning outcomes and foster an inclusive, equitable, and effective education system.

Method

This study employed a quantitative research design to investigate the role of technology in improving the quality of education. Specifically, it sought to examine the relationship between the use of technology and educational outcomes, focusing on student performance, engagement, and overall academic achievement. A structured approach was adopted to collect and analyze data from various educational settings, ensuring that the findings could be generalized to a broader population. This method allowed for an objective assessment of how technology impacts learning and academic success.

The research participants included 500 students and 50 teachers from diverse educational institutions, spanning primary, secondary, and tertiary levels. The sample was selected using a stratified random sampling technique to ensure diversity in terms of geographical regions, socio-economic backgrounds, and educational levels. Students were chosen based on their interaction with technology in the classroom, while teachers were selected based on their use of technological tools in teaching. This selection ensured that the sample accurately reflected the varying degrees of technology integration across different educational settings.

To gather data, the study utilized three primary instruments: student surveys, teacher surveys, and academic performance data. The student surveys consisted of structured questionnaires designed to measure their perceptions of technology in education, engagement with digital tools, and self-reported academic performance. Teacher surveys similarly assessed the types of technology used in teaching, the frequency of its integration, and its perceived impact on student outcomes. Academic performance data was obtained from school records, focusing on grades from subjects that involved the use of technology-based learning tools.

The key variables in this study included the independent variable of technology use and the dependent variables of student engagement, academic performance, and perceived educational quality. The frequency and types of technology used in the classroom were measured through responses from both students and teachers. Engagement was assessed through survey questions about student involvement in technology-enhanced learning activities, while academic performance was compared between students using technology in their learning and those who

DOI: https://doi.org/10.71435/610408

did not. Perceived educational quality was measured through evaluations from both students and teachers on the effectiveness of technology in enhancing teaching and learning outcomes.

Data analysis was conducted using statistical methods, including descriptive statistics such as means, standard deviations, and frequency distributions to summarize survey responses. Inferential statistics, such as Pearson correlation analysis, were employed to determine the relationship between technology use and academic outcomes. Multiple regression analysis was used to assess the influence of various factors, such as the frequency of technology use and the types of digital tools, on student outcomes. An independent samples t-test was also used to compare the academic performance of students who used technology in their learning with those who did not, providing insights into the impact of technology on educational quality.

Result and Discussion

This research sought to explore how technology integration impacts student engagement, academic performance, and overall educational outcomes across various educational levels. By focusing on both students' and teachers' perspectives, the study aimed to quantify the relationship between the use of digital tools in the classroom and improvements in learning experiences. Through the use of structured surveys and academic performance data, the research provides valuable insights into how technology, when effectively implemented, can enhance educational quality and foster greater student motivation. The following results offer a comprehensive analysis of the data collected, highlighting key trends and significant findings that contribute to the growing body of literature on technology's role in modern education.

Table 1. Descriptive Statistics of Technology Use and Academic Performance

Variable	Mean	Standard Deviation	Min	Max
Frequency of Technology Use (Students)	3.25	0.85	1	5
Student Engagement with Technology	4.10	0.75	2	5
Academic Performance (Grades)	78.45	12.30	50	100
Teacher Technology Integration	3.80	0.92	1	5

This table presents the descriptive statistics for key variables in the study. It includes the mean, standard deviation, and the minimum and maximum values for the frequency of technology use among students, their engagement with technology, academic performance (grades), and the level of teacher technology integration in the classroom. These values provide a general overview of the data and help to understand the central tendencies and variation within the sample.

Table 2. Pearson Correlation Analysis Between Technology Use, Engagement, and Academic Performance

Variable	Technology Use	Student Engagement	Academic Performance
Technology Use	1.00	0.65	0.60
Student Engagement	0.65	1.00	0.70
Academic Performance	0.60	0.70	1.00

This table presents the results of the Pearson correlation analysis, showing the relationships between technology use, student engagement, and academic performance. The correlations between the variables are positive, indicating that increased technology use is associated with higher student engagement and improved academic performance. The asterisk () next to the correlation values indicates statistical significance, with all correlations being significant at the

DOI: https://doi.org/10.71435/610408

0.05 level or lower. This suggests that technology use plays a substantial role in enhancing student engagement and performance.

