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# Impact of Technological Tools on Mathematics Pedagogy: Data-Driven Insights into Educators' Practices in Math Classrooms †

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**Abstract**

Teaching with technology enhances instructional effectiveness and student engagement, particularly in mathematics, accounting, and ICT education. Digital learning creates an interactive environment that fosters deeper understanding and keeps learners updated with current trends. For teachers, it offers tools to assess student strengths and weaknesses better, guiding them to develop targeted interventions. However, successful technology integration depends on educators' digital skills, an area where many still face challenges. This paper aims to assess teachers' technological and pedagogical proficiency and identify barriers to integration. The study employed a mixed-method approach with 60 teacher respondents selected through stratified random sampling from both urban and rural schools. Data was collected through online interviews, classroom observations, and pre- and post-survey questionnaires focusing on confidence, competence, and willingness to use technology. Thematic analysis and paired sample *t*-tests using SPSS v.20 revealed a significant improvement in teachers' technological skills following an intervention program. It also identified both internal and external factors hindering technological integration in the classroom. Findings emphasize that sustained support and training are essential for effective technology use in the classroom and recommend that school administrators embed technology in curriculum planning to enhance both instruction and extension activities.

**Keywords:** digital learning; pedagogical skills; technological skills; confidence; competence; willingness; technology integration; instructional challenges

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## 1. Introduction

Technology integration in math classrooms is increasingly crucial as both students and educators navigate a world profoundly influenced by digital technologies. Using technology to teach mathematics inside the classroom creates opportunities in various ways. If introduced and demonstrated properly, it can open a more engaging and personalized learning experience that promotes critical thinking, problem solving, and mathematical reasoning skills among students [1]. However, this integration of technology into the math classroom requires skills, careful planning, and ongoing professional development for teachers. Despite attending numerous seminars, workshops, and training programs aimed at integrating technology into classroom instruction, many educators, particularly those teaching mathematics, remain hesitant to adopt digital tools, preferring traditional methods due to perceived convenience and familiarity. This reluctance has led to the

underutilization of free and accessible technological resources, contributing to students' lack of preparedness and limited exposure to 21st-century learning tools. The effects of this resistance are evident in the poor performance of the Philippines in the PISA results. PISA is a worldwide study conducted by the OECD that assesses the knowledge and skills of 15-year-old students in reading, mathematics, and science. It uses a computer-based assessment, a student questionnaire, and a school questionnaire to collect data. This test evaluates how well students can apply their learning to real-world situations to prepare them for further education and the workforce and provides internationally comparable data on student achievement to help participating countries improve their education policies and outcomes.

According to Figure 1, the Philippines has consistently ranked poorly in the PISA. In 2018, the Philippines ranked 78th out of 78 countries. By 2022, while the number of participating countries increased to 81, the Philippines still ranked at the bottom, specifically 77th. In both 2018 and 2022, the Philippines scored below the baseline proficiency level (Level 2) in mathematics, reading, and science; although the 2022 results showed a slight improvement, the change was not statistically significant [2,3].




**Figure 1.** Philippines' involvement in the 2018 and 2022 PISA.

Figure 2 shows the PISA math scores for the Philippines in 2018 and 2022. In 2018, the country scored 353 in mathematics, ranking second lowest among the 79 participating countries. In 2022, Filipinos scored 355 in mathematics, ranking sixth lowest among the 81 participating countries. Although there was a slight improvement, from a score of 353 in 2018 to 355 in 2022, the country remains among the lowest ranked in mathematics proficiency globally [2,3].

In response, both the Department of Education and the Commission on Higher Education have been actively developing and implementing interventions to address these persistent learning gaps. These efforts include the improvement of K-12 curricula, the integration of more contextualized and technology-driven teaching strategies, and the strengthening of assessment frameworks to better track student progress. Additionally, CHED is prioritizing reforms in preservice teacher education by aligning teacher training programs with global standards, ensuring that future educators are well equipped with both content knowledge and pedagogical skills [4].

