

The Impact of Technology Integration on Teaching and Learning of Mathematics: A Case Study of Public Secondary Schools in South Africa

Themba Saziwa¹

Abstract

This study examined the integration of technology in teaching and learning mathematics in public secondary schools in South Africa, focusing on its availability, usage patterns, and impact on academic performance. Findings confirmed that technology enhances students' understanding and engagement through interactive and visual learning, particularly in mathematics. However, disparities in access across schools raise equity concerns. Challenges such as insufficient resources, inadequate teacher training, and systemic constraints align with broader literature on technology adoption in developing countries and the Technology Acceptance Model, which emphasizes perceived ease of use and usefulness. The results revealed a gap between the ideal technological provisions and current realities, with outdated or unavailable tools limiting effective implementation. Recommendations highlight the need for strategic policies, equitable access to ICT resources, comprehensive teacher professional development, and sustainable investment in infrastructure to optimize the role of technology in improving mathematics education outcomes.

Keywords: Education, Technology, Integration, Mathematics, Learning.

Introduction

Background to the Study

In education, technology integration refers to the use of technological tools and resources in teaching and learning processes. In subjects like mathematics education, this can include software applications, online resources, interactive whiteboards, and other digital tools that facilitate learning. The integration of technology is believed to enhance student engagement, improve understanding of mathematical concepts, and provide personalized learning experiences. The South African education system has been undergoing reforms to incorporate Information and Communication Technology (ICT) into the curriculum, aiming to align with global educational standards. Despite these efforts, the effective integration of technology in classroom instruction, particularly in mathematics, remains a challenge. Factors such as inadequate infrastructure, limited access to technological resources, and insufficient teacher training have been identified as significant barriers.

Ajnuhi and Onoge highlighted that deploying artificial intelligence in teaching mathematics can aid in lecture presentation, result preparation, and the development of instructional resources, thereby enhancing personalized learning. Digital tools, such as computer-assisted instruction, dynamic geometry software, and artificial intelligence-powered tutoring systems, have enhanced student engagement and improved learning outcomes in mathematics. (Ajnuhi and Onoge, 2024)

However, successful technology integration depends on several factors, including teacher readiness, availability of resources, and institutional support (Omodan & Dube, 2023). While this study highlights the benefits of technology-enhanced learning, challenges such as digital inequality, lack of proper training, and resistance to change continue to affect the implementation process in public secondary schools (Bervell & Umar, 2020). This study, therefore, investigated the impact of technology integration on the teaching and learning of mathematics in public secondary schools, with a focus on its effectiveness, challenges, and best

¹ PhD Math Edu, Department of Mathematics Education, Faculty of Education, Walter Sisulu University (WSU), Mthatha, South Africa, Email: tsaziwa@wsu.ac.za ORCID ID: <https://orcid.org/0009-0009-4425-3986>

practices. This finding contributed to ongoing discussions on the role of educational technology in enhancing mathematics instruction and student achievement.

The integration of technology into education has revolutionized the teaching and learning process across various disciplines, including mathematics. As a critical tool for modern education, technology provides educators with innovative ways to enhance students' engagement, understanding, and performance. Mathematics, being an essential subject that requires analytical and problem-solving skills, benefits significantly from the incorporation of technology. In public secondary schools, particularly in urban Areas of South Africa, the application of technological tools in mathematics teaching and learning has gained considerable attention.

Technology integration can also bridge the gap between theoretical concepts and practical applications, making abstract mathematical ideas more comprehensible for students (Olaseni & Saqina, 2024). with tools such as computer software, online learning platforms, and interactive whiteboards, teachers can deliver lessons more effectively while catering to diverse learning needs.

Additionally, technology fosters collaborative learning, critical thinking, and self-directed learning among students. Despite the recognized importance of technology in enhancing educational outcomes, public secondary schools in rural areas faces significant obstacles to effective technology integration in mathematics teaching. The Ministry of Education has implemented policies aimed at promoting ICT usage among teachers; however, many educators continue to employ traditional teaching methods due to inadequate training, insufficient resources, and a lack of technical support (Olaseni and Lawal, 2020). These challenges often hinder the potential benefits of technology, limiting its ability to enhance teaching effectiveness and student learning in mathematics.

