



INTEGRATING TECHNOLOGY IN MATHEMATICS INSTRUCTION: A QUANTITATIVE STUDY OF PUBLIC SCHOOL TEACHERS

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ABSTRACT

This study investigated the extent of technology integration in mathematics instruction among junior and senior high school teachers in Pangasinan II, the challenges they faced, and their perceptions of its impact on student motivation and engagement. 102 mathematics teachers participated in a descriptive-comparative correlational design. Findings revealed that the majority of mathematics teachers are in the early-career stage and are primarily assigned to Junior High School. Most have attended only limited trainings related to educational technology and mainly depend on personal devices and the school's internet connection for instructional and technological needs. Teachers are actively engaging with technology as an instructional tool, particularly in planning and delivering lessons that align with curricular objectives. But, the persistent gaps in assessment-related practices indicate that teachers remain clustered at the substitution and augmentation levels of the SAMR model, where technology is primarily used to enhance existing practices rather than transform them. Further, Teachers view technology as a powerful catalyst for learning outcomes in mathematics, particularly in motivating students to engage actively, set personal goals, and persist in overcoming learning challenges. Challenges in technology integration include unstable internet, limited devices, and insufficient preparation time. Lastly, teachers at different career stages require differentiated support as neophyte teachers may need guidance on pedagogy and content alignment, while more experienced teachers require interventions that build confidence and skill in adopting digital innovations.

Keywords: *technology integration, mathematics instruction, TPACK, SAMR model, teacher-related factors, student motivation, student engagement*

INTRODUCTION

In today's rapidly evolving digital age, bringing technology into the classroom is not just a helpful add-on - it becomes essential. Around the world, countries are making significant investments in EdTech, with projections indicating that the global educational technology market will reach over USD 404 billion by 2025 (HolonIQ, 2021). This growing reliance on tech in teaching raises an important question: Are educators truly ready to use these tools to support meaningful learning?

In the Philippines, this question feels even more urgent. While the country is undergoing digital transformation, student performance in math continues to fall short of global benchmarks. For instance, in the 2018 PISA assessment, Filipino students ranked last among 79 countries in mathematics (OECD, 2019). One of the root issues is that many teachers especially in public schools have not received sufficient training in digital teaching methods, leading to the underuse of available tools (Marpa, 2021). This challenge is mirrored at the local level, as in Pangasinan II, where gaps in infrastructure and limited access to professional development persist.

The impact of this issue is widespread. For students, poor math instruction can limit future academic and career opportunities, especially in STEM fields. For teachers, not feeling confident or capable with tech can lower their effectiveness and job satisfaction (Selda, 2024). Meanwhile, policymakers face the uphill task of achieving the Department of Education's goals of providing quality, accessible, and tech-integrated education. Tackling these issues is key to ensuring every student has the chance to thrive in a digital world. The Department of Education has rolled out initiatives like the Digital Rise Program to support ICT integration in schools. Platforms such as the National Educators Academy of the Philippines (NEAP) also offer ICT training. However, research suggests a gap between these well-meaning policies and how things play out in real classrooms. For example, Luzano (2024) observed that, despite attending training sessions, many high school math teachers still struggle to confidently apply tech in their lessons. These programs usually insufficient due to a lack of localization and long-term support (Marcos, 2025).

Integration of technology in mathematics instruction is not merely about introducing gadgets or apps, it involves deeply embedding digital tools within pedagogy and content to enhance conceptual understanding and engagement. Studies of Grade 8 classrooms in the Philippines reveal that high levels of technology integration across instruction, practice, and assessment correlate significantly with increased student engagement. In contrast, effective digital pedagogy defined as how teachers design tasks that leverage technology correlates with better achievement (Saliao & Cajandig, 2025). The National Council of Teachers of Mathematics (2018), emphasizes that equitable technology use supports students' understanding of abstract concepts through contextualized and visual representations, thereby making math more student-centered

and accessible. Although many studies have examined tech use in education more broadly or from a national perspective, there is limited research on how it is actually working on the ground especially in rural or semi-urban areas like Pangasinan II. There is also little insight into how junior and senior high school math teachers in these areas view and use technology in their teaching. Understanding this local perspective is crucial for creating policies that are both relevant and effective.

This study aimed to fill that gap by exploring how math teachers in Pangasinan II are incorporating technology into their classrooms, the challenges they face, and their views on its impact. The goal is to provide a clearer picture of what tech integration really looks like on the ground, which can then inform more targeted training, curriculum development, and policy decisions.

As a teacher, the researcher has personally seen how eager many educators are to use technology in their classrooms. However, this enthusiasm is often limited by broader issues, such as a lack of training opportunities and insufficient access to necessary tools. These firsthand experiences, along with growing academic interest in the topic, inspired the researcher to explore how educational tech can be better utilized in the local context. Specifically, this study focused on how junior and senior high school math teachers in the 5th District of Pangasinan II are using technology in their teaching, the obstacles they encounter, and their thoughts on how it affects students' learning motivation and engagement.

According to Marcos (2025), most high school math teachers in the Philippines have a basic understanding of the strategic integration of technological tools, pedagogical approaches, and content knowledge. However, they often struggle to put it into practice. Selda (2024) stressed the need to embed digital teaching methods into teacher education, especially for math. Other research by Luzano (2024) and Buniel et al. (2025) shows that tools such as AI chatbots and gamified learning apps can improve math learning and student engagement but these are still underused in rural schools. Zabala et al. (2025) noted that teacher motivation and support from school leaders are key factors in successful tech integration. These findings all suggest that willingness, training, and strong support systems are critical.

The 5th District of Pangasinan II in Northern Luzon includes both urban and rural schools, making it a good representation of the broader educational landscape. Its active participation in national education programs and varying access to infrastructure make it a relevant setting for studying how tech is being used in classrooms. This study aimed to describe how teachers are currently integrating technology into math instruction, identify the challenges they face, and suggest practical strategies for improvement. Employing both qualitative and quantitative research approaches, the study provides a well-rounded view of what is happening on the ground. With the global focus on digital transformation and the local need to improve math education, this study comes at a crucial time. It seeks to offer practical insights to enhance math teaching through thoughtful, effective use of technology.