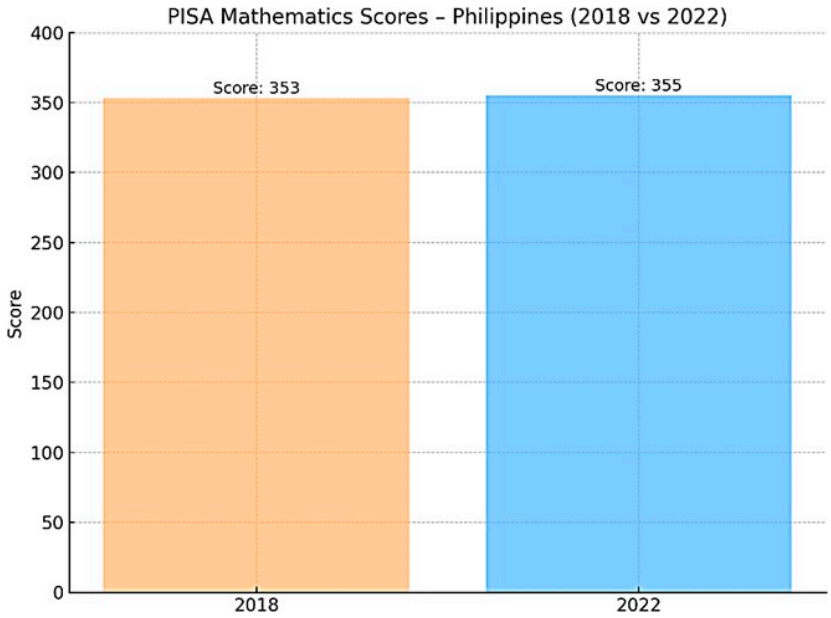



**Figure 2.** Mathematics literacy score for the Philippines in 2018 and 2022 PISA.

In addition, these interventions have gradually contributed to the improvement of the Philippine education system, beginning with improvements in school resources, infrastructure, and teacher professional development. Investments have been directed toward equipping schools with adequate learning materials, digital tools, and internet access to support more effective and inclusive instruction. Infrastructure upgrades, especially in underserved areas, aim to provide a more conducive learning environment. At the same time, continuous capacity-building programs are being implemented to upskill teachers in content mastery, 21st-century teaching strategies, and the integration of technology into the classroom.

According to Education GPS (2025) [4], the Philippines has one of the highest levels of preparedness for digital learning among OECD and partner countries/economies in terms of teachers' engagement, motivation, and drive in teaching. In terms of educational resources, the Philippines had already enforced the digital device policies at school to a great extent.

Figure 3 explains that the Philippines' preparedness for digital learning with a 1:1 ratio of students to computers is slightly negative. This means that an increase in computer availability does not significantly improve the preparedness for digital learning in the country or may even have a slight negative association. However, having formal guidelines for the use of digital devices may be more effective in increasing preparedness for digital learning than simply increasing the number of computers [4].

This result highlights the need for innovative teaching methods to equip students with the necessary mathematical skills for a technology-driven future and effective professional development programs for teachers because the ability to effectively incorporate technology into teaching practices depends on adequate professional development and access to educational resources [5].

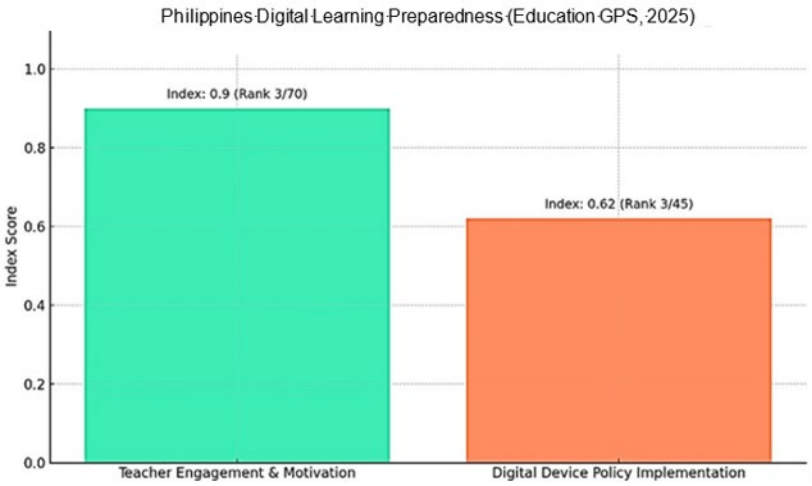



**Figure 3.** Philippines digital learning preparedness according to Education GPS (2025) [4].

## 2. Theoretical Framework

The study is anchored on the Technological Pedagogical Content Knowledge (TPACK) framework, a model developed by Koehler and Mishra (2009) [5] to describe the unique knowledge necessary for teachers to effectively integrate technology into their teaching. This model is a combination of understanding subject matter (content knowledge), pedagogical strategies (pedagogical knowledge), and technological knowledge to use digital tools and resources appropriately (technological knowledge).

