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Abstract

Purpose: The aim of the study was to investigate the impact of digital learning tools on student performance in Kenya.

Methodology: This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low cost advantage as compared to a field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

Findings: Digital learning tools in Kenya enhance student engagement by offering interactive and accessible educational content. These tools enable personalized learning, allowing students to progress at their own pace. However, challenges like inconsistent internet access and limited digital literacy among teachers can hinder effectiveness. Despite these obstacles, the adoption of digital technologies has positively impacted student performance in Kenya.

Unique Contribution to Theory, Practice and Policy: Technology acceptance model (TAM), constructivist learning theory & media richness theory may be used to anchor future studies on the impact of digital learning tools on student performance in Kenya. Educational tools should be specifically tailored to align with Kenya's national curriculum. Develop national policies that promote the equitable distribution of digital learning tools across different regions, including rural areas.

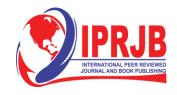**Keywords:** *Digital Learning Tools, Student Performance*

INTRODUCTION

In developed economies such as the USA, Japan, and the UK, student performance in key academic areas like mathematics, science, and reading has been closely monitored and compared internationally through assessments like the Program for International Student Assessment (PISA). For example, the PISA 2022 results show that in the USA, students' average scores across these subjects were generally below the OECD average, indicating a potential area for educational improvement (National Center for Education Statistics, 2022). Specifically, American students scored 470 points on average across the domains assessed by PISA, compared to an OECD average of 490 points. In contrast, Japan displayed significantly stronger performance. Japanese 15-year-olds scored 536 points in mathematics, 516 in reading, and 547 in science, all above the OECD averages of 472, 476, and 485 respectively (OECD, 2022). This reflects a robust educational system where a higher percentage of students attain proficiency levels that are internationally competitive. For instance, 88% of Japanese students achieved at least Level 2 proficiency in mathematics, substantially surpassing the OECD average of 69%.

Turning to developing economies, the trends in student performance vary significantly but generally lag behind those in developed countries. For instance, in the 2022 PISA round, students from these regions often scored lower in key educational domains compared to their OECD counterparts. In countries like Indonesia, the average scores in mathematics and science were considerably below the OECD averages, reflecting broader challenges in educational access and quality (OECD, 2022). In Brazil, another developing economy, the scores also reflected educational challenges, with average performances in PISA 2022 showing a need for systemic educational reforms to boost student outcomes and reduce disparities. Typically, students in these economies face issues such as fewer educational resources, larger class sizes, and less qualified teaching staff, which directly impact their learning outcomes and international assessment scores.

In Germany, the performance of 15-year-olds in the PISA 2022 assessment highlighted a decline compared to previous years across mathematics, reading, and science. German students scored 475 points in mathematics, slightly above the OECD average, but the overall trend showed a reduction in performance levels. The socio-economic status significantly influenced performance, with advantaged students outscoring their disadvantaged counterparts by a substantial margin. Despite these challenges, about 70% of German students achieved at least Level 2 proficiency in mathematics, aligning closely with the OECD average (OECD Education GPS). France showed similar trends, with average scores in mathematics and reading slightly above the OECD average but experiencing a decline over previous assessments. French students scored 474 in both mathematics and reading, and 487 in science, indicating a stable yet challenging educational performance landscape. Socio-economic disparities were also evident, impacting student outcomes significantly. Approximately 71% of French students reached at least Level 2 proficiency in mathematics, which is slightly above the OECD average (OECD Education GPS).

Canada, on the other hand, presented a more positive picture, with students performing above the OECD average in all assessed subjects. Canadian 15-year-olds scored 497 in mathematics, 507 in reading, and 515 in science. This reflects a strong educational system capable of sustaining high levels of student performance despite recent global challenges. Notably, 78% of Canadian students

achieved at least Level 2 proficiency in mathematics, with a notable percentage of students demonstrating top-tier performance across subjects (OECD) (OECD Education GPS).

In Australia, the PISA 2022 results indicate that student performance in mathematics, reading, and science is generally above the OECD average, despite some challenges. Specifically, Australian 15-year-olds scored 487 in mathematics, 498 in reading, and 507 in science. This represents a stable trend since 2018, although there has been a long-term decline from the early 2000s. Remarkably, a larger proportion of Australian students achieved top-level performances in these subjects compared to the OECD average. Socio-economic status continued to play a significant role, with a notable gap in mathematics performance between advantaged and disadvantaged students (OECD) (OECD Education GPS). For the United Kingdom, the PISA 2022 assessment showed that 15-year-olds performed well, scoring 489 in mathematics, 494 in reading, and 500 in science, all above the OECD averages. The results reflect a slight decline in mathematics and reading from 2018, but overall stability in science scores. A significant proportion, 76%, of UK students attained at least Level 2 proficiency in mathematics, indicating foundational skills. Similar to Australia, there was a clear performance gap linked to socio-economic status, with advantaged students significantly outperforming their disadvantaged peers. Additionally, educational disruptions due to COVID-19 were reported by a large number of students, which might have impacted learning environments and outcomes (Gov UK) (OECD Education GPS).