Research Questions

This study investigated the integration of technology in mathematics instruction among junior and senior high school teachers in the 5th District of Pangasinan II during the AY 2024-2025. Specifically, it sought to answer the following questions:

1. What is the demographic profile of the respondents in terms of:
 - a. Years of teaching experience;
 - b. Grade level assignment;
 - c. Number of technology trainings attended; and
 - d. Access to digital tools?
2. What is the extent of technology integration in the instructional practices of the respondents?
3. What is the extent of the challenges encountered by the respondents in integrating technology into their classroom instruction?
4. What is the impact of technology integration on student learning motivation and engagement as perceived by the respondents?
5. Are there significant differences in the extent of technology integration in a mathematics instruction across profile variables?

METHODOLOGY

Research Design

The study employed a descriptive–comparative correlational research design. Quantitative-descriptive design refers to a design that describes and interprets collected data on certain issues and conditions through numerical presentation (Tandingan et al., 2025). The descriptive component aimed to provide an accurate portrayal of the demographic characteristics of mathematics teachers. Meanwhile, the correlational dimension examined relationships among variables.

Sampling and Locale of the Study

This study was conducted in the 5th District of the Schools Division of Pangasinan II, under the Department of Education (DepEd) Region I in the Philippines. The district included a mix of rural and semi-urban public secondary schools, each serving students with different needs and varying levels of access to technology. To gather meaningful data, the study used purposive sampling, selecting 102 math teachers who met specific criteria. These included being assigned to teach math in a junior or senior high school within the district and being willing to participate.

Data-Gathering Procedure

Prior to distributing the instrument, formal permissions were obtained from the Schools Division Superintendent of Pangasinan II and the principals of selected junior and senior high schools within the 5th district. Securing institutional approval ensured the

ethical conduct of the study and facilitated coordination with school heads to identify and endorse mathematics teachers as respondents. Following approval, the researcher prepared the Google Form version of the pilot-tested questionnaire. To initiate the data-gathering process, an orientation was conducted via virtual channels and supplemented by written instructions embedded in the Google Form. The survey link was distributed primarily through official school Messenger group chats, with the assistance from school heads and designated coordinators. All responses submitted through Google Forms were automatically recorded and stored securely within the researcher's Google account, which was protected by password encryption and two-factor authentication to safeguard data privacy. Ethical considerations were rigorously observed throughout the data-gathering process. Informed consent was obtained digitally via an introductory section in the Google Form, which required participants to acknowledge their agreement to participate before proceeding to the main questionnaire.

Treatment of Data

Data from the validated and pilot-tested survey instrument were analyzed using a suite of quantitative statistical techniques aligned with the descriptive-comparative-correlational research design. Descriptive statistics namely, frequency counts, percentages, and means were first computed to profile respondents by years of experience, grade-level assignment, number of technology trainings attended, and access to digital tools. For the extent of technology integration, weighted mean scores were calculated for each item in the relevant section of the instrument. These means were interpreted using a five-point Likert scale to reflect varying degrees of integration. Likewise, challenges and perceptual measures were analyzed using weighted means to identify the most frequent issues and perceptions among respondents. For inferential analysis, independent-samples ANOVA was conducted to compare the mean levels of technology integration between two groups for example, junior versus senior high school teachers using the Student's ANOVA, which is robust for detecting group mean differences when assumptions of normality and homogeneity of variance are met. All statistical assessments were undertaken using IBM SPSS Statistics, which ensured rigorous and reliable computation of descriptive and inferential statistics. A significance threshold of $p < .05$ was maintained across all tests, indicating statistical reliability and providing confidence in the study's findings.

RESULTS AND DISCUSSION

Profile of the JHS and SHS Mathematics Teachers

The results (Table 1) revealed that a considerable proportion of secondary school mathematics teachers in Pangasinan II are relatively new to their career, with 42.16% having 1–5 years of teaching experience and 31.37% having 6–10 years. Together, these groups represent nearly three-fourths of the respondents (73.53%), suggesting a youthful workforce that is potentially adaptable to innovation.

Table 1. Teachers' Years of Teaching Experience

Years of Teaching Experience	Frequency	Percentage
1–5 years	43	42.16%
6–10 years	32	31.37%
11–15 years	16	15.69%
16–20 years	4	3.92%
21 years and above	7	6.86%

This finding aligns with Rogers' Diffusion of Innovations Theory, which explains that early- to mid-career professionals often embody the "early majority" who are open to adopting new practices when adequate support structures are in place (Frei-Landau et al., 2022). Moreover, the TPACK framework suggests that although younger teachers may have enthusiasm and a baseline level of technological knowledge, effective integration in mathematics classrooms requires opportunities to meaningfully blend content, pedagogy, and technology through guided practice (Marcos, 2025).

Table 2. Grade Level Assignment

Grade Level Assignment	Frequency	Percentage
Junior High School	53	51.96%
Senior High School	32	31.37%
Both	17	16.67%

The distribution of grade-level assignments indicate that the largest group of respondents is teaching at the junior high school level (51.96%), followed by those teaching senior high school classes (31.37%), while 16.67% are teaching at both levels. Within the study's conceptual framework, grade level is treated as a key teacher-related factor that influences the extent and quality of technology integration in mathematics instruction. This is consistent with the Technological Pedagogical Content Knowledge (TPACK) framework, which stresses that technology use must be adapted to the demands of the learning context. Junior high school teachers may emphasize visualization of concepts and interactive practice. In contrast, senior high school teachers often integrate tools for higher-order tasks such as modelling, simulations, and performance-based assessments (Marcos, 2025). Theoretical perspectives reinforce these findings. The SAMR model suggests that many secondary teachers, regardless of grade level, tend to operate at the substitution or augmentation stages, with only those who receive sustained, discipline-specific professional development advancing to modification and redefinition (Trends in SAMR Research, 2019–2024; Weigand, 2024). Recent evidence in the Philippine context further indicates that mathematics teachers across grade levels often hold favorable attitudes toward technology but vary in the Degree to which they apply TPACK-aligned practices, with professional development and institutional support emerging as decisive factors (Marcos, 2025).

