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Digital Writing Pads in Mathematics Education: Challenges Experienced by Private School Teachers

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ABSTRACT

This study explored the challenges experienced by mathematics teachers from a private school located in Bulua, Cagayan de Oro City, Philippines, in integrating digital writing pads into classroom instruction. While digital writing pads have been recognized for their potential to enhance visualization and interactivity in mathematics learning, their adoption remains inconsistent and often problematic. Using a qualitative design, three mathematics teachers from private schools were purposively selected as participants. Data were collected through semi-structured survey-interviews and analyzed thematically.

Findings revealed three major categories of challenges**:** (1) pedagogical difficulties, including adjustments in teaching pace and classroom management when using digital pads; (2) technical issues, such as device responsiveness, connectivity problems, and software limitations; and (3) institutional constraints, particularly the lack of structured training and technical support. These challenges resulted in reduced instructional efficiency, student disengagement, and limited integration of digital writing pads in mathematics lessons.

The study concludes that successful integration of digital writing pads requires not only teacher competence but also reliable infrastructure and strong institutional backing. It is recommended that private schools provide continuous professional development, strengthen ICT infrastructure, and establish supportive policies to promote effective digital pedagogy. Future research may broaden the scope to include public schools or investigate student perspectives to enrich the understanding of digital tool integration in mathematics education.

Keywords: digital writing pads, mathematics education, private school teachers, challenges, qualitative research

INTRODUCTION

The integration of digital technologies into education has transformed traditional teaching methods, particularly in mathematics instruction. Among these innovations, digital writing pads have emerged as valuable tools that allow teachers to illustrate complex mathematical concepts, perform real-time problem solving, and enhance interactive classroom discussions. Unlike traditional chalkboards or whiteboards, digital writing pads provide a platform for visualizing equations, graphs, and diagrams in a more dynamic and accessible manner. Despite their potential, the use of digital writing pads presents challenges for many educators, especially in private schools where resource allocation, teacher training, and technical support may differ significantly from public or international institutions.

In mathematics education, effective communication of abstract and symbolic representations is essential. Digital writing pads are designed to bridge this gap by providing an avenue for clear demonstrations and interactive learning. Studies have shown that technology-assisted instruction can improve student motivation, conceptual understanding, and problem-solving abilities (Nguyen et al., 2021; Li & Ma, 2010). However, the successful integration of digital writing pads depends not only on the availability of devices but also on teachers' technological competence, pedagogical adaptation, and institutional support. Without these factors, the adoption of such tools may lead to frustration, limited use, or ineffective teaching practices.

Private school teachers often face unique conditions compared to their public school counterparts. While some private institutions may provide advanced resources, others may struggle with limited funding for training,

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infrastructure, and device maintenance (Tondeur et al., 2017). Consequently, teachers in these settings may encounter challenges such as unfamiliarity with the technology, lack of technical assistance, or difficulty in aligning digital tools with established curricula. These challenges hinder the effective utilization of digital writing pads, thereby affecting the overall quality of mathematics instruction.

REVIEW OF RELATED LITERATURE

The role of technology in mathematics instruction has been widely documented. According to Mishra and Koehler's (2006) Technological Pedagogical Content Knowledge (TPACK) framework, successful technology integration requires a balance of technological skills, pedagogical strategies, and content knowledge. For mathematics teachers, this means more than simply knowing how to operate digital writing pads; it involves redesigning lessons to maximize the tool's interactive and visual potential.

Several studies emphasize the benefits of digital writing pads in improving instructional delivery. Alshahrani and Walker (2020) highlight that digital writing tools promote active engagement by allowing real-time annotation and demonstration, which enhances mathematical visualization. Similarly, Yoon and Kim (2019) found that students showed improved problem-solving performance when teachers employed digital writing technologies in classroom instruction. These findings underscore the pedagogical potential of writing pads in making abstract mathematical concepts more concrete and understandable.

Despite these advantages, research also points to persistent challenges. Ertmer and Ottenbreit-Leftwich (2010) argue that teachers' beliefs, confidence, and preparedness significantly affect their willingness to adopt new technologies. Digital writing pads, while user-friendly in design, require consistent practice and training to be effectively integrated into mathematics teaching. Teachers unfamiliar with the interface may resort to traditional methods, thereby underutilizing the device. Additionally, Hew and Brush (2007) identify barriers such as insufficient technical support, lack of professional development, and limited institutional resources as recurring issues in technology integration.