Table 3. Multiple Regression Analysis of Technology Use and Academic Performance

Variable	B	Standard Error	Beta	t-value	p-value
Constant	62.50	5.75	-	10.87	< 0.001
Technology Use	2.30	0.45	0.32	5.11	< 0.001
Teacher Technology Integration	1.50	0.50	0.24	3.00	0.003

This table presents the results of the multiple regression analysis, which examines the effect of technology use and teacher technology integration on academic performance. The coefficients (B) represent the predicted change in academic performance for each unit increase in the independent variables. The beta values show the standardized effect of each predictor, with technology use having a significant impact on academic performance ($p < 0.001$). This regression model highlights that both technology use by students and teacher technology integration are key predictors of academic success.

Table 4. Independent Samples t-Test Comparing Academic Performance Between Students Who Use Technology vs. Students Who Do Not Use Technology

Group	N	Mean	Standard Deviation	t-value	p-value
Students Using Technology	300	81.25	10.30	4.52	0.0001
Students Not Using Technology	200	72.50	12.45		

This table shows the results of an independent samples t-test, comparing the academic performance of students who use technology in their learning versus those who do not. The mean academic performance is significantly higher for students who use technology (81.25) compared to those who do not (72.50), with a t-value of 4.52 and a p-value less than 0.0001, indicating that the difference is statistically significant. This result supports the hypothesis that technology use positively influences student academic performance.

Table 5. Teacher Survey Responses on Technology Integration

Technology Tool	Percentage of Teachers Using	Average Impact Rating (1-5)
Learning Management Systems (LMS)	85%	4.10
Interactive Whiteboards	72%	3.80
Educational Software/Apps	65%	3.90
Online Assessment Tools	55%	3.75
Virtual Reality in Classrooms	40%	4.20

This table presents the results of the teacher survey on the use of various technology tools in the classroom. It shows the percentage of teachers who use each technology tool, as well as the average rating (on a 1 to 5 scale) of the perceived impact of these tools on teaching and learning. Learning management systems (LMS) and interactive whiteboards were the most commonly used tools, while virtual reality was the least commonly used but rated highly in terms of impact on student engagement and learning outcomes.

DOI: https://doi.org/10.71435/610408

Table 6. Student Perceptions of Technology's Impact on Learning

Perception of Technology	Percentage Agreeing (Strongly Agree + Agree)	Average Impact Rating (1-5)
Technology helps me understand the subject better	78%	4.20
Technology increases my motivation to learn	72%	4.10
Technology makes learning more enjoyable	70%	4.05
I am more likely to participate in class when technology is used	74%	4.15
Technology has improved my academic performance	68%	4.00

This table displays the results from the student survey regarding their perceptions of the impact of technology on their learning experience. The majority of students reported positive perceptions, with 78% agreeing that technology helps them understand the subject better, and 74% stating that they are more likely to participate when technology is used in class. The average impact ratings indicate that students find technology to have a significant and positive effect on their engagement and academic performance, reinforcing the overall positive role of technology in education.

According to this research study it can therefore be suggested that the incorporation of technology in learning enhances accountability for important stakeholder values like learner participation, learning achievements, and the perceived quality of learning. Such findings are consistent with what is known in the literature and also show how technology can be useful in enhancing learning spaces. The analysis offered fresh evidence of how specific forms of technology like LMS and Interactive Whiteboards as well as software applications affect learners. Also, the study also serves to enrich the research put into practice by coming up with empirical measures of integration scale that brings together primary, secondary and tertiary levels in educational technology, and the evaluation of the trends between technology and the perceptions of the students and the teachers.

This paper observed a strong positive relationship between the technology and classroom with performance. According to the previous research, this result supports the findings that highlighted technology's effectiveness for increasing the students' performance. Briffa et al. (2020) meta-analysed studies that indicated that technology enhanced education enhances academic achievement when technology is used appropriately in education practices. Drawing from over fifty thousand studies teaching methods that integrate technology were described by Hattie in his list of methods that have a positive impact on students' achievement. Also, the results of the t-test carried out on two independent samples showed that Students using technology far in their learning scored higher than students who did not use such gadgets (Table 4).

The evidence produced in this study is also in harmony with the idea of Alamri et al. (2021) technology increases the flow of information; enhances the flow of material for customized learning; and increases interaction which leads to improved academic performance. Consistent with Børte et al. (2023) conclusion that feedback and active learning interventions enhance the learning process, the affordances of technology introduce an opportunity for constant feedback and active practice with the content. Since the students are using technology enhanced tools, they can get feedback and a check on their performance from the tutors and this assists in

DOI: https://doi.org/10.71435/610408

evaluation of the performance. Presenting further to this, the current study establishes that students who frequently used technological resources not only academically performed well but also remained interested and participative in learning (Haleem et al., 2022).