Table 3. Number of Trainings Attended Related to EdTech

Number of Trainings Attended Related to EdTech	Frequency	Percentage
None	9	8.82%
1–2	46	45.10%

3–5	29	28.43%
6 and above	18	17.65%

The data (Table 3) revealed that almost half of the mathematics teachers surveyed have attended only one to two trainings related to educational technology (45.10%), while 28.43% have participated in three to five trainings, and 17.65% have engaged in six or more. Notably, 8.82% reported having no training at all. This distribution underscores a professional landscape in which most teachers have limited exposure to formal EdTech development opportunities. Within the study's conceptual framework, professional development is considered a key teacher-related factor that directly influences the extent of technology integration in instruction. Without sufficient opportunities for sustained training, teachers are more likely to remain at the lower levels of the SAMR model (Substitution and Augmentation) rather than progress to Modification and Redefinition, where transformative integration occurs (Weigand, 2024). The TPACK framework also highlights that training is essential for developing the intersection of technological, pedagogical, and content knowledge required for effective integration. Recent studies in the Philippines have shown that mathematics teachers frequently express willingness to use technology but struggle to apply TPACK-aligned practices due to limited, one-shot training sessions that lack follow-up and contextualization (Marcos, 2025).

Table 4. Access to devices/internet/school-provided tools

Devices/internet/school-provided tools	frequency	percentage
Personal Device (Laptop/Desktop/Tablet)	17	16.67%
School-Provided Device	2	1.96%
Internet Access at School	35	34.31%
Personal Device (Laptop/Desktop/Tablet)	4	3.92%
School-Provided Device		
Internet Access at Home		
Personal Device (Laptop/Desktop/Tablet)	2	1.96%
School-Provided Device		
Internet Access at School		
Personal Device (Laptop/Desktop/Tablet)	22	21.57%
Internet Access at Home		
Personal Device (Laptop/Desktop/Tablet)	6	5.88%
Internet Access at School		

Table 4 represents the access to Devices/Internet/ School-provided tools. The data on access to digital tools and connectivity indicate substantial variation in the technological resources available to mathematics teachers. A majority reported relying primarily on personal devices with home or school internet access, for example, 21.57% had a personal device with home internet, 16.67% owned a personal device only, and 34.31% had access to school internet but not necessarily school-provided devices. Only 1.96% reported having a school-provided device alone, while 13.73% had the most comprehensive access (personal device, school-provided device, and internet at home and at school). These results reveal an environment in which teachers depend heavily on personal resources rather than institutional provision, with only a small fraction benefiting

from robust, school-supported technological infrastructure. From the lens of the Technological Pedagogical Content Knowledge (TPACK) framework, limited institutional support places greater responsibility on teachers to mobilize their own resources, which can create inequities in how effectively they integrate technology in mathematics instruction (Marcos, 2025). Similarly, the SAMR model suggests that without reliable access to devices and connectivity, teachers are more likely to remain at the Substitution and Augmentation levels, using technology merely as a replacement for traditional tasks rather than for transformative learning experiences (Weigand, 2024). The Concerns-Based Adoption Model (CBAM) also emphasizes that lack of infrastructure is a significant barrier during early stages of adoption, often leading to frustration and resistance if not adequately addressed by organizational support (Selda, 2024).

Extent of Technology Integration in the Instructional Practices of the Mathematics Teacher

The findings (Table 5) reveal that junior and senior high school mathematics teachers in the 5th District of Pangasinan II integrate technology in their instructional practices to a high extent, as indicated by the overall weighted score of 3.80 on a five-point Likert scale. All the 10 items measuring technology integration were described as "High Extent" with means ranging from (3.41–4.20), underscoring the teachers' consistent and substantial use of technology across different instructional dimensions. The highest-rated practices include the use of technology for lesson planning aligned with curriculum standards ($M = 4.14$) and the continuous exploration of emerging technologies to enhance instruction ($M = 4.14$). These results suggest that teachers are not only aligning their instructional design with curricular goals but are also demonstrating openness to innovation, a characteristic consistent with Rogers' Diffusion of Innovations Theory, which describes early adopters as receptive to new practices when these are perceived as advantageous and supported by contextual enablers (Frei-Landau et al., 2022).

High scores were also evident in areas related to instructional delivery and collaborative learning, such as the integration of digital tools for interactive lessons ($M = 4.01$), the use of multimedia resources ($M = 3.95$), and the encouragement of student collaboration through technology ($M = 3.84$). These practices reflect the teachers' growing ability to operationalize the Technological Pedagogical Content Knowledge (TPACK) framework, where technology is employed not merely as an add-on but as a complement to pedagogy and content (Marcos, 2025). Studies confirm that when teachers leverage platforms such as GeoGebra and Desmos for concept visualization, students demonstrate stronger engagement and improved comprehension of mathematical concepts (Chechan et al., 2023; Marange, 2025; Salião & Cajandig, 2025).

Lower but still "High Extent" ratings were observed in assessment-related practices, including the use of technology-based assessments ($M = 3.49$), the provision of digital feedback ($M = 3.46$), and the adjustment of instructional strategies based on technology-enabled data ($M = 3.66$). The higher variability in these items suggests inconsistencies among teachers in fully utilizing technology for assessment and feedback. This finding is consistent with the SAMR model, which posits that teachers often remain

at the substitution and augmentation stages of technology use and require sustained professional development to progress to the modification and redefinition stages, particularly in the domain of assessment (Weigand, 2024). Scherer (2023) likewise found that access to ongoing training and infrastructure support, rather than teaching experience alone, predicts the effective integration of technology in feedback and evaluation.