In private school settings, these barriers may be more pronounced due to organizational differences in budget, management priorities, and professional development opportunities. As highlighted by Tondeur et al. (2017), unequal access to technology and training often results in a digital divide, even within the same educational sector. Thus, while some private school teachers may be equipped to use digital writing pads effectively, others may struggle due to systemic or personal limitations.

Research Gap

Although prior studies have explored the advantages and barriers of technology use in education, very few have specifically examined the lived experiences and perspectives of private school mathematics teachers in integrating digital writing pads into their instruction. Much of the existing literature focuses on quantitative measures of technology adoption or the experiences of public school teachers, leaving the private school context underexplored. This creates a gap in understanding how private school teachers—who operate under distinct resource conditions and administrative structures—navigate the challenges of using digital writing pads in teaching mathematics.

Objectives of the Study

This qualitative study aims to explore the challenges experienced by private school mathematics teachers in the use of digital writing pads. Specifically, it seeks to:

1. Explore the pedagogical, technical, and institutional barriers encountered by private school mathematics teachers.

2. Understand how these challenges influence their instructional practices in mathematics.

3. Generate insights and recommendations to improve the integration of digital writing pads in private school mathematics classrooms.

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Research Questions

Guided by the objectives, this study addresses the following questions:

1. What are the pedagogical challenges experienced by private school mathematics teachers in using digital writing pads?
2. What technical difficulties do private school mathematics teachers encounter when utilizing digital writing pads?
3. What institutional or organizational barriers shape teachers' experiences with digital writing pads?
4. How do these challenges affect the teaching and learning of mathematics in private schools?
5. What insights and recommendations can be drawn from teachers' experiences to enhance the effective use of digital writing pads?

METHODOLOGY

Research Design

This study employed a qualitative descriptive research design to explore the challenges experienced by private school teachers in the integration of digital writing pads in mathematics education. A qualitative approach was considered appropriate because it allowed the researcher to capture the respondents' authentic experiences, perceptions, and insights regarding the pedagogical, technical, and institutional issues they encountered. Descriptive research provided a clear and detailed account of the phenomenon without manipulating the environment or imposing predetermined variables.

Research Environment

The study was conducted in a private school in the Philippines where digital writing pads were recently adopted as supplementary teaching tools in mathematics instruction. The school has implemented blended and digital learning strategies, which require teachers to adapt technology-driven approaches in their classroom delivery.

Participants of the Study

The participants of the study consisted of three mathematics teachers who were purposively selected based on the following criteria:

1. They are currently employed in a private secondary school.
2. They have used digital writing pads in their mathematics instruction.
3. They have at least one year of experience in teaching with technology integration.

The participants' teaching experience ranged from three to ten years. Their demographic profiles included information such as age, gender, and years of teaching, which helped contextualize their responses. Pseudonyms (Teacher 1, Teacher 2, Teacher 3) were used to ensure anonymity and confidentiality.

Research Instrument

Data were collected using a semi-structured survey questionnaire**.** The instrument consisted of two parts:

Part I: Profile Background – This section included questions about age, gender, years of teaching experience, and level of familiarity with digital writing pads.

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Part II: Open-Ended Questions – This section contained questions designed to elicit detailed narratives regarding the teachers' experiences with digital writing pads. The key questions asked were:

1. What challenges do you experience in using digital writing pads for mathematics teaching?
2. How do these challenges affect your teaching performance and student engagement?
3. What coping strategies or adjustments do you apply to address these challenges?
4. What recommendations can you suggest to improve the use of digital writing pads in mathematics instruction?

These questions were framed to align with the research objectives and to generate data rich in detail and meaning.

Data Gathering Procedure

The following steps were undertaken in gathering the data:

1. **Permission and Consent** – A request letter was submitted to the school administration to secure approval for the conduct of the study. After approval, informed consent was obtained from the teacher-respondents.
2. **Survey Administration** – The semi-structured survey questionnaire was distributed to the participants, who were given ample time to reflect and provide written responses.
3. **Validation and Clarification** – Follow-up informal interviews were conducted to validate unclear responses and to enrich the data.
4. **Transcription** – The responses were carefully transcribed and organized for analysis.