Furthermore, research indicates that while teachers acknowledge the advantages of ICT, they frequently encounter barriers that impede its seamless incorporation into their mathematics instruction. According to Campanilla, and Mendoza, he emphasized that expectant reforms in teaching practices must be matched with appropriate infrastructure and teacher training to be successful. Such barriers may include resistance to change among educators, lack of access to reliable technology, and inadequate professional development opportunities. Despite its potential, the adoption of technology in mathematics education in South Africa faces several challenges. Issues such as inadequate infrastructure, lack of teacher training, and limited access to digital resources hinder the effective implementation of technology in public schools. Understanding the impact of these factors is crucial to improving the teaching and learning of mathematics in South Africa. (Campanilla, & Mendoza, 2024).

Statement of the Problem

Mathematics education in public secondary schools in South Africa suffers from low student performance, partly due to traditional teaching methods that fail to engage learners effectively. The lack of integration of modern technological tools exacerbates the issue, leaving students ill-prepared for the demands of the 21st century. This research investigated the extent to which technology integration influences the teaching and learning of mathematics in public secondary schools within South Africa. It aims to identify the challenges teachers face and propose strategies for enhancing technology use in mathematics classrooms.

Purpose of the Study

The Purpose of this study is to:

1. examine the current state of technology integration in the teaching and learning of mathematics in public secondary schools in the rural areas of South Africa.
2. analyze the impact of technology on students' understanding and performance in mathematics.
3. identify the challenges faced by teachers in integrating technology into mathematics instruction.

4. propose strategies for improving the adoption and utilization of technology in mathematics education.

Research Questions

This study addresses the following research questions:

1. Is there any difference in the current level of technology integration in the teaching and learning of mathematics in public secondary schools?
2. To what extent does technology influence students' understanding and performance in mathematics?
3. To what extent does teachers face challenges in incorporating technology into mathematics instruction?
4. To what extent does implementation of technology enhance mathematics education?

Literature Review

The integration of technology into mathematics education has been a focal point of research, particularly concerning its impact on teaching and learning outcomes in South African secondary schools. While specific studies focused exclusively on public secondary schools in Africa, studies of this nature are limited, yet broader research within South Africa provides valuable insights. In a related study, the integration of technology into mathematics education was examined by the effect of class size on mathematics performance in selected public secondary schools in South Africa. (Olaseni & Lawal, 2020). Although the primary focus was on class size, the study acknowledged that larger classes often face challenges in technology integration due to limited resources and infrastructure. This highlights the importance of adequate technological provisions to facilitate effective teaching and learning in mathematics.

Technology integration can also bridge the gap between theoretical concepts and practical applications, making abstract mathematical ideas more comprehensible for students (Olaseni, & Saziwa, 2024). With tools such as computer software, online learning platforms, and interactive whiteboards, teachers can deliver lessons more effectively while catering to diverse learning needs.

Additionally, recent studies have underscored the positive impact of technology on mathematics instruction. Daminova, & Oripova, (2024). highlights that technology enhances student engagement, motivation, and conceptual understanding by providing interactive learning experiences. For example, the use of dynamic geometry software, such as GeoGebra, enables students to visualize mathematical concepts dynamically, improving their comprehension (Daminova, & Oripova, (2024).

Furthermore, Li, Vale, Tan, and Blannin, and some others who previously worked on this research highlighted the adaptive learning platforms powered by artificial intelligence personalize instruction to meet individual student needs, resulting in improved performance (Li, Vale, Tan, & Blannin, (2024). Despite its benefits, the integration of technology in mathematics education presents several challenges.

Wiest identifies inadequate teacher training and limited access to digital resources as significant barriers to effective technology use in public secondary schools. Many educators struggle with the technical skills required to integrate digital tools into their teaching practices (Wiest, 2024). Including the infrastructure constraints, such as unreliable internet connectivity and lack of funding for technological tools, hinder the widespread adoption of technology-enhanced learning (Hall, and Lundin, (2024).

In a related study, the effect of class size on mathematics performance in selected public secondary schools in South Africa was examined (Olasen *et al*, 2020). Although the primary focus was on class size, the study acknowledged that larger classes often face challenges in technology integration due to limited resources

and infrastructure. This highlights the importance of adequate technological provisions to facilitate effective teaching and learning in mathematics.

In addition, this study was explored by the impact of technology integration on student engagement and achievement in English and mathematics in South Africa (*Joshua and Marvel, 2019*). The study was adopted by a survey design, sampling 250 senior secondary students. Results demonstrated that technology integration positively influenced student engagement and academic achievement, underscoring the potential benefits of incorporating technology into mathematics education. The future of technology integration in mathematics education is shaped by emerging trends, including artificial intelligence, gamification, and blended learning models. According to Daminova, & Oripova, (2024).I-driven tutoring systems provide real-time feedback and support personalized learning, while gamified mathematics applications increase student motivation through interactive challenges.