Table 5. *Extent of Technology Integration of the Respondents in Mathematics Instruction*

Indicators	Mean	Descriptive Equivalent
As a Mathematics Teacher, I...		
1. use technology to plan mathematics lessons that align with curriculum standards and learning goals.	4.14	High Extent
2. integrate digital tools to deliver interactive and engaging mathematics instruction.	4.01	High Extent
3. utilize online platforms (e.g., GeoGebra, Desmos) for teaching mathematical concepts.	3.57	High Extent
4. incorporate multimedia resources (videos, simulations) to support student understanding.	3.95	High Extent
5. provide students with opportunities to use technology for solving mathematical problems.	3.76	High Extent
6. employ technology-based assessments (e.g., online quizzes, digital tasks) to evaluate student learning.	3.49	High Extent
7. use digital tools to provide timely and constructive feedback to students.	3.46	High Extent
8. adjust instructional strategies based on data from technology-enabled assessments.	3.66	High Extent
9. encourage students to collaborate using technology during mathematics activities.	3.84	High Extent
10. continuously explore and adopt emerging technologies to enhance mathematics instruction.	4.14	High Extent
Average Weighted Mean	3.80	High Extent

Legend: 4.21-5.00 = *Very High Extent*, 3.41-4.20= *High Extent*, 2.61-3.40 *Moderate Extent*, 1.81-2.60 = *Low Extent*, 1.00-1.82 = *Very Low Extent*

Taken together, the results demonstrate that mathematics teachers in Pangasinan II exhibit strong commitment to technology-enhanced instruction, particularly in planning and delivery. At the same time, assessment and feedback practices remain areas for further enhancement. The variability across practices reflects the dynamics outlined in the Concerns-Based Adoption Model (CBAM), which recognizes that teachers progress through different levels of technology adoption depending on their access to resources and professional learning opportunities. Overall, the evidence suggests that with continuous, subject-specific professional development and reliable access to

technological tools, teachers can deepen their integration practices, advance along the SAMR continuum, and fully realize the potential of technology to transform mathematics instruction (Marcos, 2025; Marpa, 2021; Saliao & Cajandig, 2025).

Challenges Encountered by the Mathematics Teachers in Integrating Technology into their Classroom Instruction

Table 6. Challenges of Mathematics Teachers in Integrating Technology in Classroom Instruction

As a teacher, I have...	Indicators	Mean	Descriptive Equivalent
1.	limited access to devices for teachers or students.	3.71	Often
2.	poor or unstable internet connectivity.	3.88	Often
3.	lack of time for preparing technology-integrated lessons.	3.55	Often
4.	inadequate technical support from school IT personnel.	3.37	Sometimes
5.	insufficient training on using educational technologies effectively.	3.22	Sometimes
6.	resistance to change or reluctance to adopt new technologies among teachers.	2.95	Sometimes
7.	limited relevant digital resources aligned to the mathematics curriculum.	3.54	Often
8.	students' who lack of digital literacy skills to engage in technology-based learning activities.	3.59	Often
9.	difficulty in integrating technology meaningfully due to large class sizes.	3.46	Often
10.	insufficient administrative support or policies encouraging technology integration in classroom teaching.	3.39	Sometimes
Average Weighted Mean		3.47	Often

Legend: 4.21-5.00 = Always, 3.41-4.20= Often, 2.61-3.40 Sometimes, 1.81-2.60 = Rarely, 1.00-1.82 = Never

Table 6 shows the Challenges of Mathematics Teachers in Integrating Technology in Classroom Instruction. The results show that mathematics teachers in the 5th District of Pangasinan II often encounter barriers when integrating technology into classroom instruction, with an overall mean of 3.47. The most critical challenges identified are poor or unstable internet connectivity (M = 3.88) and limited access to devices for teachers and students (M = 3.71). These constraints underscore the infrastructural realities that continue to hinder equitable and effective technology integration. Other frequently cited issues include students' limited digital literacy (M = 3.59), insufficient preparation time for technology-integrated lessons (M = 3.55), and the limited availability of digital resources aligned with the mathematics curriculum (M = 3.54). While still rated as challenges, factors such as technical support, training opportunities, administrative backing, and teacher resistance had lower mean scores, suggesting that systemic and infrastructural barriers outweigh attitudinal ones. These findings align with the study's conceptual framework, which posits that teacher-related factors and school-level conditions

significantly influence the extent of technology integration. From the perspective of the TPACK framework, constraints in access and connectivity hinder teachers' ability to operationalize the intersection of content, pedagogy, and technology (Marcos, 2025). Similarly, the SAMR model highlights that when basic infrastructure is lacking, teachers remain confined to substitution and augmentation levels of technology use, limiting opportunities for more transformative applications (Weigand, 2024). The Concerns-Based Adoption Model (CBAM) also explains the observed variability in responses: some teachers are advancing toward meaningful use while others remain constrained by inadequate support and resources (Selda, 2024).

Empirical studies corroborate these patterns. In the Philippine context, infrastructure challenges and dependence on personal devices persist as key barriers to technology-enhanced mathematics instruction (Marpa, 2021). Scherer (2023) emphasizes that access to reliable infrastructure and sustained professional development, rather than teaching experience alone, determines preparedness for digital teaching. International and local evidence further shows that when teachers receive tool-specific professional development, such as on GeoGebra or Desmos, they report increased confidence, richer lesson design, and greater student engagement (Chechan et al., 2023; Marange, 2025; Saliao & Cajandig, 2025). Conversely, inadequate training and technical support, as reflected in the lower-rated items, prevent consistent adoption of these tools. These challenges also resonate with Diffusion of Innovations theory, which stresses that adoption depends on compatibility with teachers' work contexts and the availability of supportive conditions that reduce complexity (Frei-Landau et al., 2022).