Figure 4 shows the three areas of knowledge that are interconnected and interdependent. Teachers cannot effectively integrate technology without a solid understanding of the subject content and teaching approaches. Similarly, technological knowledge alone is insufficient without a deep understanding of content and pedagogy.

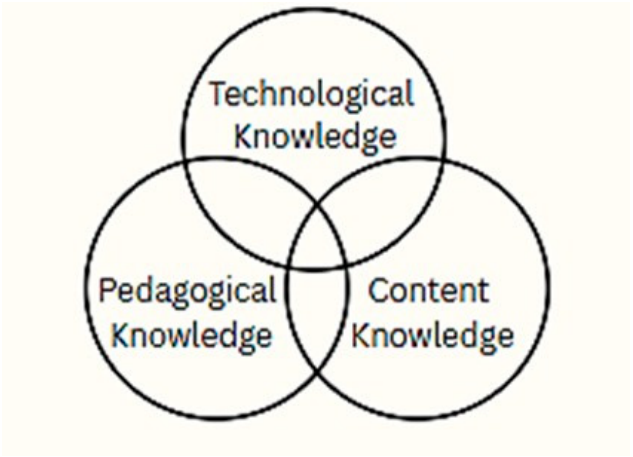



**Figure 4.** TPACK framework.

The TPACK framework examines how technological tools enhance mathematics pedagogy in creating more interactive and impactful learning experiences for students [5]. Specifically, this model assesses the current level of technological proficiency among mathematics educators in using digital tools for learning, identifies the external and internal factors that prevent effective integration of technology in math instruction, and assesses the educators' level of confidence, competence, and willingness to use technology tools after the implementation of three knowledge areas to the respondents.

Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK) were systematically addressed in this study. Technological Knowledge (TK)

focused on teachers' understanding and proficiency in using tools such as calculators, interactive whiteboards, computational software, and other technological platforms. Pedagogical Knowledge (PK) was examined through evaluating teachers' instructional strategies, including their ability to align digital tools with student-centered teaching methods using a self-assessment survey and in-depth interviews to obtain reflection data for analyzing pedagogical improvements. Content Knowledge (CK) was assessed through pre-training tests and post-training evaluations, focusing on teachers' ability to connect complex mathematical concepts with technology-enhanced teaching approaches. TPK (Technological Pedagogical Knowledge), TCK (Technological Content Knowledge), and PCK (Pedagogical Content Knowledge) were emphasized through training that demonstrated best practices, facilitated peer collaboration, and required teacher participants to design and implement technology-enhanced lessons [6].

This research study will investigate the following questions:

1. What is the confidence, competence, and willingness level of teachers before and after using technology tools in mathematics classrooms?
2. Is there a significant difference in the educators' technology integration in math classrooms before and after the professional development program?
3. What are the key components of effective professional development programs for technology integration in math classrooms?
4. How can professional development programs be designed to empower educators to integrate technology effectively into their math classrooms?

Connecting the framework with the presented problems addresses prior solutions to the issues encountered by teachers in their pedagogical approach in modern classrooms.

Some of the issues encountered during the baseline evaluation include a lack of initiation for teachers to incorporate technology in teaching because teachers are more familiar with using the conventional approach to teaching rather than exploring the technology and using it in the classroom. Some examples of technology tools in mathematics education include online tutorials, interactive simulations, virtual manipulatives, graphing calculators (GeoGebra, Desmos, Wolfram Alpha, and MATLAB), and educational software (SPSS, JASP, and MS Excel). These technological tools help the students to visualize abstract concepts, explore real-world applications of mathematics, and practice problem-solving skills in a dynamic and interactive environment [7]. Another issue refers to the educators' level of self-proficiency about their abilities and mastery in teaching mathematics using technology. These levels of self-proficiency include confidence level, competence level, and willingness to use technology. Confidence level is the behavior of educators in feeling at ease in selecting tools. When the teacher is confident in using technology, he/she knows how to utilize the proper functions of the tools. According to the study of McCulloch, et al. (2018) [8], when thinking about how to use technology in teaching, it is helpful to look at the types of tools a teacher will use, how they will use them in class, and how each activity supports their learning goals.

Competency level is a person's capability to do something adequately. According to Tabach (2021) [9] cited in OECD Volume I and II (2023) [2,3], competency is more than just knowledge or skills. Teachers must be competent enough to handle knowledge and skills accurately to design a relevant intervention for the task given [10].

According to Kreijns et al. (2013) [11], teachers' negative attitudes come from the idea that the traditional way of teaching math is the right one. The goal of the intervention is to change this thinking, and after the intervention, their willingness to try new methods will be measured.

