Technological Usage and Students' Performance in Mathematics in Public Secondary Schools in Rwanda: A Case of Kayonza District

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ABSTRACT

This study investigated the effect of technological usage on Mathematics performance in public secondary schools in Kayonza District, Rwanda. It aimed to evaluate the current level of technological usage for Mathematics education in public secondary schools within Kayonza District. This study was conducted under two theories: behaviorist instructional theory and cognitive instructional theory and descriptive survey design was used to the target population of 199, including 145 Mathematics teachers and 54 head teachers to get the sample size of 155 respondents, that involving 107 Mathematics teachers and 48 head teachers, obtained by using Yamane's formula. Purposive and simple random sampling methods were employed to select 155 sampled respondents. Data was collected through questionnaires and interviews, analyzed using SPSS version 20.0 for quantitative data, and thematic analysis for qualitative responses. According to the results for the objective, the study indicates that technological tools like digital devices, interactive whiteboards and educational software are widely used in Mathematics education, with 84.1% of teachers reporting that such tools enhance problem-solving skills (mean = 4.73). Online resources and software like Google Classroom also significantly contribute to learning outcomes (mean = 4.50). However, over 60% of schools face challenges such as limited internet connectivity and inadequate digital resources. However, disparities in technology access among schools result in uneven student performance improvements. The researcher concludes that while technology positively affects problem-solving and conceptual understanding in Mathematics, effectiveness is hindered by inconsistent access and insufficient teacher training. To address these issues, the researcher recommends investing in teacher professional development, improving infrastructure, and developing policies for equitable access to technology across all schools, aiming to bridge the technology gap and enhance Mathematics education quality in Rwanda's public schools. He also recommends further studies related to this study.

Keywords: Performance in Mathematics, Public Secondary School, Secondary Schools, Technological Usage, Technological Infrastructure

I. INTRODUCTION

Globally, the integration of technology in education has significantly affected student performance, particularly in Mathematics. Studies from countries like the United States, Finland, and South Korea have shown that the use of technological tools such as educational software, digital textbooks, and online platforms can enhance students' understanding of complex mathematical concepts (The Organization for Economic Cooperation and Development, [OECD], 2015). These tools offer interactive and personalized learning experiences, allowing students to engage with content at their own pace. However, the effectiveness of technology depends on the quality of implementation and teacher preparedness (Serrano et al., 2019).

In Africa, the adoption of technology in education, including Mathematics instruction, has been growing, but it faces several challenges such as limited infrastructure and access to devices. Countries like Kenya, South Africa, and Rwanda have made strides in incorporating Information and Communication Technology (ICT) into the curriculum, supported by government initiatives and international partnerships (Tusiime, 2020). Research suggests that where technological tools are adequately used, students demonstrate improved performance in subjects like Mathematics (Murithi et al., 2018). However, disparities in resource availability between urban and rural schools can hinder consistent results across the region.

In many developing countries, technological usage in Mathematics education is often limited by factors such as inadequate teacher training, poor internet connectivity, and insufficient funding (Mwangi & Karanja, 2019). Teachers may struggle to integrate technology effectively into their instruction due to a lack of resources or proper support. Consequently, students in under-resourced schools may not benefit from the potential improvements in learning outcomes that technology can offer. Addressing these challenges requires investments in infrastructure, professional development, and tailored solutions for local needs (Yusuf & Balogun, 2021).

As technology continues to evolve, the potential for improving student performance in Mathematics through digital tools is significant. With advancements in artificial intelligence and data analytics, educational technology can provide more tailored learning experiences that cater to individual student needs (Luckin, 2018). To maximize the benefits, governments and educational institutions must focus on equal access, continuous teacher training, and sustainable technology integration. By addressing these areas, the gap between regions and schools can be reduced, leading to enhanced student outcomes in Mathematics globally (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2022).