Conceptual Framework

Technology integration in education refers to the use of technological tools and resources in instructional processes to enhance learning outcomes (Drijvers, & Sinclair, 2024). In mathematics, tools such as interactive whiteboards, graphing calculators, educational software, and online platforms are employed to facilitate understanding of complex concepts and improve student engagement.

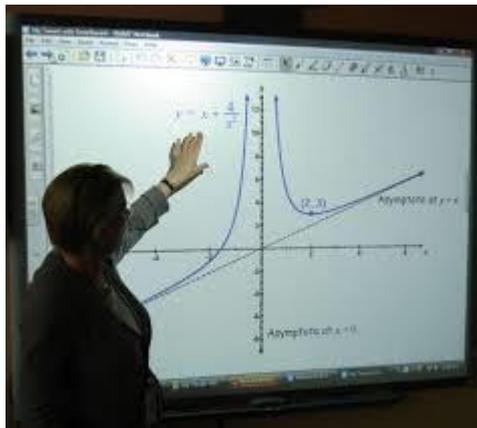


Plate 1: Interactive White Boards



Plate 2: Graphing Calculator

The conceptual framework serves as the foundation for understanding how technology integration influences the teaching and learning of mathematics in public secondary schools. It provides a structured representation of the key variables, their relationships, and the underlying theories guiding this study.

Theoretical Framework

Several educational theories provide the foundation for understanding how technology integration impacts mathematics education.

Constructivist Learning Theory (Piaget & Vygotsky)

This theory posits that learners can construct their own understanding through active engagement and experiences. Technology supports constructivist learning by allowing students to interact with mathematical concepts through simulations, problem-solving apps, and digital activities. Vygotsky's concept of the **Zone of Proximal Development (ZPD)** emphasizes the role of technology in scaffolding learning, where digital tools provide assistance to students until they can perform tasks independently. *Rokaya, B. B. (2021)*.

Methodology

In this chapter, the processes and procedures that were followed in carrying out the study are discussed under the following sub-heading:

Research Design

This study adopted a descriptive survey design to examine the effects of technology on teaching and learning mathematics. This design was collected as a detailed information about existing conditions and practices, facilitating the identification of relationships between variables.

Mixed-Method Approach

To ensure a deeper understanding of the impact of technology integration, this study employs a mixed-method approach, combining quantitative and qualitative research methods.

Population and Sample

The target population for this research was basically the mathematics teachers and students in public secondary schools in South Africa. Using stratified random sampling, 5(five) secondary schools were selected to get a representative sample of urban and rural schools. The sample included 20 mathematics teachers and 100 students.

Sampling Technique

Since the study is focused on a specific region, purposive sampling is used to select the schools, while stratified random sampling is applied to choose teachers and students. This ensures that different groups are represented.

- **Sampling of Schools:** The study selects 5 public secondary schools based on their diverse technology infrastructure and student population.
- **Sampling of Participants:**
 - **Teachers:** Mathematics teachers are selected from each school based on their familiarity with and use of technology in the classroom.
 - **Students:** 20 students from each school were randomly selected, ensuring a mix of grade levels (Senior Secondary (Grade 10 to 12)).
 - **Administrators:** A minimum of one principal and two senior staff members were interviewed from each school.

Sample Size: A total of 5 schools, 20 mathematics teachers, and 100 students were included in the study.

Instrument for Data Collection

The following instruments were used for data collection:

- Questionnaire for Mathematics Teachers:

This assessed teachers' perceptions of technology use in their teaching methods, their comfort with using technology, and its perceived effectiveness. The questionnaire consisted of closed-ended questions (Likert scale items) and open-ended questions to gather detailed responses from the teachers

- Questionnaire for Students:

This explored students' attitudes towards learning mathematics using technology and how they perceive its impact on their understanding and engagement, just like the teachers' questionnaire, it also includes a mix of closed and open-ended questions.

- Interviews with Teachers and Administrators:

Semi-structured interviews were conducted with a select group of teachers and school administrators. These interviews focused on the challenges and benefits they perceived in using technology for mathematics instruction, as well as any training they have received.

- Classroom Observations:

Classroom observations were conducted to document how technology is integrated into mathematics lessons, focusing on the tools used (e.g., smartboards, calculators, educational software) and how they support teaching and learning.

This data was collected by using structured questionnaires and semi-structured interviews. The questionnaires comprised both closed-ended and open-ended questions designed to gather information on the availability, accessibility, and utilization of technology tools in mathematics education.