Data Analysis

The study employed thematic analysis following Braun and Clarke's (2006) six-phase framework:

1. **Familiarization with the Data** – The researcher repeatedly read the transcripts to gain a thorough understanding of the responses.
2. **Generating Initial Codes** – Relevant excerpts were labeled with codes such as "technical glitches," "extra preparation," or "student engagement issues."
3. **Searching for Sub-Categories** – Similar codes were clustered into sub-categories (e.g., "device malfunction," "lack of training").
4. **Forming Categories** – Sub-categories were grouped into broader categories such as *Technical Challenges*, *Pedagogical Concerns*, and *Institutional Limitations*.
5. **Defining Themes** – The categories were abstracted into overarching themes (e.g., "Digital writing pads disrupt lesson pacing," "Teachers require institutional support").
6. **Producing the Report** – The final themes were presented in a coding matrix with five columns: Transcription, Codes, Sub-Categories, Categories, and Themes.

This systematic process ensured that the analysis was rigorous and grounded in the participants' narratives.

Trustworthiness of the Data

To ensure the credibility and dependability of the findings, the researcher employed the following strategies:

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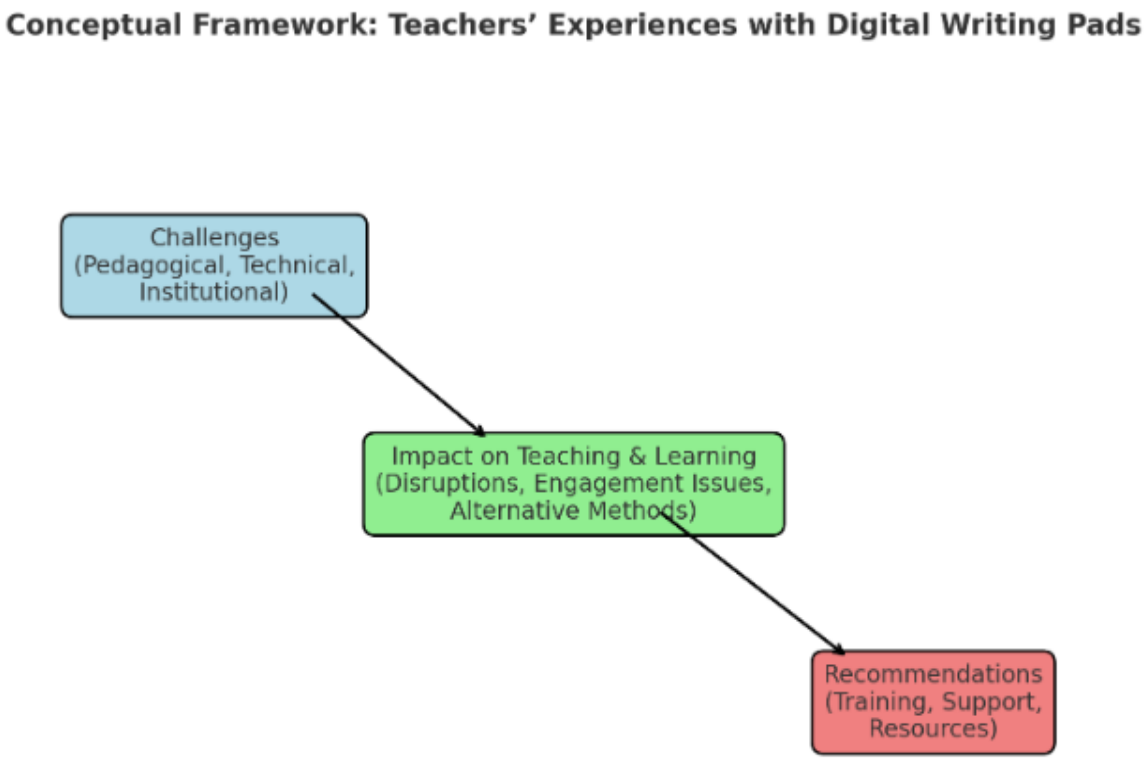
- **Credibility** – Member checking was conducted by sharing the summarized results with the respondents to confirm the accuracy of interpretation.
- **Dependability** – The coding and thematic process was systematically documented to provide an audit trail.
- **Transferability** – Rich and detailed descriptions of the participants and research environment were provided to allow readers to relate findings to similar contexts.
- **Confirmability** – The researcher-maintained reflexivity throughout the process, ensuring that personal biases did not influence the interpretation of the data.