The Rwandan government considers ICT as crucial for economic transformation, especially in education for producing skilled human resources. Since 2000, computers have been introduced in classrooms to integrate ICT into the curriculum through various activities (Nteziryimana & Niyobuhungiro, 2023). However, disparities in Mathematics performance persist among upper secondary school students (Uwineza et al., 2018). Despite the importance of grades for further education and the high costs associated with maintaining ICT equipment, student performance remains low in upper secondary schools. A general assessment of students' performance in Mathematics in the HUYE area showed very low performance in recent years (Uwineza et al., 2018). As a result, the issue of Mathematics performance must be addressed. The set out to investigate the impact of technology use on students' performance in Mathematics.

Mugiraneza et al. (2020) highlight that public secondary schools in Rwanda encounter difficulties in mathematics performance largely due to limited resources, overcrowded classrooms, and diverse levels of teacher qualifications. Although the Rwandan government has attempted to address these issues by introducing competency-based curricula and enhancing teacher training, Nsengiyumva and Butare (2018) observe that many schools still lack consistent access to crucial instructional materials and educational technology. Additionally, Habineza and Niyibizi (2019) indicate that teacher attitudes and teaching methods play a significant role in shaping student outcomes, noting that positive teacher attitudes are linked to improved achievement in mathematics. To improve mathematics performance, ongoing professional development and targeted interventions such as supporting students with learning difficulties and incorporating technology are critical. These initiatives can help address disparities and promote stronger mathematics proficiency across public secondary schools in Rwanda (World Bank, 2021).

1.1 Statement of the Problem

The integration of technology into Mathematics education has the potential to enhance student performance and engagement, but its effectiveness is inconsistent due to challenges such as limited resources, teacher preparedness, and infrastructure. Globally, while some studies show that technology can improve learning outcomes, especially in subjects like Mathematics, its success depends heavily on proper implementation and teacher training (Serrano et al., 2019). In regions such as Africa, these challenges are more pronounced due to inadequate infrastructure and lack of devices, which limits the widespread positive impact of technology on education (Mwangi & Karanja, 2019).

In developing countries, including Rwanda, these barriers have resulted in unequal learning opportunities, where students in well-resourced schools outperform those in underfunded institutions. Poor student performance in Mathematics remains a significant concern, as seen in regions like Kayonza District, where the introduction of ICT has not yet led to the anticipated improvements. The high cost of maintaining technological tools, insufficient teacher training, and limited internet connectivity exacerbate the problem, further hindering educational advancement and national development (Yusuf & Balogun, 2021; Uwineza et al., 2018; Ministry of Education [MINEDUC], 2018).

While existing studies by Akçay et al. (2021), Mosqueira-Rey et al. (2023), and Nteziryimana and Niyobuhungiro (2023) provide insights into the impact of technology on Mathematics performance across primary and college levels, a gap remains in understanding its effects in secondary education. Akçay et al. (2021) focused solely on primary education, omitting the secondary level, while Mosqueira-Rey et al. (2023) examined college students, specifically millennials, without investigating technology's influence during the critical secondary school years. Additionally, Nteziryimana and Niyobuhungiro (2023) limited their study to upper primary schools within Rwanda, leaving secondary education unaddressed. Consequently, further research is necessary to assess the broader impact of technology on Mathematics achievement in secondary education, especially in Rwanda, where contextual factors may shape how technology affects learning outcomes.

This study seeks to investigate the relationship between technology use and student performance in Mathematics in Rwanda, with a focus on secondary schools in Kayonza District. It aims to explore the barriers to effective technology integration and propose strategies to optimize its use for improving educational outcomes. The findings are expected to contribute to addressing the gaps in resource allocation, teacher support, and policy implementation to enhance Mathematics education in the region (Mukuka, 2024; Nteziryimana & Niyobuhungiro, 2023).

1.2 Research Objectives

Specifically, the study intends to:

(i) Evaluate the current level of technological usage for Mathematics education in public secondary schools within Kayonza District.

1.3 Research Question

This study seeks to address the following research question:

(i) What is the status of technological usage for Mathematics education in public secondary schools within Kayonza District?