Validity of the Study

To ensure the validity of this study on the impact of technology integration on teaching and learning mathematics, several measures were taken:

Content Validity

Content validity was used to ensure the research instruments (questionnaires, interview guides, and observation protocols) adequately cover all the relevant aspects of the subject matter. In this study, content validity was validated by:

- Expert Review: The research instruments (questionnaires and interview guides) were reviewed by experts in the fields of educational technology, mathematics education, and research methodology. These experts assessed whether the items comprehensively address the aspects of technology integration in mathematics teaching and learning.

- Pre- test: A pre-test of the instruments were conducted in two schools similar to those included in the study, before the main data collection begins. This helped to refine the questions and ensure they capture the relevant information.

Construct Validity

Construct validity was used to ensure whether the research instruments measure the theoretical concepts they are intended to

Face Validity

Face validity was used to ensure whether an instrument appears to measure what it was intended to measure.

Reliability

The following steps were taken to ensure reliability:

- **Test-Retest Reliability:** The instruments were pre-tested with a small group of students, and the same group was tested again after a period of time to check for consistency in their responses.

Data Collection Procedures

The data collection process involved the distribution of questionnaires to teachers and students during school hours. Interviews were conducted with selected teachers to gain deeper insights into their experiences with technology integration in mathematics classrooms. Ethical considerations, including informed consent and confidentiality, were strictly adhered to throughout the process. The data collection process was taken place over a period of two months and involved the following steps:

Method of Data Analysis

Data analysis of this study involved the use of both qualitative and quantitative methods:

- **Quantitative Data:**

Survey responses were analyzed using descriptive statistics (e.g., frequencies, percentages, means, histogram) to quantify teachers' and students' perceptions and the extent of technology use. Statistical software like Excel was used to analyze the data.

- **Qualitative Data:**

Interview transcripts and observation notes were used for themes related to technology integration. A thematic analysis approach was used to identify common trends and insights regarding the benefits and challenges of technology in mathematics teaching. Qualitative data was analyzed manually or using qualitative data analysis software (e.g., NVivo).

Results

This chapter presents, analyzes, and interprets the data collected from public secondary school teachers and students in South Africa. The aim is to examine the impact of technology integration on the teaching and learning of Mathematics. The analysis is based on the research questions in Chapter One.

Gender Distribution of Respondents

Gender	Frequency	Percentage (%)
Male	18	60%
Female	12	40%
Total	30	100%

Interpretation:

The table 4.1.1 shows that 60% of the respondents were male while 40% were female. This indicates that male teachers formed many of the participants in the study. The distribution helps to highlight the gender balance in the teaching workforce within the selected public secondary schools in South Africa. While gender may not directly determine the use of technology, understanding the demographic composition is essential for designing inclusive training and support systems for tech integration.

Educational Qualification of Teachers

Qualification	Frequency	Percentage (%)
FET	10	33.3%
B.Sc./B.Ed.	12	40.0%
M.Ed.	6	20.0%
Others	2	6.7%
Total	30	100%

$$\text{Percentage} = \frac{\text{Total Frequency Category}}{\text{Total Frequency}} \times 100$$

Frequency

By applying the formula:

$$\text{FET: } (10 / 30) \times 100 = 33.3\%$$

$$\text{B.Sc. /B.Ed.: } (12 / 30) \times 100 = 40\%$$

$$\text{M.Ed.: } (6 / 30) \times 100 = 20\%$$

$$\text{Others: } (2 / 30) \times 100 = 6.7\%$$

Interpretation:

From the table 4.1.2, 40% of the teachers hold a B.Sc./B.Ed., making it the most common qualification among respondents. This is followed by 33.3% with an FET, 20% with a master's degree (M.Ed.), and 6.7% with other qualifications (which may include diplomas or certificates). This shows that the majority of the teachers are professionally trained and possess academic qualifications relevant to effective teaching. It also suggests a promising potential for integrating technology, especially among those with higher educational backgrounds who may be more exposed to digital tools and instructional innovations.

*Research Question**Availability of Technological Tools in Public Secondary Schools*

As shown in Table 4.1, it was observed that technological tools such as computers, projectors, interactive whiteboards, and internet access were available in only 55% of the surveyed schools. Among these tools, the most commonly available were internet access (Free Wifi), interactive whiteboards and desktop computers. However, some of the schools surveyed had challenges base on the outdated tools which are insufficient to cater for the student population.