Ethical Considerations

Ethical standards were strictly observed throughout the study. Participants were informed about the objectives, scope, and voluntary nature of their involvement. They were assured of confidentiality and anonymity, and pseudonyms were used to replace their real names. All information collected was used solely for academic purposes. Participants were also informed that they could withdraw from the study at any point without consequence.

RESULTS

The qualitative analysis of the responses from three private school mathematics teachers revealed five major themes that reflected their experiences in using digital writing pads for classroom instruction. These themes were derived from transcription coding and categorization of their answers to the survey questions.



Theme 1: Pedagogical Challenges in Mathematics Instruction

Teachers reported experiencing difficulties in sustaining student engagement when using digital writing pads. Delays in navigating the device and problems in writing mathematical symbols and figures affected lesson delivery.

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One teacher shared, *"Sometimes students lose focus because I take time navigating the device,"* while another added, *"Drawing graphs and figures is challenging, especially if the pen calibration is off."* These challenges highlighted the pedagogical limitations of digital writing pads in facilitating smooth mathematical instruction.

Theme 2: Technical Difficulties with Device Use

Technical challenges emerged as a recurring issue. Teachers encountered device malfunctions such as screen lag, freezing, and calibration errors. Limited troubleshooting skills also added to the burden, especially during class. Power interruptions and Internet dependency further hampered the use of digital writing pads. As one participant mentioned, *"The device lags when I write fast, and sometimes the screen freezes."* These technical concerns disrupted the continuity of lessons and reduced instructional efficiency.

Theme 3: Institutional and Organizational Barriers

Institutional support was found to be inadequate, with teachers citing the lack of formal training and limited availability of devices. Two respondents emphasized that they had to learn how to use the tool through "trial and error" due to the absence of structured training programs. Furthermore, the shortage of IT personnel and technical assistance during teaching hours hindered problem resolution. One teacher explained, *"We only have two devices for the entire department."* This indicated that organizational limitations significantly contributed to the challenges faced by teachers.

Theme 4: Impact on Teaching and Learning

The combined pedagogical, technical, and institutional challenges directly influenced classroom instruction. Teachers expressed that interruptions in lesson flow caused students to lose interest, which affected learning outcomes. Despite this, some recognized the potential of digital writing pads to enhance visualization of mathematical concepts when functioning properly. A participant noted, *"Students like the visuals, but when the pad fails, they become distracted."* To address this, teachers often resorted to using backup tools such as PowerPoint presentations or traditional whiteboards.

Theme 5: Recommendations for Improvement

Teachers recommended institutional support through training programs, provision of additional devices, and access to technical assistance. Respondents highlighted the need for professional development to improve mastery in using digital writing pads effectively. One teacher suggested, *"We need formal training to maximize its use,"* while another stressed, *"Better technical support should be available when issues arise."* These recommendations underline the importance of organizational interventions to improve the integration of digital writing pads in mathematics education.

The findings of this study highlight the complex realities faced by private school mathematics teachers in integrating digital writing pads into classroom instruction. Consistent with prior studies, the results revealed that teachers encounter pedagogical, technical, and institutional challenges which collectively influence their capacity to maximize the benefits of technology in mathematics education.

Pedagogical Challenges in Mathematics Instruction

The study found that teachers struggled with lesson pacing when using digital writing pads, as the process of writing formulas and diagrams was slower compared to traditional chalkboards or whiteboards. This aligns with the observations of Yusof et al. (2022), who noted that digital tools, while promising, often require additional instructional time and adjustments in teaching strategies. Moreover, as Mishra and Koehler's (2006) Technological Pedagogical Content Knowledge (TPACK) framework emphasizes, effective integration of digital tools requires not only content and pedagogical expertise but also a solid understanding of how technology can enhance learning. In this study, the absence of specialized training hindered teachers from achieving this integration smoothly.

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Technical Limitations and Their Impact on Learning

Teachers in this research emphasized recurring problems with device responsiveness, software compatibility, and internet connectivity. Such findings are consistent with the work of Ozdilek and Robeck (2020), who found that technical barriers are a primary factor that discourages teachers from adopting digital innovations in mathematics classrooms. The lack of reliability in devices not only disrupted teaching but also caused disengagement among students. This reflects earlier findings by Ertmer and Ottenbreit-Leftwich (2019), who argued that without dependable technological infrastructure, teachers are less likely to embrace long-term digital integration.