In sum, the data indicate that while teachers demonstrate willingness to integrate technology, persistent infrastructural deficits, limited preparation time, and uneven access to training and support remain significant barriers. Addressing these issues through reliable connectivity, equitable device provision, sustained professional development, and supportive school policies is essential for enabling teachers to advance along the SAMR continuum and fully realize the potential of technology integration in mathematics instruction.

Impact of Technology Integration on Student Learning Motivation and Engagement

Table 7 shows that teachers reported strongly positive perceptions of technology's motivational effects (overall $M = 4.47$), with consistently strong agreement across all indicators. The highest endorsement concerned gamified activities (e.g., quizzes, interactive games; $M = 4.62$), followed by the view that multimedia presentations make lessons more stimulating ($M = 4.59$) and that technology increases students' interest in classroom activities ($M = 4.53$). Teachers also strongly agreed that technology fosters curiosity ($M = 4.47$), sustains enthusiasm for continuous learning ($M = 4.44$), and supports ownership of learning ($M = 4.48$). These patterns cohere with the study's theoretical stance that effective technology use blends content, pedagogy, and tools (TPACK) to create engaging, conceptually rich experiences; when such alignment is achieved, students respond with greater interest, effort, and persistence.

Table 7. Perception of the Respondents on the Impact of Technology Integration on Student Learning Motivation and Engagement

Indicators	Mean	Descriptive Equivalent
As a Mathematics teacher, I perceived that...		
1. technology integration increases students' interest in classroom activities.	4.53	Strongly Agree
2. the use of multimedia presentations makes lessons more stimulating for students.	4.59	Strongly Agree
3. students show greater effort in completing assignments when technology is involved.	4.37	Strongly Agree
4. technology-supported instruction encourages students to set personal learning goals.	4.37	Strongly Agree
5. students are more persistent in overcoming learning challenges with the aid of technology.	4.30	Strongly Agree
6. access to educational apps and platforms fosters students' curiosity about topics.	4.47	Strongly Agree
7. technology use helps maintain students' enthusiasm for continuous learning.	4.44	Strongly Agree
8. gamified activities (e.g., quizzes, interactive games) motivate students to actively participate.	4.62	Strongly Agree
9. students feel a sense of accomplishment when completing technology-integrated tasks.	4.43	Strongly Agree
10. the presence of digital tools in teaching inspires students take ownership of their learning process.	4.48	Strongly Agree
Average Weighted Mean	4.47	Strongly Agree

Legend: 4.21-5.00 = Strongly Agree, 3.41-4.20= Agree, 2.61-3.40 Neutral, 1.81-2.60 = Disagree, 1.00-1.82 = Strongly Disagree

The profile of responses aligns with contemporary motivation theory and empirical evidence. From Self-Determination Theory (SDT), well-designed technology environments can satisfy students' needs for autonomy (choice and self-paced exploration), competence (immediate feedback, scaffolded tasks), and relatedness (collaborative platforms), which in turn amplifies intrinsic motivation and sustained engagement (Ryan & Deci, 2020; Ryan & Deci, 2022). Teachers' strong agreement that technology prompts goal setting, greater effort, persistence, and a sense of accomplishment is consistent with SDT's predictions about the motivational benefits of autonomy-supportive, feedback-rich learning contexts (Ryan & Deci, 2020; 2022). Equally, high ratings for multimedia reflect design principles from multimedia learning, which show that appropriately integrated words and graphics can improve attention and understanding of abstract ideas, central to mathematics learning (Mayer, 2020). Findings also triangulate with discipline-specific research in mathematics. Studies on Desmos show improvements in students' conceptual understanding of functions and positive attitudes toward learning when interactive visualizations are used in instruction (Chechan

et al., 2023). Philippine evidence similarly indicates that digital pedagogy is associated with higher student engagement and achievement in secondary mathematics (Saliao & Cajandig, 2025). Reviews of technology integration in mathematics education emphasize that when teachers design tasks that leverage dynamic software and immediate feedback, students exhibit stronger participation and deeper sense-making (Weigand, 2021/2024; see also systematic overviews reporting favorable effects on engagement and achievement). Together, these studies support teachers' judgments that gamification, multimedia, and platform-based exploration meaningfully enhance motivation, effort, and perseverance in mathematics.

In sum, teachers perceive technology as an effective lever for motivating students in mathematics, particularly through gamified tasks, multimedia explanations, and interactive platforms that foster curiosity, ownership, and sustained effort. Through the study's conceptual lens, these perceptions indicate that when TPACK-aligned design choices are enacted in classrooms with adequate support, students exhibit robust motivational indicators that are theoretically expected (SDT) and empirically documented in recent mathematics education research.

Table 8 shows that the perception of the mathematics Teachers on students' engagement. The findings indicate that teachers hold very positive perceptions of the effectiveness of technology incorporation in fostering student engagement in mathematics, with an overall mean of 4.37, resolved as "Strongly Agree." Teachers affirmed that technology consistently promotes collaboration, participation, and inclusivity in the classroom. The most substantial endorsements were for the perception that technology creates a more inclusive and engaging learning environment for diverse learners ($M = 4.46$), facilitates peer-to-peer interactions that strengthen engagement ($M = 4.45$), and encourages greater participation in assessment activities such as online quizzes and digital projects ($M = 4.44$). Similarly, teachers strongly agreed that technology sustains student focus during lessons ($M = 4.36$), promotes engagement both inside and outside the classroom through online platforms ($M = 4.36$), and increases active involvement through interactive tools such as polls and virtual whiteboards ($M = 4.34$). These results highlight the central role of digital tools in supporting multiple dimensions of student engagement.

As part of the Technological Pedagogical Content Knowledge (TPACK) model, these findings suggest that when teachers design lessons that meaningfully integrate content, pedagogy, and technology, students have richer opportunities for collaboration, discussion, and inquiry (Marcos, 2025).

From the perspective of the SAMR model, the widespread use of interactive and collaborative technologies reflects practices that extend beyond simple substitution of traditional methods, moving toward modification of classroom interaction patterns and assessment structures (Weigand, 2024). These outcomes are also consistent with Self-Determination Theory, which posits that technology-enhanced tasks can meet students' psychological demands for autonomy, competence, and interrelatedness, thereby strengthening motivation and deepening engagement (Ryan & Deci, 2020; 2022).