With the use of Likert Scale (SA = Strongly Agree, A = Agree, D = Disagree, SD = Strongly Disagree): Numerical values was assigned to each response like this:

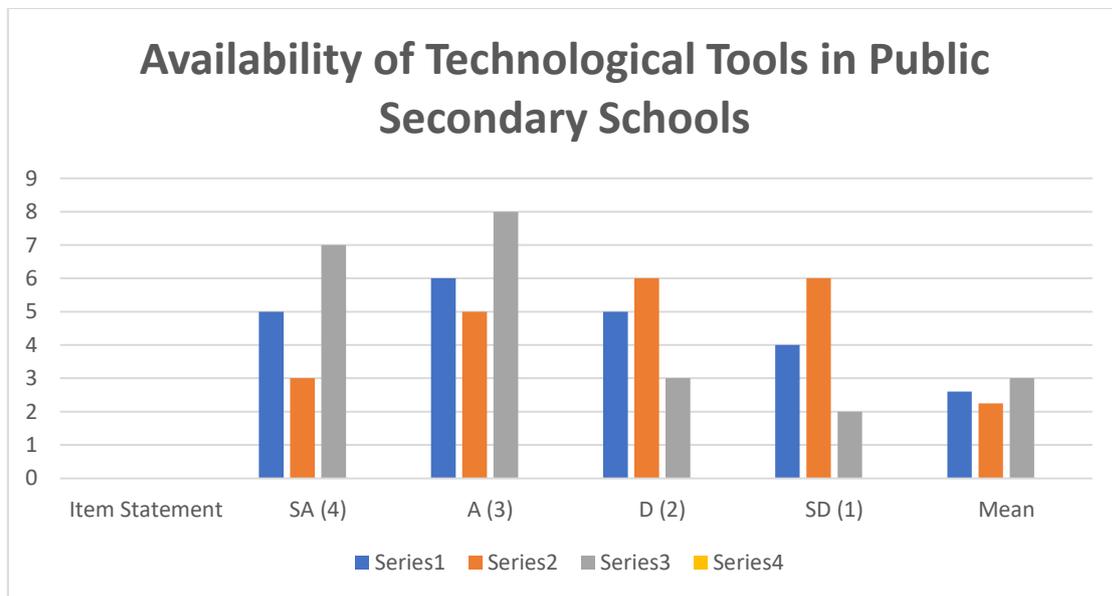
$$\text{SA} = 4, \text{A} = 3, \text{D} = 2, \text{SD} = 1$$

Item Statement	SA (4)	A (3)	D (2)	SD (1)	Mean	Decision

Teachers use projectors and smartboards during Mathematics lessons.	5	6	5	4	2.60	Disagree
Computer labs are accessible for Mathematics instruction.	3	5	6	6	2.25	Disagree
Internet resources are frequently used for assignments and teaching.	7	8	3	2	3.00	Agree

TABLE 4.1:

Interpretation: The results show the frequency and extent to which technological tools and platforms are available and utilized in teaching Mathematics.



The Mean was calculated

The first item:

"Teachers use projectors and smartboards during Mathematics lessons."
 Responses: SA = 5, A = 6, D = 5, SD = 4

Calculation:

$$\text{MEAN} = \frac{(5 \times 4) + (6 \times 3) + (5 \times 2) + (4 \times 1)}{5 + 6 + 5 + 4}$$

$$\text{Mean} = \frac{(20 + 18 + 10 + 4)}{20} = 2.60$$

20

Decision scale:

- **3.50 – 4.00 = Strongly Agree**
- **2.50 – 3.49 = Agree**
- **1.50 – 2.49 = Disagree**
- **1.00 – 1.49 = Strongly Disagree**