## 3. Materials and Methods

Through stratified random sampling, this study included sixty teacher respondents teaching mathematics, accounting, and ICT subjects.

Figure 5 shows the sample size and subjects handled by the respondents in the study. The sample included 20 teachers from junior high school, 20 from senior high school, and 20 from the college level. The selection ensured representation across different teaching environments, including urban and rural schools. Employing a mixed-method approach, the study designs a training workshop through virtual sessions, including collaborative activities and interviews with teacher respondents.

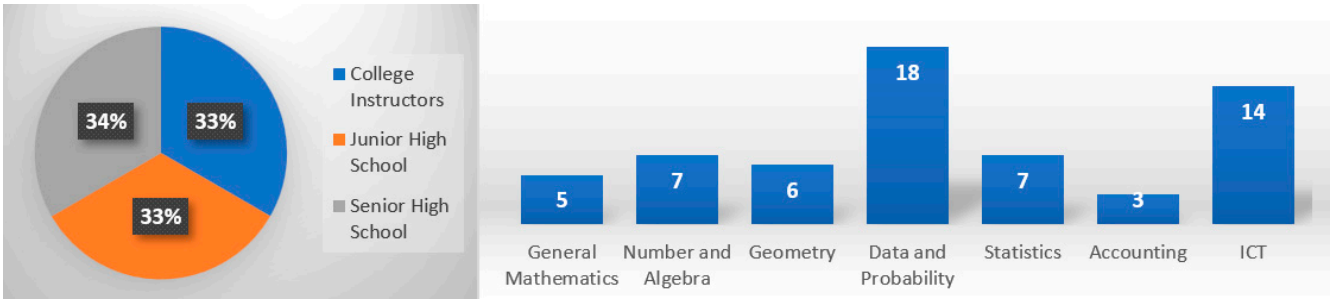



**Figure 5.** Sample distribution and subjects handled by the respondents.

For the quantitative phase, data was collected through pre- and post-self-assessment survey questionnaires designed to measure educators' levels of confidence, competence, and willingness. Each item assessed aspects of teachers' TPACK competencies in integrating technological tools into mathematics instruction. The survey instrument was researcher-developed and validated by field experts, yielding a reliability coefficient of 0.830 (Cronbach's alpha), which indicates a good and acceptable level of internal consistency. The data collected was statistically analyzed using SPSS software, employing a paired-samples *t*-test to evaluate significant differences between pre- and post-assessment results.

For the qualitative method, data was collected through in-depth online interviews and observations to gain insights into the practical implementation of technology in classrooms. The questions in this method assessed the perception of the teacher participants about their mentors, peers, and self-experience, where effective implementation of technology in teaching was demonstrated. The data in this method was analyzed through a thematic approach.

The Figure 6 shows the methodology structure of a proposed professional development program using technological tools in a mathematics classroom. The process begins with the collection of baseline evaluation data, which serves as the foundation for understanding the current levels of teachers' skills, attitudes, and practices related to technology integration. Based on this initial data, a training workshop is conducted to enhance teachers' competencies. Following the workshop, two methods of data collection are employed to assess its effectiveness: the qualitative method, which involves interviews to capture teachers' in-depth reflections and experiences, and the quantitative method, which utilizes pre- and post-self-assessment surveys. These surveys evaluate three key indicators: confidence level, competence level, and willingness level in integrating technology into teaching practices. This program is aimed at equipping teachers with the necessary skills and mindset to thrive in a technology-integrated, modern classroom environment.

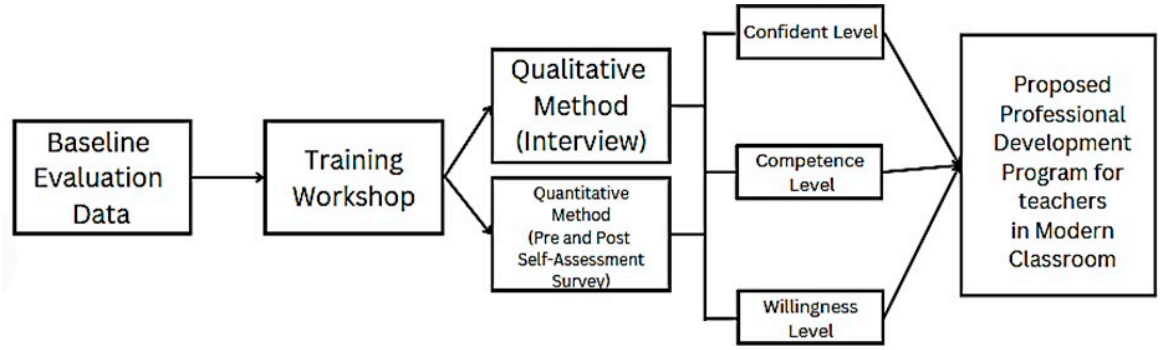



**Figure 6.** Structure of methodology.

## 4. Results

The quantitative findings of the research showed a significant improvement in educators' confidence, competence, and willingness to integrate technology into their math classrooms after participating in an online training program. The results presented below answer the problem identified in the introduction.