II. LITERATURE REVIEW

2.1Theoretical Review

2.1.1 Behaviorist Instructional Technology

Behaviorist learning theories, as outlined by Dabbagh (Imenda, 2017), view knowledge as fixed truths and define learning as a behavioral response to instructional stimuli. This approach emphasizes observable actions, with successful learning marked by correct responses to educational material. Teachers reinforce desired behaviors through immediate rewards and consequences, discouraging incorrect responses to promote mastery.

Research shows that incorporating technology into Mathematics education can enhance student performance in areas such as proficiency, problem-solving, conceptual understanding, and assessment results. However, the success of technology integration relies on factors such as the quality of educational tools, teacher training, and the availability of infrastructure. Further research is needed to assess how technological integration affects Mathematics education, especially in regions like Rwanda's Kayonza District (Uworwabayeho, 2016). Mathematics has deep historical roots, with significant contributions from philosophers like Plato and Aristotle. Plato distinguished between logistics and arithmetic, emphasizing the philosophical nature of Mathematics. While Mathematics is often seen as abstract and disconnected from daily life, it remains essential in education. This highlights the importance of teaching Mathematics universally in schools, though discussions on gender dynamics in Mathematics are often absent (Danesi, 2016).

Information and communications technology (ICT) plays a transformative role in education. Students use ICT tools such as interactive whiteboards, educational software, and dynamic geometry software to enhance their learning in Mathematics. These tools improve students' mathematical skills by providing access to realistic visualizations, improving problem-solving techniques, and supporting self-regulated learning (Bouma et al., 2023). However, continuous internet access and teacher training are critical for effective ICT integration (Uworwabayeho, 2016).

2.1.2 Cognitivist Instructional Technology

Harasim (2017) describes Cognitivist instructional technology (IT) as a learning framework focused on mental processes, using cognitive psychology to create tools that support information acquisition and memory. The mind is seen as an information processor, with memory, attention, and decision-making aiding learning. Cognitivist IT emphasizes structured learning methods like scaffolding, tutorials, and simulations to reinforce memory and skills. While beneficial for retention and immediate feedback, it may lack support for social interaction, creativity, and critical thinking. To address these gaps, educators should balance it with methods that foster collaboration and higher-order thinking.

Effective technology integration in Mathematics can significantly boost student performance by tailoring instruction to individual needs and providing personalized feedback through online quizzes and interactive activities. However, challenges such as teacher preparedness, equitable access to technology and the risk of distractions must be addressed. Proper planning, professional development, and ensuring equal access to technology resources are essential for optimizing the benefits of technology in Mathematics education (Mpuangnan, 2024; Downey, 2014).

The concept of technology tools in education includes various digital resources that enhance teaching and learning. Interactive whiteboards, educational software, and online resources provide multisensory learning experiences and personalized instruction. Technology also supports collaborative learning and communication beyond the classroom, fostering critical thinking and teamwork (Wang et al., 2019). However, challenges such as the digital divide and inadequate teacher training continue to limit the full potential of ICT integration in education.

2.2 Empirical Review

Technological advancements have significantly influenced education, particularly in Mathematics. The portability, usability, and widespread access to the internet have made ICT devices valuable learning aids beyond traditional classrooms (Johnson et al., 2016). These tools have expanded educational boundaries, contributing to more engaging and effective teaching methods. Research suggests that technology in classrooms positively influences students' attitudes, improving their understanding and ability to engage with mathematical concepts (Gibbs & Simpson, 2015).

A key feature of educational technology is its ability to save time on manual computations, allowing students to focus on higher-order tasks, such as analyzing graphs and mathematical data (Saparbayeva et al., 2024). The use of technology supports deeper learning of Mathematics by fostering generalization and abstraction, which are vital for conceptual understanding. Moreover, research indicates that the integration of ICT in Mathematics instruction enables students to approach problems with greater critical thinking and problem-solving skills (Collins & Halverson, 2018).