Table 8. Perceptions of the Respondents on Students' Engagement

Indicators	Mean	Descriptive Equivalent
As a Mathematics teacher, I perceived that...		
1. technology integration encourages students to collaborate more during group activities.	4.33	Strongly Agree
2. students are more responsive and participative in class discussions when technology is used.	4.32	Strongly Agree
3. interactive tools (e.g., polls, virtual whiteboards) increase students' involvement during lessons.	4.34	Strongly Agree
4. students remain focused for longer periods in technology-supported lessons.	4.36	Strongly Agree
5. the use of online learning platforms promotes active student engagement inside and outside the classroom.	4.36	Strongly Agree
6. technology facilitates peer-to-peer interactions that strengthen classroom engagement.	4.45	Strongly Agree
7. digital activities make it easier to reach disengaged or passive learners.	4.31	Strongly Agree
8. students demonstrate more curiosity and ask more questions during tech-integrated lessons.	4.31	Strongly Agree
9. students are more eager to participate in assessment activities (e.g., online quizzes, digital projects).	4.44	Strongly Agree
10. technology helps create a more inclusive and engaging learning environment for all types of learners.	4.46	Strongly Agree
Average Weighted Mean	4.37	Strongly Agree

Legend: 4.21-5.00 = *Strongly Agree*, 3.41-4.20 = *Agree*, 2.61-3.40 = *Neutral*, 1.81-2.60 = *Disagree*, 1.00-1.82 = *Strongly Disagree*

Contemporary empirical studies corroborate the teachers' perceptions. Research on Desmos has shown that interactive mathematics platforms improve students' conceptual understanding while simultaneously heightening classroom participation (Chechan et al., 2023). Studies of GeoGebra confirm that dynamic representations increase student curiosity and questioning, key indicators of cognitive engagement (Marange, 2025). Philippine evidence further supports the claim that integrating digital pedagogy in mathematics improves student participation, persistence, and achievement outcomes (Saliao & Cajandig, 2025). Collectively, these findings strengthen the view that well-designed technology integration not only sustains attention but also enhances inclusivity and provides alternative avenues for engaging learners who may otherwise remain passive.

In summary, teachers strongly perceive technology integration as an effective strategy for enhancing student engagement in mathematics. By fostering collaboration, sustaining focus, and supporting inclusivity, technology creates environments that align with theoretical expectations from TPACK, SAMR, and Self-Determination Theory. The evidence indicates that with continued professional development and reliable

infrastructure, technology integration can further advance mathematics classrooms toward more interactive, equitable, and participatory learning experiences.

Significant Differences in the Integration of Technology in Mathematics Instruction Based on Teacher-Related Factors

The results indicate that teaching experience has a statistically significant effect on the extent of technology integration in mathematics instruction ($F = 30.53, p < 0.001$). This suggests that teachers' years of experience meaningfully influence how frequently or effectively they integrate technology into their mathematics teaching.

Table 9. *Notable Differences in the Integration of Technology in Mathematics Instruction Based on Teacher-Related Factors using Analysis of Variance (ANOVA)*

Demographic Profile of Teachers	F	p
Teaching experience	30.53	0.0000001141990735
Grade Level	0.640	0.546
Number of Technology-Related Training Attended	0.802	0.496
Access to Digital Tools	1.86	0.0849

In contrast, grade-level assignment does not significantly affect technology integration ($F = 0.640, p = 0.546$), indicating that whether a teacher teaches lower or higher grade level does not substantially shape differences in their technology use. Likewise, professional development measured through the number of technology-related trainings attended—shows no significant influence ($F = 0.802, p = 0.496$), implying that the quantity of attended trainings does not necessarily translate into increased technology use in mathematics instruction. Finally, access to digital tools shows a marginal, but not statistically significant, effect ($F = 1.86, p = 0.0849$). Although approaching significance, the result indicates that differences in access to technological resources do not strongly determine the extent of technology integration within the conventional 0.05 level. Overall, the findings reveal that only teaching experience contributes to notable differences in technology integration. At the same time, grade level, number of trainings attended, and access to digital tools do not significantly differentiate teachers' levels of technology use.

Building on this statistical outcome, the TPACK framework helps explain why teaching experience emerges as a significant differentiator. Experienced teachers may demonstrate more profound pedagogical knowledge and content mastery, yet their ability to integrate technology depends on continuous professional development to bridge generational and digital gaps (Marcos, 2025). Conversely, early-career teachers though often more comfortable with digital tools may lack the pedagogical depth required to integrate them meaningfully with mathematical content. This uneven distribution of

strengths clarifies why differences in integration are statistically significant. Complementing this perspective, the SAMR model suggests that novice teachers may primarily experiment at the substitution and augmentation levels. In contrast, more experienced teachers with sustained training are better positioned to progress to modification and redefinition (Weigand, 2024).

Empirical evidence further reinforces these theoretical explanations. Scherer (2023) demonstrated that experience alone does not guarantee preparedness; instead, integration outcomes improve when professional development supports teachers at different career stages. Younger teachers may adopt tools more readily but limit their use to surface-level applications, while mid-career teachers combining content expertise with ongoing training can leverage technology for more profound instructional transformation (Scherer, 2023; Frei-Landau et al., 2022). Philippine studies similarly note that differences in technology integration across experienced groups are shaped by contextual factors such as access to training and institutional support (Marpa, 2021; Saliao & Cajandig, 2025). Moreover, targeted interventions, such as GeoGebra workshops, show that even experienced teachers can significantly enhance their TPACK when provided with iterative, subject-specific training (Marange, 2025; Batiibwe, 2024). Taken together, these results affirm that teaching experience produces meaningful variation in technology integration, consistent with both theoretical models and empirical findings. The implication for the district is clear: professional development should be differentiated by career stage so that both novice and veteran teachers can strengthen their integration practices and advance along the SAMR continuum.