Institutional Support as a Critical Factor

Perhaps the most significant finding of this study was the lack of structured support from private school administrations. Teachers were often left to navigate the use of digital writing pads independently, relying on trial and error. This finding resonates with Tondeur et al. (2018), who identified institutional support—through training, mentorship, and policy direction—as a crucial enabler of successful technology adoption. Without such support, teachers are burdened with additional responsibilities, which can result in inconsistent or ineffective use of technology.

Implications for Mathematics Education

Taken together, the findings suggest that while digital writing pads offer substantial potential to improve visualization and interactivity in mathematics education, their effectiveness is highly dependent on the readiness of teachers and the support structures within schools. Addressing these challenges requires a twofold approach: (1) providing sustained professional development that equips teachers with the technical and pedagogical skills needed to integrate digital tools effectively, and (2) ensuring institutional commitment to upgrading resources and maintaining reliable technological infrastructure.

Contribution to the Field

This study adds to the growing body of research on digital technology integration in education by focusing on the underexplored context of private school mathematics teachers. Unlike public school contexts that often receive government-driven ICT support, private institutions may vary in their technological provisions, leaving gaps in teacher preparedness. By surfacing these contextualized challenges, this study contributes a nuanced understanding of how digital tools are adopted in mathematics education.

CONCLUSION AND RECOMMENDATIONS

Conclusion

This study explored the challenges experienced by private school mathematics teachers in the use of digital writing pads as instructional tools. Findings revealed that while teachers recognized the potential of digital writing pads to enhance visualization and interactivity in mathematics learning, their effective utilization was constrained by several factors.

First, pedagogical challenges emerged, as teachers needed to adjust their pacing and teaching strategies to accommodate the slower and sometimes cumbersome process of digital writing. Second, technical issues such as device responsiveness, connectivity problems, and software limitations disrupted the smooth flow of instruction and affected student engagement. Third, a lack of institutional support left teachers without adequate training or guidance, forcing them to rely on personal effort and experimentation.

These findings affirm that successful technology integration in mathematics education is not solely dependent on teacher willingness but also on the availability of resources, technical reliability, and structured institutional support. Without addressing these concerns, the potential of digital writing pads to improve mathematics teaching and learning may remain underutilized.

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Recommendations

Based on the findings, the following recommendations are proposed:

1. **Professional Development for Teachers**

- Organize sustained training sessions and workshops to equip teachers with both technical and pedagogical skills in integrating digital writing pads into mathematics instruction.
- Encourage peer-sharing sessions where teachers can exchange strategies and best practices.

2. **Strengthening Technical Support and Infrastructure**

- Schools should invest in upgrading devices, ensuring compatibility of digital writing pads with commonly used applications, and improving internet connectivity.
- Provide readily accessible technical support staff to troubleshoot device or software issues during instructional hours.

3. **Institutional Support and Policy Development**

- Private school administrations should establish clear policies that promote and support the effective integration of digital technologies.
- Allocate funds specifically for ICT in teaching, ensuring continuous upgrading and maintenance of digital resources.

4. **Student-Centered Approaches**

- Explore creative strategies, such as interactive applications or gamified tasks, to sustain student engagement while using digital writing pads.
- Provide students with opportunities to use digital tools themselves, fostering active learning and technology fluency.

5. **Further Research**

- Future studies may expand the sample to include public school teachers or compare experiences across grade levels.
- Additional research could also examine student perspectives to provide a more holistic understanding of the impact of digital writing pads on mathematics learning.

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APPENDIX:

Part I. Profile of the Respondents

(Please provide the following information. This will be used for research purposes only and will be kept confidential.)