Despite its benefits, integrating technology in Mathematics education faces challenges, particularly in terms of access and teacher training. Studies have shown that mobile learning and digital tools generally have positive effects on student performance, though results vary depending on the specific intervention and study design (Sung et al., 2016; Ghanbari et al., 2021). While students often view mobile technology positively, especially for collaborative and visual learning (Mei et al., 2023), ongoing research is required to understand the long-term impact of these tools on students' attitudes towards Mathematics.

Teachers' beliefs about technology play a crucial role in its classroom implementation. Educators often hesitate to adopt new methods, especially if they were trained in traditional, technology-free environments (Ajani, 2016). However, research suggests that as students demonstrate improved learning outcomes, teachers' attitudes towards technology shift, leading to changes in teaching practices (Chu et al., 2021). The successful integration of technology requires professional development for teachers, enabling them to leverage digital tools effectively in their instruction (Kalyani, 2024). Lastly, technology enhances collaboration and problem solving among students by promoting trial-and-error learning and fostering independence (Collins & Halverson, 2018). Tools like interactive whiteboards and portable devices increase student interest in Mathematics, making lessons more engaging and enjoyable. This shift in student perception is critical, as a positive attitude towards Mathematics often leads to better performance, particularly among those who previously struggled with the subject (Alsawaier, 2018; Maass et al., 2019).

III. METHODOLOGY

The study adopted a descriptive survey research design, combining both quantitative and qualitative methodologies (Kirumbi, 2018). The target population was 199, including 145 Mathematics teachers and 54 Head teachers from which the sample size was drawn. Questionnaires were distributed to 107 Mathematics teachers and 48 head teachers that made the entire sample of 155 respondents, while five head teachers participated in guided interviews to gather narrative data. The sample was determined using Taro Yamane's formula, ensuring a representative selection of participants from public secondary schools in Kayonza District. Purposive and random sampling techniques were used to select teachers and head teachers based on their roles and school location (Majid, 2018; Hazari, 2024). Data were collected using questionnaires and interviews, with a focus on how technological tools affect Mathematics teaching.

Data analysis involved both descriptive and inferential statistical methods. Quantitative data were analyzed using SPSS Version 21.0, with descriptive statistics such as means, frequencies, and regression coefficients, while qualitative data from interviews were organized thematically (Agresti & Franklin, 2015). The study employed correlation and regression analyses to assess the relationship between the integration of ICT tools and student performance in Mathematics, providing insights into the extent to which technology influences academic outcomes. Ethical considerations were paramount, with informed consent obtained from participants, and confidentiality maintained by anonymizing the data (Kadam, 2017; Bakar, 2018).

IV. FINDINGS & DISCUSSION

4.1 Quantitative Data

This section is concerning with data presentation, interpretations and discussions. It contains quantitative data as spanned through questionnaires from both Mathematics teachers and Head teachers, and qualitative data collected with Head teachers through interview.

4.1.1 Response Rate

The table below shows the response rate for all participants relative to the total sample size.

Table 1
Response Rate

Category	Participants	Responses	%
Mathematics teachers	107	107	100
Head teachers	48	48	100
Total	**155**	**155**	

As shown in table 1, all the respondents actively engaged in the information collecting. In other words, the table 1 shows that there were 107 Mathematics teachers and 48 head teachers participating, and all of them responded, as indicated by a 100% response rate for both groups.

4.1.2 Respondents Characteristics

The study analyzed the demographic characteristics of the 155 respondents, comprising Mathematics teachers and head teachers, achieving a 100% response rate. Key factors considered included age, gender, educational background, and teaching experience. The maturity and age distribution of the teachers were essential in assessing their professional capability, while gender was analyzed to evaluate balance in secondary schools. Additionally, the teachers' education levels and experience were examined to understand their expertise and its impact on the teaching process in Kayonza District.