Table 1 shows the teachers' confidence level before and after using technology tools in mathematics classrooms. With a mean difference of 0.9 and a computed t-value of 5.4, the results show that there is a statistically significant difference in teachers' confidence levels before and after using technology tools in their mathematics classrooms ($p < 0.05$). The mean level of confidence based on the Likert scale is 56.67%, or disagree, before the training workshop and 85.09%, or strongly agree, after the intervention.

**Table 1.** Confidence level of teachers in using technology tools in mathematics classrooms before and after the intervention.

| Treatments | Mean | N | Mean Difference | Std. of Mean Difference | t-Value | *p*-Value | Percentage |
|---|---|---|---|---|---|---|---|
| Confidence level before | 3.2 | 60 | 0.9 | 0.5 | 5.4 | 0.001 | 56.67% |
| Confidence level after | 4.1 | 60 | | | | | 85.09% |

Table 2 shows a highly significant difference in teachers' competence levels before and after using technology tools in their mathematics classrooms ($p < 0.05$). The mean level of competence of teacher participants before implementing the program is 63.02%, or agree, versus 92.13%, or strongly agree, after implementing the program.

**Table 2.** Competence level of teachers in using technology tools in mathematics classrooms before and after the intervention.

| Treatments | Mean | N | Mean Difference | Std. of Mean Difference | t-Value | *p*-Value | Percentage |
|---|---|---|---|---|---|---|---|
| Competence level before | 3.5 | 60 | 0.9 | 0.4 | 6.8 | <0.001 | 63.02% |
| Competence level after | 4.4 | 60 | | | | | 92.13% |

The result of the *t*-test in Table 3 shows a highly significant difference in teachers' willingness before and after using technology tools in their mathematics classrooms ($p < 0.05$). The mean percentage of willingness before the implementation of the program is 68%, or agree, versus 95%, or Strongly Agree, after the program implementation.

**Table 3.** Willingness of teachers to use technology tools in mathematics classrooms before and after the intervention.

| Treatments | Mean | N | Mean Difference | Std. of Mean Difference | t-Value | *p*-Value | Percentage |
|---|---|---|---|---|---|---|---|
| Willingness level before | 3.8 | 60 | 0.9 | 0.3 | 7.3 | <0.001 | 68% |
| Willingness level after | 4.7 | 60 | | | | | 95% |

As shown in Table 4, the computed value of the *t*-test for the pretest of 0.072 with *p*-value (<0.05) and the post-test t-value (2.437) with *p*-value (<0.05) shows that there is a significant difference in teachers' technology integration levels before and after the professional development program.

**Table 4.** Significant difference in educators' technology integration in mathematics classrooms before and after the professional development program.

| Test | *t* | df | *p*-Value | Mean Difference | SE Difference |
|---|---|---|---|---|---|
| Post-test | 2.437 | 58 | 0.017 | 1.68 | 0.689 |
| Pretest | 0.072 | 58 | 0.043 | 0.04 | 0.554 |

Note. Student's *t*-test.

On the other hand, qualitative results revealed external and internal factors that discourage teachers from implementing technological tools, particularly in math classrooms. The respondents were interviewed to assess their opinions about what available technologies there are in their school and how to use them effectively in a classroom, and the following are the external and internal factors identified by different levels of educators: External factors include the availability of technology in classrooms, unreliable usage of technology, and support. Internal factors include a lack of time and knowledge. The study also found that effective professional development programs for technology integration in math classrooms must be hands-on, with every technological tool presented. This is an area to be enhanced in the next training workshops, where teachers should have the opportunity to learn how to use technological tools in their classrooms, face-to-face. Nevertheless, the result for self-proficiency shows a significant increase.