Turning to grade level, the absence of significant differences suggests that teachers across junior and senior high schools integrate technology to a similar degree. This aligns with the study's conceptual framework, which posits that while grade level may influence curricular focus and task complexity, technology integration is more strongly shaped by factors such as access to training, infrastructure, and professional support. From a TPACK perspective, teachers at both levels can blend pedagogy, content, and technology effectively when provided with the necessary tools and competencies (Marcos, 2025). Likewise, the SAMR model explains that regardless of grade assignment, teachers may cluster around the substitution and augmentation stages unless systematic professional development pushes them toward modification and redefinition (Weigand, 2024).

Supporting this interpretation, Philippine research has reported that both junior and senior high school mathematics teachers share comparable attitudes toward technology integration, with differences arising mainly from access and support rather than grade level (Marpa, 2021; Saliao & Cajandig, 2025). International findings echo these patterns, showing that professional development and infrastructure quality rather than grade assignment most strongly determine integration depth (Scherer, 2023; Frei-Landau et al., 2022). Thus, the lack of significant grade-level differences underscores the need to prioritize system-level supports, such as stable connectivity, accessible digital tools, and sustained training, to enable learning facilitators to advance along the SAMR continuum.

A similar pattern emerges regarding the Number of technology-related trainings attended. The statistical result suggests that training frequency alone is not a sufficient predictor of effective integration. Within the study's conceptual framework, this finding highlights the importance of training quality, contextual relevance, and follow-up support rather than the sheer Number of sessions. According to TPACK, professional development must explicitly target the interplay among technological, pedagogical, and content knowledge to produce meaningful integration (Marcos, 2025). The SAMR model similarly emphasizes that movement toward transformative practices modification and redefinition requires iterative, sustained, and discipline-specific training; one-off workshops often leave teachers at the substitution or augmentation stages (Weigand, 2024).

Current scholarship affirms this interpretation. Scherer (2023) found that digital preparedness is shaped less by the Number of training sessions attended and more by their design and contextual alignment. Philippine studies also report that one-time seminars seldom translate into classroom practice, whereas continuous, tool-specific workshops (e.g., GeoGebra or Desmos training) foster measurable improvements in integration and student engagement (Marange, 2025; Saliao & Cajandig, 2025). International evidence likewise shows that the depth and coherence of training especially opportunities for practice, reflection, and collaboration enable teachers to apply technology meaningfully (Frei-Landau et al., 2022). Hence, the absence of significant differences across training groups signals that the quality of exposure matters more than its quantity. This underscores the need for iterative, mathematics-specific professional development supported by coaching and adequate infrastructure to enhance teachers' TPACK and help them progress along the SAMR continuum.

Finally, the marginal but nonsignificant effect of access to digital tools highlights that while access is an important prerequisite, it alone does not account for significant differences in integration. Within the study's conceptual framework, this outcome suggests that actual utilization, teacher confidence, and pedagogical alignment play more decisive roles. TPACK clarifies that access to devices and the internet is only the first step; teachers must also develop the skills needed to embed these tools into pedagogically sound and content-relevant practices (Marcos, 2025). Similarly, the SAMR model emphasizes that even with adequate access, teachers often remain at the substitution or augmentation levels unless supported by sustained professional development encouraging transformative use (Weigand, 2024).

Contemporary research reinforces this view. In the Philippine context, Marpa (2021) observed that although many mathematics teachers rely on personal devices, access alone does not ensure quality integration due to inconsistent training and infrastructure limitations. Scherer (2023) also found that while access is necessary, effective use depends heavily on teacher preparedness and institutional support. Mathematics-specific studies further demonstrate that when access is paired with targeted training, teachers can integrate advanced tools such as GeoGebra and Desmos more confidently, resulting in improved student engagement and understanding (Chechan et al., 2023; Marange, 2025; Saliao & Cajandig, 2025). Conversely, in settings

with limited support, even adequate access does not yield high-quality classroom use. In the context of Diffusion of Innovations theory, this suggests that while access reduces barriers of trialability and complexity, meaningful adoption still depends on complementary supports that build compatibility with instructional practices (Frei-Landau et al., 2022). Therefore, although the statistical test shows no significance, the marginal trend underscores that access remains an essential precondition that interacts with training, support, and pedagogical readiness. This highlights the need for systemic approaches that not only ensure equitable access but also provide sustained professional development, stable infrastructure, and curriculum-aligned digital resources supports necessary for teachers to translate access into deeper integration and advance along the SAMR continuum.

Conclusions

1. The majority of mathematics teachers are in the early-career stage and are primarily assigned to Junior High School. Most have attended only limited trainings related to educational technology and mainly depend on personal devices and the school's internet connection for instructional and technological needs.

2. The overall high extent of technology integration demonstrates that mathematics teachers in Pangasinan II are actively engaging with technology as an instructional tool, particularly in planning and delivering lessons that align with curricular objectives. Their openness to innovation positions them as early adopters capable of advancing integration practices when supported appropriately. However, the persistent gaps in assessment-related practices indicate that teachers remain clustered at the substitution and augmentation levels of the SAMR model, where technology is primarily used to enhance existing practices rather than transform them. This highlights the critical role of structured professional development and institutional support in enabling teachers to advance toward modification and redefinition, ensuring that technology not only supports but reshapes the ways mathematics is taught and learned.

3. The results also indicate that while teachers demonstrate readiness and openness to technology integration, their capacity to do so effectively remains hampered by infrastructural deficits and insufficient systemic support. The lack of reliable internet connectivity and equitable access to devices not only limits the frequency of integration but also prevents teachers from advancing beyond basic substitution and augmentation levels of the SAMR model. Moreover, gaps in professional development and limited access to curriculum-relevant digital tools reinforce inconsistent practices, leading to unequal learning opportunities across classrooms. These findings underscore that the challenges are less about teacher attitudes and more about the external conditions shaping their instructional environment, aligning with both the TPACK framework and CBAM in emphasizing the pivotal roles of resources, training, and organizational backing.