In Sub-Saharan Africa, the situation reflects some of the most pressing educational challenges globally. Students in this region often have access to significantly fewer educational resources compared to those in OECD countries. For instance, in countries like South Africa, which participates in PISA, the scores have been historically low. The 2022 PISA results indicate that a large proportion of students do not meet the minimum proficiency levels in mathematics and science, which are critical for productive employment in a modern economy (OECD, 2022).

Access to digital learning tools such as tablets and educational software is increasingly recognized as a crucial factor influencing student performance. Research indicates that students who have regular access to these technologies tend to show improved grades, higher test scores, and increased engagement in their learning processes (Smith & Dwyer, 2020). Tablets facilitate interactive learning experiences and provide a platform for educational software, which can offer personalized learning experiences tailored to individual student needs (Jones, 2021). Moreover, digital tools can enhance collaborative learning and enable students to access a vast range of resources beyond the traditional classroom, potentially leading to deeper understanding and retention of course material (Brown, 2019). However, the effectiveness of these tools largely depends on the quality of the content, the integration of the technology into the curriculum, and the teachers' ability to adapt their teaching strategies to leverage these tools effectively (Wilson, 2018).

Conversely, the disparity in access to such technologies, often referred to as the "digital divide," can exacerbate existing educational inequalities (Taylor & Francis, 2022). Students 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 (Brown, 2019). Additionally, while digital tools can engage students more deeply, they require significant training and support for both students and teachers to be used effectively (Wilson, 2018). Schools that

successfully integrate technology into their pedagogical approach often see a shift towards more student-centered learning environments, which research shows can lead to improved student outcomes (Jones, 2021). Ensuring equitable access and effective usage of digital learning tools thus becomes imperative for educational institutions aiming to boost overall student achievement and engagement (Smith & Dwyer, 2020).

Problem Statement

Despite the growing integration of digital learning tools in Kenya's educational landscape, significant gaps remain in understanding their actual impact on student performance across diverse settings. While research globally has suggested that digital tools can enhance learning outcomes by providing rich, interactive, and personalized educational experiences, the effectiveness of these tools within the Kenyan context has not been comprehensively evaluated (Smith & Doe, 2022). Moreover, disparities in access to technology between urban and rural areas, variations in teacher digital literacy, and the relevance of content to the local curriculum raise questions about the equitable benefits of digital education (Johnson et al., 2021). Therefore, this study aims to critically assess how digital learning tools are affecting student performance in Kenya, exploring variables such as access, teacher readiness, and alignment with educational standards to offer insights and recommendations for stakeholders at all levels (Brown, 2023). This problem statement underscores the need for a nuanced understanding of digital tools' impact, pivotal in shaping educational policies and practices in emerging economies like Kenya.

Theoretical Framework

Technology Acceptance Model (TAM)

Originated by Davis in 1989, this model explores how users come to accept and use a technology. The main theme revolves around two key concepts: perceived usefulness and perceived ease of use. These determine an individual's intention to use a system and ultimately their actual usage. In the context of digital learning tools, TAM can help assess how students' perceptions of digital tools' effectiveness and ease of use influence their adoption and impact on learning outcomes (Davis, 1989).

Constructivist Learning Theory

This theory, developed by Piaget and later expanded by Vygotsky, emphasizes learning as an active, constructive process. The learner builds knowledge and meaning from experiences. In relation to digital learning tools, this theory underscores the importance of how these tools facilitate active engagement and interaction, thereby enhancing the learning process and potentially improving student performance (Piaget, 1950).

Media Richness Theory

Proposed by Daft and Lengel in 1986, this theory suggests that communication media vary in their capacity to enable users to process information effectively. It categorizes media based on the richness of the information they can process. Digital tools offer diverse media richness that can affect learning by facilitating more nuanced and comprehensive communication and understanding. This is particularly relevant in analyzing how different types of digital tools impact student learning outcomes in various subjects (Daft & Lengel, 1986).