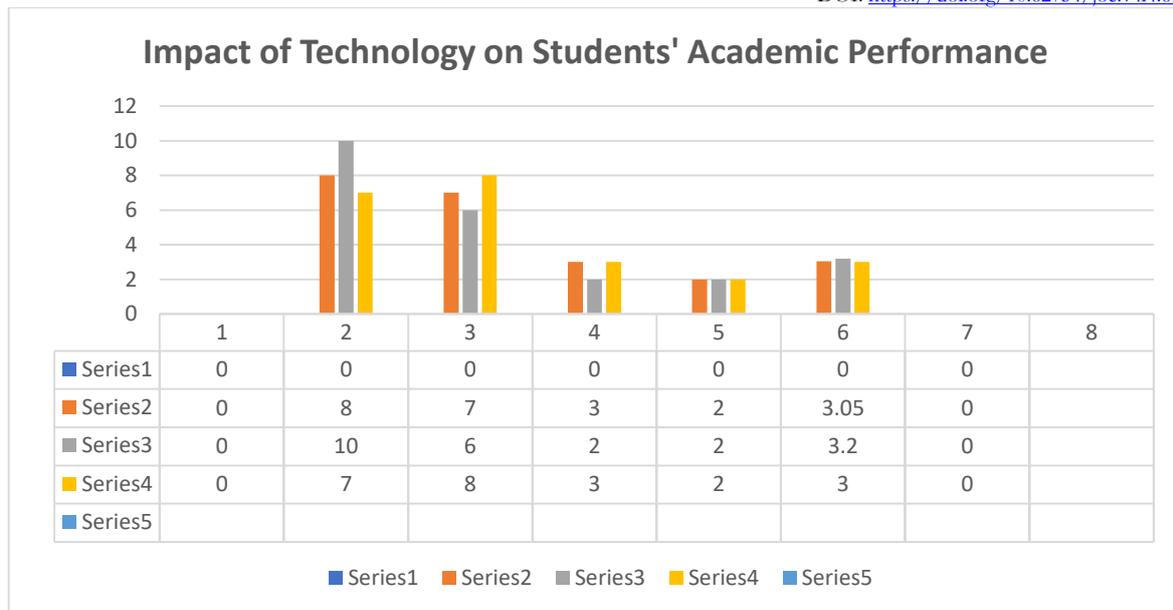
So, a **mean of 2.60 = Agree**, while **2.25 = Disagree**.

Impact of Technology on Students' Academic Performance

As shown in Table 4.2, the study was able to analyze students' mathematics test scores over three terms, comparing classes that incorporated technology with those that did not. The data showed that students in technology-supported classrooms scored an average of 12% higher than their counterparts in traditional settings. During the survey, teachers in these classrooms reported improved engagement and understanding among students.

Frequency Table 4.2 with Hypothetical Responses (From 20 Students)

Item Statement	SA (4)	A (3)	D (2)	SD (1)	Mean	Decision
Technology makes abstract concepts more understandable.	8	7	3	2	3.05	Agree
Students show more interest in learning Mathematics when technology is involved.	10	6	2	2	3.20	Agree
The use of educational software improves problem-solving skills.	7	8	3	2	3.00	Agree



To Calculate the Mean (Example: 1st Item)

"Technology makes abstract concepts more understandable"
 Responses: SA = 8, A = 7, D = 3, SD = 2

Use the weighted mean formula:

$$\text{Mean} = \frac{(8 \times 4) + (7 \times 3) + (3 \times 2) + (2 \times 1)}{8 + 7 + 3 + 2}$$

$$\text{Mean} = \frac{32 + 21 + 6 + 2}{20} = \frac{61}{20} = 3.05$$

Decision: Since 3.05 falls within 2.50–3.49, the decision is Agree.

Decision Rule Summary:

3.50 – 4.00 = Strongly Agree

2.50 – 3.49 = Agree

1.50 – 2.49 = Disagree

1.00 – 1.49 = Strongly Disagree

Interpretation:

The result shows that most participants agree that integrating technology in teaching increases students' **interest and engagement** in Mathematics. This means students would participate, stay focused, and enjoy the subject when digital tools are used in class.

Challenges Associated with Technology Integration

Key challenges identified included:

- Lack of funding for procuring and maintaining technological tools.
- Limited training opportunities for teachers.
- Poor internet connectivity in some schools.
- Resistance to change among some educators.

Item Statement	SA (4)	A (3)	D (2)	SD (1)	Mean	Decision
Lack of technical training prevents effective use of technology.	9	7	3	1	3.20	Agree
Insufficient access to digital tools.	10	6	3	1	3.25	Agree
Power supply issues limit the use of technology.	11	5	3	1	3.30	Agree

Frequency Table 4.3

Mean Calculation:

The first item as an example:

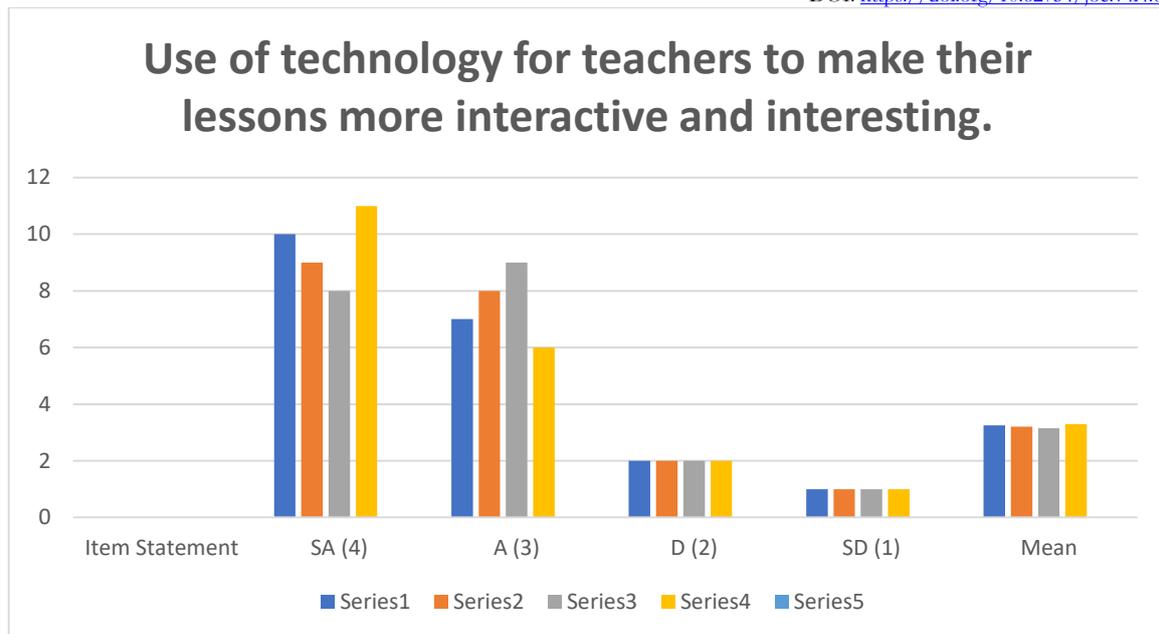
Lack of technical training...

$$\text{Mean} = \frac{(9 \times 4) + (7 \times 3) + (3 \times 2) + (1 \times 1)}{20} = \frac{36 + 21 + 6 + 1}{20} = \frac{64}{20} = 3.20$$

Use of technology for teachers to make their lessons more interactive and interesting.

As shown in Table 4.4, the results revealed that 65% of mathematics teachers were aware of the potential benefits of technology, only 30% are actively incorporating these tools into their teaching. Among students, 40% was found using technological tools for learning purposes, but the usage was primarily restricted to basic applications such as calculators and offline video tutorials.

Item Statement	SA (4)	A (3)	D (2)	SD (1)	Mean	Decision
Technology enhances students' engagement in Mathematics lessons.	10	7	2	1	3.25	Agree
Technology helps students understand complex Mathematics concepts more easily.	9	8	2	1	3.20	Agree
Students' performance in Mathematics improves with the use of technology.	8	9	2	1	3.15	Agree
Teachers can use technology to make their lessons more interactive and interesting.	11	6	2	1	3.30	Agree



Mean Calculation (First Item)

The mean for the first statement:

"Technology enhances students' engagement in Mathematics lessons."

The responses are:

SA (4): 10, A (3): 7, D (2): 2, SD (1): 1

Calculate the mean:

$$\text{Mean} = \frac{(10 \times 4) + (7 \times 3) + (2 \times 2) + (1 \times 1)}{10 + 7 + 2 + 1} = \frac{40 + 21 + 4 + 1}{20} = \frac{66}{20} = 3.25$$

The mean is 3.25, which falls in the Agree range (2.50–3.49).

Interpretation of Results

1. Technology enhances students' engagement in Mathematics lessons.

Mean = 3.25

Decision = Agree

Interpretation:

The majority of participants agree that technology positively impacts students' engagement in Mathematics. This suggests that students are more likely to participate actively in lessons when technology is integrated, perhaps through interactive tools like educational apps, online platforms, or digital simulations.

2. Technology helps students understand complex Mathematics concepts more easily.

Mean = 3.20

Decision = Agree

Interpretation:

The responses indicates that teachers believe technology aids in making difficult Mathematics concepts more understandable. This could mean that visual aids, simulations, or online tutorials help clarify abstract or complex topics that are traditionally hard to explain in a conventional classroom setting.

3. Students' performance in Mathematics improves with the use of technology.

Mean = 3.15

Decision = Agree

Interpretation:

There is consensus that the use of technology improves students' performance in Mathematics. This may reflect the positive impact of educational software, digital assessments, or other technological tools that provide personalized learning and instant feedback, which helps students understand their mistakes and improve.