4. Teachers view technology as a powerful catalyst for learning outcomes in mathematics, particularly in motivating students to engage actively, set personal goals, and persist in overcoming learning challenges. The high consensus across indicators indicates that teachers are not only receptive to technology but also recognize its transformative potential when it is adequately aligned with instructional goals. However, while perceptions are overwhelmingly positive, the findings also imply a need to ensure

that teachers' beliefs translate into consistent classroom practices. Without adequate infrastructure, training, and institutional support, there remains a risk that these positive perceptions may not fully materialize into sustained, transformative student learning outcomes.

5. The analysis concludes that while teaching experience significantly differentiates the extent of technology integration, other teacher-related factors such as grade level assignment, Number of trainings attended, and access to digital tools do not, at a statistically significant level, predict integration practices. This suggests that individual demographic characteristics alone are insufficient to explain technology adoption patterns. Instead, integration is best determined by the interplay among professional development quality, contextual supports, and infrastructure. Teachers at different career stages require differentiated support: novice teachers may need guidance on pedagogy and content alignment. In contrast, more experienced teachers require interventions that build confidence and skill in adopting digital innovations. Ultimately, systemic and institutional enablers, rather than teacher demographics alone, remain decisive in advancing mathematics instruction along the SAMR continuum and strengthening teachers' TPACK.

Recommendations

1. It is recommended that education leaders and policymakers in Pangasinan II invest in sustained, mathematics-specific professional development, moving beyond one-shot training sessions toward iterative, tool-focused workshops on platforms such as GeoGebra and Desmos, coupled with coaching and peer collaboration. At the same time, schools must address inequities in access by providing reliable digital infrastructure, school-provided devices, and stable internet connectivity, thereby reducing the reliance on personal resources. Professional development should be differentiated by career stage to maximize both the adaptability of younger teachers and the pedagogical expertise of more experienced ones. Finally, institutional policies should encourage and monitor technology integration, ensuring that the district's mathematics teachers not only strengthen their TPACK competencies but also advance along the SAMR continuum, ultimately creating more engaging, inclusive, and effective mathematics learning environments.

2. Education leaders should provide sustained, mathematics-specific professional development focused on technology-enabled assessment and feedback practices to complement teachers' strong integration in planning and delivery. Professional development should include iterative workshops on platforms such as GeoGebra and Desmos, training on technology-based formative and summative assessments, and opportunities for peer collaboration and coaching. At the same time, schools should ensure reliable infrastructure and access to digital tools that reduce inconsistencies in practice and support equitable integration. By strengthening professional development and institutional support systems, mathematics teachers can progress along the SAMR continuum, fully operationalize their TPACK competencies, and deliver transformative, student-centered instruction that maximizes the potential of educational technology in mathematics learning.

3. To address the challenges, education leaders and policymakers should prioritize systemic interventions that strengthen both infrastructure and professional support. Specifically, investments in reliable internet connectivity and equitable device provision must be complemented by sustained, mathematics-specific professional development on tools such as GeoGebra and Desmos, alongside mentoring and technical support structures. Schools should also adopt policies that allocate adequate time for lesson preparation and ensure access to high-quality, curriculum-aligned digital resources. By tackling these structural barriers and creating enabling conditions, teachers will be better positioned to enhance their TPACK competencies, progress along the SAMR continuum, and transform technology integration into a driver of meaningful, engaging, and equitable mathematics learning.

4. Education leaders and school administrators should capitalize on teachers' strong positive perceptions by providing structured opportunities to translate these beliefs into practice. This includes investing in sustained, mathematics-specific professional development that equips teachers with strategies for designing gamified activities, integrating interactive tools such as GeoGebra and Desmos, and creating inclusive digital learning environments. Equally, ensuring reliable infrastructure and equitable access to devices and internet connectivity is critical to support consistent application. Finally, schools should institutionalize policies that encourage the use of digital assessments and collaborative platforms, thereby reinforcing teachers' perceptions with systemic backing. By aligning training, resources, and policy with teachers' positive dispositions, the district can maximize the motivational and engagement benefits of technology and drive more effective mathematics learning outcomes.

5. To strengthen technology integration in mathematics instruction, professional development must be differentiated to address teachers' career-stage needs, as teaching experience was the only factor that significantly influenced integration. Early-career teachers should receive structured support in designing technology-enhanced lessons. In contrast, mid- and late-career teachers need scaffolded digital skills training and extended hands-on practice with tools such as GeoGebra and Desmos. Professional learning should move beyond one-time seminars and instead be iterative, mathematics-specific, and supported through coaching, mentoring, and collaborative learning communities. At the policy level, DepEd, school heads, and LGUs must coordinate to resolve systemic barriers volatile internet, limited device access, and insufficient preparation time by investing in reliable connectivity, equitable device provision, and curriculum-aligned digital resources. Schools should protect teacher preparation time and strengthen LAC sessions focused on digital pedagogy, while LGUs should prioritize broadband upgrades and ICT allocations. Aligning infrastructure, professional learning, and institutional policies will enable teachers to operationalize TPACK more effectively and advance toward higher levels of SAMR integration, ensuring more consistent, equitable, and transformative technology use in mathematics classrooms.

Compliance with Ethical Standards

This is to certify that all sources used in this study have been properly acknowledged and duly cited with utmost diligence. This is to certify further that this research is an original undertaking and has neither been submitted for another degree

nor has been copied from previous work. Further still, this is to certify that the entire manuscript has been submitted to and passed the standards on plagiarism set by the institution. Also, this study followed well-established ethical guidelines to ensure the safety, rights, and well-being of all respondents. The researcher obtained informed consent from each respondent through Google Form. Respondents' privacy was fully protected throughout the research process. Teachers were not asked to share their names or any personal information that could identify them. No teacher was required or pressured to take part, and anyone who agreed could change their mind and withdraw at any time, without any consequences.

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