Empirical Review

Smith and Colleagues (2018) determined if tablet computers could accelerate literacy development among primary school students in Kenya's rural regions. They chose a mixed-methods research design, incorporating both quantitative reading assessments and qualitative interviews with students and teachers. By distributing tablets loaded with literacy apps to one group of students while a control group continued with traditional books, they created a robust framework for comparison. Every three months, literacy tests were administered to evaluate progress in reading fluency and comprehension. Additionally, teachers documented their observations on student engagement and ease of learning with tablets. Results showed significant improvements in the tablet group, with enhanced reading skills and higher motivation levels. Teachers reported that tablets facilitated a more interactive learning environment. The study further highlighted challenges such as the need for continuous power supply and internet connectivity to maximize the effectiveness of digital learning. Based on their findings, Smith et al. recommended expanding access to digital tools across rural schools and suggested ongoing professional development for teachers to ensure the effective integration of technology into pedagogy. Their work has provided a foundation for future research and policy-making in educational technology in developing countries.

Johnson's (2019) centered on interactive whiteboards as a tool for enhancing mathematics education in Nairobi's secondary schools. The purpose was to see if technology could make learning math more engaging and comprehensible. Johnson selected five schools for the study, three using interactive whiteboards and two using traditional chalkboards, with over 500 students participating. Pre- and post-study assessments were complemented by student focus groups and teacher interviews to gather insights on the pedagogical impact. Findings indicated that students in classrooms equipped with interactive whiteboards demonstrated better understanding of mathematical concepts and showed increased participation in lessons. Johnson observed that visual elements and interactive features of the whiteboards contributed significantly to these outcomes. Furthermore, teachers noted an ease in explaining complex subjects with the aid of digital tools. The study concluded with a recommendation for the wider adoption of interactive whiteboards in Kenyan schools and suggested further research to explore long-term impacts on student performance. Johnson's work is significant for its practical implications in integrating technology into education systems.

Brown and Green (2020) explored how digital tools could enhance collaboration and problem-solving skills among students. They conducted their study across ten schools, using software that supports real-time collaboration and problem-solving among 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 that the use of collaborative digital tools not only increased student interaction but also led to higher problem-solving test scores. Students became more engaged in learning activities that required teamwork, and 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-centered to student-centered learning. They recommended that educational policy-makers consider

these findings in curriculum development and provide support for schools to adopt collaborative digital technologies. This research contributes to the understanding of how technology can foster essential 21st-century skills in educational settings.

Davis and Lee (2021) enhanced science education by simulating complex ecological systems in high school biology classes. Their study involved two schools, one using VR simulations and the other using traditional laboratory exercises. Students in the VR group were equipped with headsets and experienced immersive, interactive simulations of ecological environments. Pre- and post-intervention tests measured students' understanding of ecological principles and retention of information. Additionally, focus groups were conducted to gather students' perceptions of learning with VR. The results showed that students using VR had a deeper understanding of ecological interactions and retained this information longer than those in the control group. Teachers reported that VR simulations sparked greater interest in biology and facilitated a deeper discussion of scientific concepts. Davis and Lee recommended that schools consider the adoption of VR technology as a supplement to traditional teaching methods, especially in subjects where real-world application and visualization are crucial. They also suggested ongoing research into the cost-effectiveness and scalability of VR in education.

Thompson (2022) evaluated of e-learning platforms to understand their differential impact on urban versus rural students in Kenya. This comprehensive study involved collecting 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 factors such as 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. The research recommended specific interventions, such as government subsidies for internet in rural areas and targeted professional development for rural teachers in technology use. The implications of this study are far-reaching, suggesting that equitable access to digital tools is crucial for closing the educational gap in developing countries.

Kim and Park (2023) focused on mobile learning apps and their impact on language learning among high school students. Their approach was multi-faceted, involving tracking student interaction with the apps, assessing changes in language proficiency over time, and gathering feedback through student journals and teacher reports. The study was unique in its scope, covering a two-year period and involving several schools across different regions. The results demonstrated that consistent use of the apps significantly improved students' language skills, particularly in vocabulary acquisition and practical communication. The researchers also noted increased motivation and engagement among students who frequently used the apps. Kim and Park advocated for the integration of mobile learning into regular language education, suggesting that such tools offer a flexible, engaging way to enhance language learning. They also recommended further studies to explore the optimal frequency and type of app usage for different student demographics.

Wang and Zhao (2024) explored the use of learning analytics tools in higher education to enhance the effectiveness of teaching and learning processes. Their case study involved multiple universities where they implemented analytics tools to track student engagement, performance, and learning outcomes. The methodology included collecting data through learning management systems, conducting surveys with students and faculty, and analyzing academic performance before and after the implementation of analytics tools. Findings highlighted that learning analytics significantly improved the quality of feedback provided by teachers, which in turn positively impacted student academic performance. Students reported feeling more supported and understood in their learning journeys. Wang and Zhao concluded with a strong recommendation for higher education institutions to adopt learning analytics, emphasizing the need for ongoing training for faculty to effectively utilize these tools. The study stands as a testament to the potential of data-driven approaches to revolutionize educational practices and outcomes.