Another is the collaborative training workshop for technology integration in mathematics, proposed to be collaborative at work, where teachers should have the opportunity to collaborate, share ideas, and learn from each other's experiences. The last suggestion is to have support from administration, either moral or financial. This is where teachers should have access to support from mentors, coaches, or other professionals who can help them integrate technology into their classrooms, whereas financial support includes letting teachers attend programs in other places and acquire subscriptions for some mathematical software that helps both teachers and students experience the purpose of the technology.

## 5. Discussion

### 5.1. Quantitative Data

There was a significant increase in the teachers' level of self-proficiency, particularly in confidence, competence, and willingness, after attending the online training workshop on technology integration in mathematics classrooms. Based on the results shown in Table 1, the teachers are more confident in integrating technology into their math classrooms after participating in the professional development program. The educator's behavior when selecting tools relies most heavily on use for both them and their students. When the teacher is confident in using technology in his/her math classroom, he/she knows how to utilize the proper functions of the tools [8]. In terms of the competence levels, shown in Table 2, the teachers are more competent in using technology to teach mathematics after participating in the professional development program. Competence level involves meeting complex demands by drawing on and mobilizing psychosocial resources (including skills and attitudes) on how technology is implemented in their teaching practice [9]. Table 3 presents the teachers' willingness level before and after the intervention. It shows that teachers are more willing to integrate technology into their math classrooms and feel a positive impact on their perception of technology. Negative attitudes come from the idea that teaching math the traditional way is the right way to do it [11]. Moreover, there is a big impact of knowing how to use technology in a pedagogical approach rather than knowing its availability. As Table 4 presents, there is a significant difference in the teachers' integration of technology in their classrooms before and after the training workshop.

The transformative impact of a well-structured program emphasizes the need for ongoing support and training. Empowering educators through professional development in learning how to integrate and use these technologies appropriately in a classroom enhances teaching practices and enriches students' learning journeys [12].

### 5.2. Qualitative Data

In terms of qualitative data, respondents participated in a series of interviews and discussions. The participants agreed that using technology in schools provides more engaging learning and promotes curiosity among the students. However, it was not enough for schools with limited access to the devices. The availability of these devices is the primary component of technology integration in schools. Most respondents said their schools had TVs, laptops, some working on computers with pocket Wi-Fi, calculators, and interactive whiteboards but added that these were only used in a few subjects.

Moreover, these technological tools were supposed to enhance learning; however, some teachers felt that the purpose of these devices was to drill and practice when visitors arrived, and not for everyday teaching. There is software available that the teachers use in the classroom, but that software is only free for several days, and after that, the full features of the software are inaccessible because of its subscription. The interview conducted shows that there was an inequal distribution of technology within the school district.

In many cases, teachers lack access to computers in school; instead of relying on the school's computer, it is better to use a personal laptop. Nevertheless, some schools provide a free laptop for the students; however, one teacher said it is not entirely accessible even if there is a laptop provided, because not all the students have one. She said, *"One of my students had to share a laptop with others, working while someone stood over them asking when they'd be done"*. Participants interviewed said cell phones are allowed in some schools but not others, so the students may access the application only when they get home and must ask for guidance from the teacher to navigate the application late in the evening.

The second external factor is the unreliability of technology usage. Aside from being available, it must be reliable. In the whole program discussion, many teachers complained

that because computers were connected to a network, it was often difficult to use them because the servers were slow or, at times, the server was offline; therefore, many teachers avoided using technology in the classroom because they feared it might fail in the middle of instruction.

Third, as a technical aspect, respondents said that the availability of technology is unpredictable, passwords must be remembered and changed every other month, and the subscription to technology software is said to be pricy. Therefore, many teachers are not authorized to download or install software, even if it is helpful for instruction. In some instances, the responsibility fell on the teachers to independently seek grants for acquiring technological tools and to personally fund their participation in workshops or conferences aimed at developing their technological competencies.

The internal factors found in the challenges that hinder teachers from using technology in the classroom include a lack of time and a lack of knowledge. Respondents need more time to invest in technology for teaching because it is very time-consuming to utilize in a class that is only 1 to 1.5 h. Also, there is an increasing demand for time to prepare instructional materials, urgent meetings, and developing assessment approaches for students. This is one of the reasons why respondents hardly find the time to explore software and technology tools to incorporate as part of their instructional practice. Using technology was seen as additional work, as one teacher noted: *"Due to our existing commitments, we are unable to accommodate any additional responsibilities at this time."* In addition, teachers need more knowledge of skills and expertise in using technology and software appropriately. They preferred to use the traditional type of teaching because it was still effective and more reliable in every aspect: time, effort, and reliability.