1. **Age:** _____
2. **Sex:** ☐ Male ☐ Female ☐ Prefer not to say
3. **Highest Educational Attainment:**

☐ Bachelor's Degree

☐ Master's Degree (units/graduate)

☐ Doctoral Degree (units/graduate)

4. **Years of Teaching Experience in Mathematics:** _____
5. **Grade/Year Levels Currently Teaching:** _____
6. **Average Class Size:** _____ students
7. **Access to Digital Writing Pad:**

☐ Personal Device

☐ Provided by School

☐ Shared/Occasional Access

8. **Frequency of Use of Digital Writing Pad in Teaching:**

☐ Daily

☐ Weekly

☐ Occasionally

☐ Rarely

9. **Training or Workshop Attended on the Use of Digital Writing Pads:**

☐ Yes (please specify: _____)

☐ No

Part II. Open-Ended Questions

A. Pedagogical Challenges

1. How has the use of a digital writing pad influenced your teaching strategies in mathematics?
2. What challenges do you experience when explaining mathematical concepts using a digital writing pad?
3. How do these challenges affect your interaction with students during lessons?

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B. Technical Challenges

4. What difficulties do you encounter when operating or setting up the digital writing pad?
5. Can you share an experience where technical issues disrupted your lesson?
6. How confident do you feel in troubleshooting problems related to the digital writing pad?

C. Institutional/Organizational Challenges

7. What kind of support (e.g., training, technical assistance, administrative support) have you received from your school regarding the use of digital writing pads?
8. What challenges do you face in terms of resources, training, or policies when using digital writing pads in your school?
9. How do institutional factors influence your willingness or ability to integrate digital writing pads into your teaching?

D. Impact and Recommendations

10. How do the challenges you experience with digital writing pads affect student learning in mathematics?
11. What strategies have you personally developed to cope with these challenges?
12. What recommendations can you suggest to improve the effective use of digital writing pads in private school mathematics classrooms?

Thematic Analysis Coding:

TRANSCRIPTION	CODES	SUB-CATEGORIES	CATEGORIES	THEME
"Sometimes students lose focus because I take time navigating the device." (T1)	Students distracted; time-consuming navigation	Student engagement issues	Pedagogical Challenges	Digital writing pads disrupt lesson pacing and student focus.
"Drawing graphs and figures is challenging, especially if the pen calibration is off." (T2)	Difficulty drawing figures; pen calibration issues	Difficulty in representing math symbols/figures	Pedagogical Challenges	Device limitations hinder smooth teaching of mathematical concepts.
"I had to prepare digital lesson slides in advance to avoid delays." (T3)	Extra preparation; pre-loading lessons	Preparation demands	Pedagogical Challenges	Teachers exert extra effort to prepare lessons for efficiency.
"The device lags when I write fast, and sometimes the screen freezes." (T2)	Lagging; freezing screen	Device malfunctions	Technical Challenges	Technical glitches interfere with lesson delivery.
"I do not know how to troubleshoot when errors appear." (T1)	Lack of troubleshooting skills	Limited teacher tech skills	Technical Challenges	Teachers lack sufficient digital literacy to handle device issues.
"Power interruptions make the device unusable at times." (T3)	Dependence on electricity	Power supply issues	Technical Challenges	Infrastructure constraints limit device reliability.
"We were not given proper training; I just learned to use it through trial and error." (T1)	Lack of training	Training gaps	Institutional Challenges	Teachers lack formal training on effective device use.

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"There is no IT personnel available during class hours." (T3)	No technical support	Support gaps	Institutional Challenges	Lack of institutional support hampers device integration.
"We only have two devices for the entire department." (T2)	Limited devices	Resource insufficiency	Institutional Challenges	Insufficient resources limit equitable access to digital tools.
"Students like the visuals, but when the pad fails, they become distracted." (T1)	Student distraction; mixed effects	Student learning effects	Impact on Instruction	Device failures disrupt learning continuity despite positive potential.
"I always prepare a PowerPoint backup or revert to the whiteboard." (T2)	Backup strategies	Adaptive practices	Impact on Instruction	Teachers develop contingency strategies to sustain lessons.
"Sometimes I cannot continue the lesson smoothly when there's a glitch." (T3)	Interrupted flow	Lesson disruptions	Impact on Instruction	Instructional flow is heavily dependent on device functionality.
"We need formal training to maximize its use." (T3)	Request for training	Capacity building	Recommendations	Teachers need structured professional development for effective use.
"Better technical support should be available when issues arise." (T2)	Call for support	Technical assistance	Recommendations	Technical support is essential for sustainability of technology use.
"More devices should be provided so teachers can use them regularly." (T1)	More devices needed	Resource provision	Recommendations	Adequate provision of devices ensures consistent integration.