Table 2 below outlines the demographic characteristics of respondents, categorized by gender, age, education level, and work experience. Of the 107 respondents, 57% are male and 43% female, reflecting a male-dominated sample. Most respondents are aged 26-35 (43%), with a notable younger demographic, as only 11.2% are aged 46 and above. Educationally, a significant majority hold a Bachelor’s Degree (78.5%), indicating a highly educated group, while only 9.3% have advanced degrees. In terms of work experience, 48.6% possess 6-10 years, suggesting a relatively experienced workforce, with 88.8% having at least one year of experience. Overall, the table 2 illustrates that the majority of respondents are male, predominantly aged between 26-35 years, highly educated (mostly holding Bachelor's degrees), and have significant work experience, primarily within the range of 6-10 years.

This demographic profile may indicate a workforce that is relatively young, educated, and experienced, which can have implications for research, policy-making, or workforce development strategies.

Table 2

Demographic Information of Teachers (N=107)

Descriptives	Label	Frequency	Percentage
Gender of Respondents	Male	61	57.0
	Female	46	43.0
Age of Respondents	Age 21-25	12	11.2
	Age 26-35	46	43.0
	Age 36-45	37	34.6
	Age 46 and above	12	11.2
Education of Respondents	A1 Diploma or Advanced Diploma	13	12.1
	Bachelor’s Degree (Ao)	84	78.5
	Master’s Degree and PhD	10	9.3
Work Experience	Less than 1 year	8	7.5
	1-5 Years	35	32.7
	6-10 Years	52	48.6
	Above 10 years	12	11.2

The table 3 reveals a demographic breakdown of respondents, with a majority being male (68.8%), indicating a gender imbalance. The largest age group is 26-35 years (35.4%), followed by 36-45 years (31.3%), while only 14.6% are aged 21-25 and 18.8% are 46 and older. Most respondents hold a Bachelor’s Degree (87.5%), with only 12.5% having advanced degrees. In terms of work experience, 37.5% have over 10 years, and 62.5% have more than 5 years, highlighting an experienced, predominantly male and well-educated workforce, mainly in their early to middle adulthood.

Table 3
Demographic Information of Head Teachers (N=48)

Demographic Information	Label	Frequency	Percentage
Gender of Respondents	Male	33	68.8
	Female	15	31.3
Age of Respondents	Age 21-25	7	14.6
	Age 26-35	17	35.4
	Age 36-45	15	31.3
	Age 46 and above	9	18.8
Education of Respondents	Bachelor's Degree (Ao)	42	87.5
	Master's Degree and PhD	6	12.5
Work experience	Less than 1 year	5	10.4
	1-5 Years	12	25.0
	6-10 Years	13	27.1
	Above 10 years	18	37.5

4.2 Presentation of Findings

The study presents two types of findings: quantitative data from questionnaires completed by both teachers and head teachers, and qualitative data from head teachers' interviews. The researcher first presents the quantitative findings. The researcher utilizes descriptive and inferential statistics to present and analyze data. He discusses the current level of technological usage for Mathematics education in public secondary schools within Kayonza District.

4.2.1 Quantitative Results

The following table 4 shows teachers' perceptions of how technology usage influences Mathematics education in public secondary schools in Kayonza District, Rwanda.

Table 4
Teachers' Perceptions on the Current Level of Technological Usage for Mathematics Education in Public Secondary Schools within Kayonza District

Statement	N	Mean	Std. Dev.	Variance	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
Using interactive whiteboards in Mathematics indicates use of Technology	107	4.4579	.74328	.552	1.003	.463
Using any educational software Google Classroom, Kahoot, etc.) in Mathematics subject means that I am using technology	107	4.5047	.73168	.535	3.988	.463
Using online resources indicate technology in teaching Mathematics subject	107	4.3645	.81718	.668	2.185	.463
Using digital devices indicate technology usage in Mathematics	107	4.7290	.57577	.332	3.022	.463
Valid N (listwise)	107					

The table 4 presents descriptive statistics on teachers' perceptions of technological usage in Mathematics education, based on responses from 107 participants. It outlines four key aspects of technology integration, including the number of respondents (N), mean scores reflecting perceptions, standard deviation indicating response variability, variance, and kurtosis, which measures distribution shape. For interactive whiteboards, the mean score is 4.4579, suggesting a general agreement on their significance, with low variability. Educational software like Google Classroom received a mean of 4.5047, indicating strong support among teachers and a positive skew in responses.