Professional development programs for technology integration in math classrooms should be designed focusing on different aspects; for example, it must be relevant to the needs of teachers, the focus must be on pedagogy, and the sustainability of using the technology in classrooms must be ensured. To integrate technology into classrooms, it should first be designed to be relevant to teacher needs. The programs should be based on a needs assessment of the teachers who will be participating, which will ensure that the impact of using technologies really addresses the specific needs of the teachers and students. The programs should focus on how to use technology to enhance teaching and learning, rather than simply teaching teachers how to use specific technology tools. Teachers should know how to operate the technology before their students teach them. The programs should provide teachers with the tools and resources to continue integrating technology into their classrooms after the program ends. The key to sustainability is learning how to use technology tools in the classroom. This can be ensured by adequately participating in hands-on activities in every professional development program inside and outside the school. Using the opportunity for hands-on learning, teachers can independently learn the basics and transfer the knowledge they have learned to their students.

Additional barriers to technology integration in math classrooms are the digital divide, where socioeconomic differences result in unequal access to technology between urban and rural schools, often compounded by inadequate infrastructure such as unreliable Internet or limited power supply [13]. Resistance to change also poses a barrier. Some teachers are hesitant to adopt new methods due to comfort with traditional practices or fear of failure [14]. Time constraints also exist, with educators reporting limited opportunities to explore and incorporate technology into their lesson plans due to demanding curricula and administrative duties [15]. Lastly, technical issues, including outdated equipment and network problems, often discourage the consistent use of digital tools in teaching [16].

## 6. Conclusions

Integrating a technology approach, such as software application and other digital tools in teaching mathematics, significantly enhances the ability of educators to teach. This not only improves their confidence, willingness, and competence through professional development but also enhances engaging and innovative learning environment for students. Continuous support in attending training and workshops for teachers is essential to sustain the effective use of technology in math instruction, ensuring that educators can blend traditional teaching methods with modern digital tools to optimize learning outcomes. This study also supports administration in designing curriculum effectively, considering the integration of technology not only in instruction but also in extension and improvement. The digital divide highlighted in the data emphasizes the need for equitable access to technology. Rural and underserved schools require additional support, such as subsidized devices, improved internet connectivity, and mobile technology solutions. To enhance the implementation of technology, schools should create collaborative environments where teachers share the best practices and innovative strategies. Peer observation, team teaching, and professional learning communities focused on technology integration in mathematics can provide valuable opportunities for shared growth and innovation.

Addressing barriers requires educators to develop specific pedagogical and professional skills, such as adaptive pedagogical skills. These are essential because they modify traditional strategies to integrate technology seamlessly into lessons [1]. Educators must also possess assessment literacy in utilizing digital tools to design, implement, and analyze assessments that provide meaningful feedback [17]. Cultural competence is another vital skill to ensure teachers understand and accommodate diverse student backgrounds when implementing technology [18]. Furthermore, leadership and advocacy skills help teachers to integrate technology within their schools and influence institutional policies [19]. Lastly, adopting a mindset of continuous learning is crucial, as the rapid evolution of technology necessitates ongoing professional development to stay updated on new tools and trends [19].

Schools in urban and rural areas should leverage both PISA and local assessment data to identify specific weaknesses in students' mathematical skills. Regular feedback loops between policy, training, and classroom practices will ensure that interventions remain responsive and effective in educational settings [20].

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**Informed Consent Statement:** The researchers ensured observance of the protocol and courtesy in performing the study. Likewise, Free, Prior, and Informed Consent (FPIC) was provided by the respondents to publish this paper. Information on all individuals concerned in the study served as the utmost priority of the researchers.

**Data Availability Statement:** The raw data supporting the conclusions of this article will be made available by the author on request.

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## Abbreviations

The following abbreviations are used in this manuscript:

| | |
|---|---|
| CHED | Commission on Higher Education |
| CK | Content Knowledge |
| DEPED | Department of Education |
| ICT | Information and Communications Technology |
| JASP | Jeffreys's Amazing Statistics Program |
| MatLab | MATrix LABoratory |
| MS Excel | Microsoft Excel |
| OECD | Organization for Economic Co-Operation and Development |
| PCK | Pedagogical and Content Knowledge |
| PISA | Programme for International Student Assessment |
| PK | Pedagogical Knowledge |
| SPSS | Statistical Package for the Social Sciences |
| TCK | Technological and Content Knowledge |
| TK | Technological Knowledge |
| TPACK | Technological Pedagogical Content Knowledge |
| TPK | Technological and Pedagogical Knowledge |