The strong positive relationship, which exists between the degree of technology used and students' engagement, (r = 0.70) reinforces the view that enhancing learning engagement is made possible through a high degree of technological input. This is in line with the study by Johnson et al (2014) who concluded that the use of interactive technologies like smart learning applications and shared tools enhance the activity level of the students. Students in the current study stated that use of technology motivated them and made them willing to participate in class activities, this is in support of Bizami et al. (2023) that engaging student through the pedagogy of the digital tool will create a positive attitude and willingness required in class activities.

The survey showed that a high proportion of students had a perception that the use of technology enhanced understanding of related course content and raised the level of learners' contributions to a class (Table 6). This is in line with previous findings by other scholars including Zou et al. (2023) arguing that the use technologies enrich students' engagement to content, especially those that promote cooperative learning and individually tailored content search. Likewise, research by Bond et al. (2020) has provided evidence that technology increases student engagement due to the additional engagement that technology brings to the learning process particularly if learning resources are presented in the format that is best suited to students' needs.

The current study's results are also consistent with Chng et al. (2023) who opined that the use of technology in classroom makes the learning process more active and less receptive as viewed from the traditional perspectives. The use of technology helps students get more material, and the interaction between students and content and between students and professors is extended. Such alteration is crucial to achieving optimal students' engagement and the general effectiveness of the process.

One of the important indicators for the successful use of technology in education is teachers' implementation. From the regression analysis done in the study as presented in table 3 it was established that the adoption of technology by teachers was positively influenced student performance. This agrees with other similar research done in the past for instance, who maintained that the beliefs and attitudes of the teachers towards the technologies that were being used dictated how effective the implementation of technology would be. This implies that technology integration can be effectively realized in classroom contexts once teachers have high self-efficacy regarding the use of technology in context of teaching and learning practices that impact students 'learning outcomes.

According Backfisch et al. (2021) explained in their study that the implementation of technology into classrooms was not only a matter of the presence of application but also readiness with the tools as well as ability to use them in exemplary manner. In the current study, the high percentage of teachers, especially those who utilized different technological tools such as Learning Management Systems and educational software (Table 5) indicates the importance of professional development and training as the factors for the efficient implementation of technology in education. This is in line with the views who opined that technologies integration for learning can only be accomplished effectively by Teachers: Professional development programs for technology tools improve the abilities of teachers in using informations technology technology to foster students learning. The study also found that teachers who had more self-efficiency in embracing technology were likely to have students with better academic results in the current study.

DOI: https://doi.org/10.71435/610408

This study is valuable for filling several gaps in the existing literature. The current literature on integrating technology in school has been generally done without focusing on or evaluating specific technologies like learning management systems, interactive whiteboards, and educational software, and their impact on student achievement. As the type of the technology used is more granularly analyzed and the effects of the technology are rated separately in this research, this paper brings more insights as to how and with what technologic tool educational performance is enhanced.

The respondents of the study are students and teachers, randomly selected from primary, secondary and tertiary institutions to bridge the existing literature lacking enough data as per the educational stages. Although prior literature has primarily investigated technology-enhanced learning in the context of university students, the present study contributes to the literature by demonstrating that such students also gain from using technology in their classroom. The research, therefore, proposes that technology might have the potential of enhancing academic achievement irrespective of the learner's learning level, an area that extends the literature.

The use of a large sample size and a stringent quantitative data analysis method based on multiple regression analyses, Pearsons's correlations and independent samples t- tests fills a gap in the literature as most literature review reveal that a large portion of research conducted in the field of technology integration lacks a substantial and quantitative methodological design. This study contributes to the body of knowledge the implication of technological integration in instruction by employing statistical data to provide more concrete findings on correlation between use of technology in classroom and students' achievement.

Conclusion

Emphasizes positive effects of technology to students' activities, achievement, as well as the quality of education. Alike, the study supports the idea that technology when incorporated into teaching practices promotes not only more engagement and motivation of learners to achieve the intended teaching outcomes but also increases their performance. This study therefore fills some of these gaps through its quantitative undertakings as well as through its cross-sectional comparisons of the various educational technologies available at the multiple levels of education. The students in this study underscore the need for teacher professional development, access to adequate technology and support, and offering to fully unlock the potential of technology to promote enhancement of student learning and achievement.

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