Online resources garnered a mean of 4.3645, reflecting their relevance, though with slightly more variability in perceptions. Finally, digital devices scored the highest mean at 4.7290, signifying strong consensus on their importance in Mathematics instruction, accompanied by lower variability in responses. Overall, the data highlights a positive attitude toward various technology tools in enhancing mathematics education. Overall, the table indicates that teachers have a positive perception of various technology tools in Mathematics education, with digital devices being the most strongly endorsed. The means suggest a general consensus on the importance of these technologies, while the standard deviations reflect some variation in opinions, particularly regarding online resources. The kurtosis values indicate that perceptions are skewed positively, with a tendency toward agreement among respondents.

The results in the table 4 align with Albeshree et al. (2022) that explain technology-based simulations and online resources to create interactive spaces for practicing problem-solving techniques and offer extensive collections of practice exercises and tutorials.

Table 5

Head Teachers' Perceptions on the Current Level of Technological Usage for Mathematics Education in Public Secondary Schools within Kayonza District

Statement	N	Mean	Std. Dev.	Variance	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
The use of interactive whiteboards in Mathematics indicates the use of technology	48	3.8125	.86679	.751	.733	.674
Using educational software in Mathematics class indicates technological usage	48	3.8958	.92804	.861	-.299	.674
The use of online resources in the teaching of Mathematics demonstrates the use of technology	48	4.0417	1.07106	1.147	-.534	.674
The use of digital devices indicates technological usage in Mathematics	48	4.3333	.55862	.312	-.664	.674
Valid N (listwise)	48					

This table 5 presents descriptive statistics on teachers' perceptions of technology usage in mathematics education, based on responses from 48 participants. It includes key statistical measures for four aspects of technology integration: the total number of respondents (N), the mean score indicating teachers' perceptions, standard deviation reflecting response variability, variance showing how much values differ from the mean, and kurtosis assessing the distribution shape. For interactive whiteboards, the mean score of 3.8125 suggests a moderately positive perception, while the educational software received a mean of 3.8958, indicating somewhat favorable views but greater variability. Online resources scored higher at 4.0417, reflecting their perceived value, albeit with increased variability. Finally, digital devices garnered the highest mean of 4.3333, demonstrating strong agreement among teachers on their importance in Mathematics instruction, with relatively low variability in responses. Overall, the data suggests a generally positive attitude toward technology in Mathematics education, with particular emphasis on digital devices.

Overall, this table illustrates that teachers hold generally positive perceptions of various technological tools in Mathematics education, with digital devices being particularly well regarded.

The means indicate a favorable attitude toward the integration of technology, while the standard deviations and kurtosis values reflect varying levels of agreement and distribution shapes in the responses. This data suggests that while teachers recognize the importance of technology, their views on specific tools like interactive whiteboards and educational software exhibit some variability. The results are in accordance with Brown (2015) that highlighting interactive whiteboards and adaptive learning software to customize lessons to fit the needs of each student, making complex ideas easier to understand and aiding in skill development.

Table 6

Regression Coefficients between Independent Variables and Mathematics Proficiency as Answered by Teachers

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.482	.388		-1.242	.217
	Using interactive whiteboards in Mathematics indicates use of Technology	.231	.101	.214	2.300	.023
	Using any educational software (Google Classroom, Kahoot, etc.) in Mathematics subject means that I am using technology	-.145	.071	-.132	-2.044	.044
	Using online resources indicate technology in teaching Mathematics subject	.330	.082	.336	4.045	.000
	Using digital devices indicate technology usage in Mathematics	.677	.094	.485	7.194	.000

a. Dependent Variable: Mathematics proficiency in numeracy shows the level of student's performance

The multiple regression analysis shows that digital devices have the strongest positive effect on Mathematics proficiency in numeracy (Beta = .485, Sig. = .000), followed by online resources (Beta = .336, Sig. = .000) and interactive whiteboards with a moderate positive effect (Beta = .214, Sig. = .023). Interestingly, educational software has a small but significant negative effect on proficiency (Beta = -.132, Sig. = .044). All variables are statistically significant, indicating their reliability as predictors of student performance in numeracy. The results in this table confirm the statement of Aksu and Erdem (2018) that assert that the successful integration of technology can have a substantial impact on student performance in Mathematics across different areas.