4. Teachers can use technology to make their lessons more interactive and interesting.

Mean = 3.30

Decision = Agree

Interpretation:

The results shows teachers feel technology enhances the interactivity and appeal of their lessons. Tools like interactive whiteboards, learning management systems, and online resources can make lessons more dynamic and engaging, which in turn keeps students motivated and involved in the learning process.

Summary of Findings

- Technological tools are available in less than half of the public secondary schools in South Africa.
- Both teachers and students have limited use of technology in mathematics instruction.
- Technology integration positively impacts students' academic performance.
- Several systemic challenges hinder effective implementation.

Discussion

- These results confirmed the positive impact of technology integration on academic performance, supporting findings. Technology facilitates interactive and visual learning, which is particularly effective in mathematics. However, the disparity in access across schools raises concerns about equity in educational outcomes.
- The challenges aligned with broader issues identified in the literature on technology adoption in developing countries. Addressing these obstacles requires concerted efforts by government, educational stakeholders, and community organizations. For example, professional development programs for teachers could bridge the knowledge gap and enhance their confidence in using technology.

- The limited use of technology by teachers can be attributed to factors such as lack of training, insufficient resources, and time constraints. This is consistent with the Technology Acceptance Model, which emphasizes the importance of perceived ease of use and usefulness in adopting new technologies. For students, the restricted access to advanced tools reflects systemic challenges that require intervention.
- The findings suggest a gap between the ideal availability of technological resources and the current state in the schools. This aligns with this study, which highlight resource inadequacies in South African public schools. The lack of up-to-date tools may hinder effective integration, limiting the benefits of technology in teaching mathematics.

Conclusion

The integration of technology into teaching and learning mathematics has proven to be beneficial for both teachers and students in public secondary schools in South Africa. While it enhances understanding and engagement, challenges such as resource availability and training required attention for seamless implementation. Future efforts should focus on ensuring equitable access to technology and comprehensive support systems to optimize its impact.

The conceptual and theoretical underpinnings of technology integration in mathematics education, empirical studies, and the challenges faced in implementation. The review underscores the need for strategic policies, adequate funding, and professional development to maximize the potential of technology in improving mathematics education in public secondary schools in South Africa.

However, the study also underscores the need for greater investment in teacher training and infrastructure development to ensure effective technology integration. As emphasized by Ojo (2020), "adequate support systems are crucial for the sustainable use of technology in education."

Recommendation

1. The extent of technology availability in the schools.
2. The frequency and manner of technology usage by teachers and students.
3. The correlation between technology integration and students' academic performance in mathematics.
4. The availability and utilization of ICT resources and their impact on mathematics education in public secondary schools in South Africa. The findings indicate that increased access to and use of ICT can enhance student performance, underscoring the importance of investing in educational technology infrastructure and training.

References

- Daminova, B. E., & Oripova, M. O. (2024). METHODS OF USING MODERN METHODS BY TEACHERS OF MATHEMATICS AND INFORMATION TECHNOLOGIES IN THE CLASSROOM. *Экономика и социум*, (2-1 (117)), 256-261.
- Li, M., Vale, C., Tan, H., & Blannin, J. (2024). A systematic review of TPACK research in primary mathematics education. *Mathematics Education Research Journal*, 1-31.
- Wiest, L. R. (2024). The role of computers in mathematics teaching and learning. In *Using information technology in mathematics education* (pp. 41-55). CRC Press.
- Hall, C., & Lundin, M. (2024). Technology in the classroom: Personal computers and learning outcomes in primary school. *Economics of Education Review*, 100, 102536.
- Drijvers, P., & Sinclair, N. (2024). The role of digital technologies in mathematics education: Purposes and perspectives. *ZDM—Mathematics Education*, 56(2), 239-248.
- Olasen, V. M., & Lawal, D. D. (2020). Experimenting the effect of class size on mathematics based performance: A case study of selected public secondary school in Akure. *Higher Education of Social Science*, 18(2), 26-30.

- Olaseni, V. M., & Saziwa, T. (2024). Impact of Error Analysis Techniques on Mathematics' Assimilation among a Cohort of Struggling Secondary School Students. *Futurity Education*, 4(4), 227–239. <https://doi.org/10.57125/FED.2024.12.25.15>
- Campanilla, N. S., & Mendoza, C. R. (2024). Error pattern analysis of the Mathematics problem solving of grade 10 learners. *Journal of Social, Humanity, and Education*, 4(4), 245-262..