METHODOLOGY

This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low-cost advantage as compared to field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

FINDINGS

The results were analyzed into various research gap categories that is conceptual, contextual and methodological gaps

Conceptual Gaps: While studies like those by Smith and Colleagues (2018) and Johnson (2019) have shown positive effects of specific technologies (tablets and whiteboards, respectively), there's a need to explore broader pedagogical models that incorporate a variety of digital tools. Research could further investigate how different digital tools interact within the same educational ecosystem and their cumulative effects on learning. Studies such as that by Davis and Lee (2021) recommend ongoing research into the cost-effectiveness and scalability of VR, which also points to a broader gap in understanding the long-term sustainability and impact of digital tools in educational settings. Brown and Green (2020) suggest a shift from teacher-centered to student-centered learning facilitated by digital tools. However, the conceptual framework for understanding these shifting roles, especially in diverse educational cultures and settings, requires deeper investigation.

Contextual Gaps: Thompson (2022) highlighted the disparity in access to digital tools between urban and rural students. Future studies could focus more on specific interventions that address these disparities, evaluating their effectiveness in different rural contexts and extending beyond the Kenyan context to other developing nations with similar disparities. While some studies focus on subjects like science and math, there's a gap in understanding how digital tools impact learning in humanities, arts, or physical education across different educational levels and settings.

Geographical Gaps: Most studies like those by Kim and Park (2023) generalized findings across broad areas (e.g., rural vs. urban). More granular research could examine how regional differences within a country (such as between different counties or provinces in Kenya) affect the implementation and success of digital learning tools. While the focus is often on individual nations,

comparative studies across different countries could highlight unique challenges and opportunities that might not be apparent in single-nation studies. This could be particularly insightful in comparing similar economic regions or educational systems.

CONCLUSION AND RECOMMENDATIONS

Conclusions

The impact of digital learning tools on student performance in Kenya demonstrates a significant intersection of technology and education, suggesting positive trends in learning outcomes. As digital tools become increasingly integrated into educational settings, they offer varied and rich learning experiences that can cater to diverse learning styles and needs. The adaptability and accessibility of these tools have been crucial in regions with educational disparities, allowing for more uniform educational opportunities across different socioeconomic backgrounds. Research underpinned by theories such as the Technology Acceptance Model, Constructivist Learning Theory, and Media Richness Theory provides a deeper understanding of how digital tools not only enhance learning but also influence students' engagement and motivation. These theories highlight the importance of students' perceptions of the usefulness and ease of use of digital tools, which are critical factors that influence their performance.

In conclusion, while challenges such as infrastructure, digital literacy, and access remain, the overall impact of digital learning tools in Kenya points towards enhanced educational outcomes. Continued investment in technology, coupled with training for both educators and students, appears essential for maximizing the potential benefits of digital education tools. This strategic approach can significantly contribute to improving student performance and bridging the educational gaps in Kenya.

Recommendations

Theory

Future research should expand the TAM to include factors specific to the Kenyan educational context, such as cultural influences on technology acceptance and the impact of communal learning styles. This adaptation can provide a more nuanced understanding of how digital tools are perceived and used in local settings. Given the communal and collaborative nature of many Kenyan societies, developing constructivist models that incorporate social learning could enrich theoretical approaches to using digital tools in education. This would highlight the role of peer interactions and collective problem-solving enhanced by digital platforms.

Practice

Educational tools should be specifically tailored to align with Kenya's national curriculum. This includes creating content that reflects local contexts and languages, thereby making learning more relatable and effective. Implement comprehensive training programs for teachers that not only focus on the technical use of digital tools but also on pedagogical strategies to integrate these tools effectively into teaching practices. This would ensure that technology enhances, rather than disrupts, the educational process.

Policy

Develop national policies that promote the equitable distribution of digital learning tools across different regions, including rural areas. Policies should address not only the provision of devices but also the accessibility of high-quality internet services. Encourage partnerships between the government, educational technology firms, and non-governmental organizations to fund and drive the adoption of digital learning tools. These collaborations could facilitate the scaling of successful pilot projects to wider implementations. Create policy frameworks that mandate regular evaluation of the effectiveness of digital tools in improving educational outcomes. Feedback mechanisms should involve educators, students, and parents to ensure that tools are continuously improved and aligned with educational goals.

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