Table 7

Model Summary between Independent Variables and Mathematics Proficiency

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.850[a]	.722	.711	.43228

a. Predictors: (Constant), Interactive whiteboards, Google Classroom, Online resources and Digital devices

The regression analysis in table 7 indicates that the use of Interactive whiteboards, Google Classroom, Online resources, and Digital devices has a strong positive impact on the dependent variable (R = .850), explaining 72.2% of the variation (R Square = .722). After adjusting for the number of predictors, the model still explains 71.1% of the variance (Adjusted R Square = .711), with a low standard error (.43228), demonstrating accuracy. These technologies significantly contribute to the outcome, aligning with Collins and Halverson (2018), who highlight their role in fostering problem-solving, independence, and self-efficacy in students.

Table 8

Regression Coefficients between Independent Variables and Improved Problem Solving Skills

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.330	.443		.744	.459
	Using interactive whiteboards in Mathematics indicates use of Technology	-.104	.115	-.105	-.902	.369
	Using any educational software (Google Classroom, Kahoot, etc.) in Mathematics subject means that I am using technology	-.027	.081	-.027	-.339	.735
	Using online resources indicate technology in teaching Mathematics subject	.188	.093	.209	2.014	.047
	Using digital devices indicate technology usage in Mathematics	.881	.108	.691	8.186	.000

a. Dependent Variable: Improved problem-solving skills indicate the level of student's performance

The regression analysis reveals that digital devices have the strongest positive impact on improving students' problem-solving skills in Mathematics (B = 0.881, Beta = 0.691, Sig. = 0.000), followed by online resources, which show a moderate positive effect (B = 0.188, Beta = 0.209, Sig. = 0.047). However, interactive whiteboards and educational software display slight negative effects, though these are not statistically significant, suggesting minimal influence on performance. These findings align with Ghanbari et al. (2021) and Perry and Steck (2015), who observed declines in test scores with certain mobile interventions.

Table 9

Model Summary between Independent Variables and Improved Problem Solving

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.751[a]	.565	.548	.49386

a. Predictors: (Constant), Interactive whiteboards, Google Classroom, Online resources and Digital devices

The regression analysis in this model summary shows that the use of Interactive whiteboards, Google Classroom, Online resources, and Digital devices explains a significant portion (56.5%) of the variance in the dependent variable, with a strong positive relationship between these technologies and the outcome. The model remains robust after adjustment (Adjusted R Square = 54.8%), with moderate variability in predictions. These findings align with Maass et al. (2019), who suggest that technology facilitates continuous knowledge construction, improving the understanding of mathematical concepts.

Table 10
Regression Coefficients between Independent Variables and Conceptual Understanding

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.137	.419		-.328	.744
	Using interactive whiteboards in Mathematics indicates use of Technology	.473	.109	.436	4.351	.000
	Using any educational software (Google Classroom, Kahoot, etc.) in Mathematics subject means that I am using technology	-.138	.076	-.125	-1.798	.075
	Using online resources indicate technology in teaching Mathematics subject	.249	.088	.253	2.821	.006
	Using digital devices indicate technology usage in Mathematics	.437	.102	.313	4.296	.000

a. Dependent Variable: Improved conceptual understanding proves the level of student's performance

The multiple regression analysis in Table 10 shows that the use of interactive whiteboards (B = 0.473), online resources (B = 0.249), and digital devices (B = 0.437) positively and significantly enhances students' conceptual understanding in mathematics, with digital devices having the strongest impact. While educational software shows a slight negative effect (B = -0.138), it is not statistically significant. These findings align with Nteziryimana and Niyobuhungiro (2023), who found that students using ICT tools in Huye district, Rwanda, outperformed those relying on traditional methods, recommending more teacher training and ICT resources.