## References

1. Harris, J.; Mishra, P.; Koehler, M. Teachers' technological pedagogical content knowledge and learning activity types. *J. Res. Technol. Educ.* **2009**, *41*, 393–416. [CrossRef]
2. OECD. *PISA 2022 Results (Volume I): The State of Learning and Equity in Education*; OECD Publishing: Paris, France, 2023. [CrossRef]
3. OECD. *PISA 2022 Results (Volume II): Learning During—And from—Disruption*; OECD Publishing: Paris, France, 2023. [CrossRef]
4. OECD. Education, G.P.S. 27 June 2025. Available online: http://gpseducation.oecd.org (accessed on 15 June 2025).
5. Koehler, M.J.; Mishra, P.; Cain, W. What is Technological Pedagogical Content Knowledge (TPACK)? *J. Educ.* **2013**, *193*, 13–19. [CrossRef]
6. Hill, J.E.; Uribe-Florez, L. Understanding secondary school teachers' TPACK and technology implementation in mathematics classrooms. *Int. J. Technol. Educ.* **2019**, *3*, 1. [CrossRef]
7. Cirneanu, A.; Moldoveanu, C. Use of digital technology in integrated mathematics education. *Appl. Syst. Innov.* **2024**, *7*, 66. [CrossRef]
8. McCulloch, A.W.; Hollebrands, K.; Lee, H.; Harrison, T.; Mutlu, A. Factors that influence secondary mathematics teachers' integration of technology in mathematics lessons. *Comput. Educ.* **2018**, *123*, 26–40. [CrossRef]
9. Tabach, M. Competencies for teaching mathematics in the digital era: Are we ready to characterize them? In Proceedings of the 44th Conference of the International Group for the Psychology of Mathematics Education, Khon Kaen, Thailand, 19–22 July 2021; pp. 32–47. Available online: https://researchportal.bath.ac.uk/files/303250813/Volume-1_final.pdf#page=99 (accessed on 18 August 2025).
10. Spiteri, M.; Rundgren, S.C. Literature review on the factors affecting primary teachers' use of digital technology. *Technol. Knowl. Learn.* **2018**, *25*, 115–128. [CrossRef]
11. Kreijns, K.; Vermeulen, M.; Kirschner, P.A.; Van Buuren, H.; Van Acker, F. Adopting the Integrative Model of Behaviour Prediction to explain teachers' willingness to use ICT: A perspective for research on teachers' ICT usage in pedagogical practices. *Technol. Pedagog. Educ.* **2013**, *22*, 55–71. [CrossRef]
12. Lawless, K.A.; Pellegrino, J.W. Professional development in integrating technology into teaching and learning: Knowns, unknowns, and ways to pursue better questions and answers. *Rev. Educ. Res.* **2007**, *77*, 575–614. [CrossRef]
13. Warschauer, M. *Technology and Social Inclusion: Rethinking the Digital Divide*; MIT Press: Cambridge, MA, USA, 2003. [CrossRef]
14. Ertmer, P.A.; Ottenbreit-Leftwich, A.T. Teacher technology change. *J. Res. Technol. Educ.* **2010**, *42*, 255–284. [CrossRef]
15. Hew, K.F.; Brush, T. Integrating technology into K–12 teaching and learning: Current knowledge gaps and recommendations for future research. *Educ. Technol. Res. Dev.* **2006**, *55*, 223–252. [CrossRef]
16. Tondeur, J.; Devos, G.; Van Houtte, M.; Van Braak, J.; Valcke, M. Understanding structural and cultural school characteristics in relation to educational change: The case of ICT integration. *Educ. Stud.* **2009**, *35*, 223–235. [CrossRef]
17. Volman, M. A variety of roles for a new type of teacher: Educational technology and the teaching profession. *Teach. Teach. Educ.* **2004**, *21*, 15–31. [CrossRef]

18. Zeng, J. Study on the ideological and political practice teaching of college students based on the Internet + technology. *IJIIS Int. J. Inform. Inf. Syst.* **2023**, *6*, 24–30. [CrossRef]
19. Voogt, J.; Erstad, O.; Dede, C.; Mishra, P. Challenges to learning and schooling in the digital networked world of the 21st century. *J. Comput. Assist. Learn.* **2013**, *29*, 403–413. [CrossRef]
20. Chi, C. Philippines Ranks at the Bottom of New PISA Test on Creative Thinking. Available online: https://www.philstar.com/headlines/2024/06/19/2364001/philippines-ranks-bottom-new-pisa-test-creative-thinking (accessed on 19 June 2024).

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