Table 11
Model Summary between Independent Variables and Conceptual Understanding

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.822[a]	.676	.663	.46724

a. Predictors: (Constant), Interactive whiteboards, Google Classroom, Online resources and Digital devices

The regression analysis in Table 11 reveals that the use of interactive whiteboards, Google Classroom, online resources, and digital devices has a strong positive impact on the dependent variable, explaining 67.6% of its variation (R Square = 0.676). The model remains robust after adjustment (Adjusted R Square = 66.3%) and provides reasonably accurate predictions. These technologies are significant contributors to improving conceptual understanding. The findings align with Kalyani (2024), which emphasizes the importance of teachers' technological knowledge in enhancing student interaction and problem solving in Mathematics.

4.2.2 Qualitative Results

Interviews with five anonymized head teachers revealed varying levels of technology integration in Mathematics instruction across schools in Kayonza District. Most schools use computers, projectors, and online resources, but face challenges such as limited training, insufficient computers, and poor internet connectivity. Teachers generally view technology as beneficial, motivating students and improving performance, though time management and preparation are issues. Schools assess technology's effectiveness through exams and supervision, and provide professional development for teachers. Future plans include expanding training, building smart classrooms, and increasing computer labs, with head teachers calling for more support from policymakers in terms of resources and infrastructure. These findings align with previous studies, such as Downey (2014), which emphasize that differences in access to technology and internet connectivity contribute to educational inequalities. Mpuangnan (2024) also highlights the potential for technology to boost student engagement, but warns that it can be distracting if not properly managed. Helsper (2021) and Aidoo et al. (2022) further emphasize that inadequate teacher training and unequal access to technology infrastructure exacerbate educational disparities.

V. CONCLUSIONS & RECOMMENDATIONS

5.1 Conclusions

The study found that both teachers and head teachers in Kayonza District recognize the positive impact of technology on Mathematics education, with digital devices seen as particularly beneficial for improving students' skills.

Teachers showed a strong consensus in support of digital tools like educational software, interactive whiteboards, and online resources, aligning with findings from previous studies that highlight technology's role in fostering interactive learning in Mathematics.

Although teachers and head teachers mostly agreed on the advantages of these tools, there was some variation in their views on specific technologies, especially interactive whiteboards and educational software. This difference suggests a need for consistent training and strategic approaches to integrating these tools effectively in the classroom. The findings emphasize the importance of digital devices and online resources in supporting mathematical learning and underscore the role of continuous training to maximize the benefits of technology in education.

The findings conclude that both teachers and head teachers in Kayonza District recognize the importance of technology in Mathematics education, with digital devices being the most valued tool for improving numeracy and problem-solving skills. Teachers show strong consensus on the positive impact of technology, though head teachers express more opinions that are varied on specific tools like interactive whiteboards and educational software, highlighting the need for consistent training and strategies. Digital devices and online resources significantly boost student performance, while interactive whiteboards show mixed results, and educational software has a minor negative effect. Schools face challenges such as limited training, insufficient computers, and poor internet connectivity, but efforts are underway to expand technology use through more training and infrastructure development. Substantial support from policymakers is needed to address these challenges and ensure effective, equitable access to technology for improving student outcomes in Mathematics.

5.2 Recommendations

The researcher recommends prioritizing the acquisition of more digital devices, such as computers and projectors, to enhance the integration of technology in Mathematics instruction in secondary schools, particularly in Kayonza District. Policymakers and education stakeholders should provide financial support to ensure equal access to technological resources across all schools, while expanding professional development programs to improve teachers' skills in using digital tools. Enhancing internet connectivity is essential for utilizing online resources, and developing smart classrooms equipped with interactive boards and multimedia systems should be a focus. Schools should establish regular monitoring and evaluation systems to track the impact of technology on student performance, while also addressing challenges with educational software through tailored programs and teacher training. Collaboration with policymakers is necessary to secure resources and infrastructure for sustainable, technology-based learning environments.

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