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Pre-service teachers' knowledge of how to use modern technological resources in teaching mathematics in the new normal: A foundation of strategic intervention plan

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Abstract
Integrating recently developed technological resources in mathematics education has gained significant prominence, especially in the current paradigm shift. This research assesses the preservice teachers' knowledge of using modern technological resources in teaching mathematics. The study used a descriptive survey design and purposive sampling to collect data from the twenty-nine (29) BSED-Math preservice teachers currently enrolled at the University of Cabuyao (Pamantasan ng Cabuyao). Standardized questionnaires were used to collect data. Descriptive statistics were employed to analyze the gathered data. The findings suggest that preservice teachers possess much technological knowledge of using modern technological resources to teach mathematics. Preservice teachers can proficiently integrate technology into their pedagogical methodologies. However, preservice teachers exhibit an average comprehension of technological pedagogical and technological content knowledge. This knowledge suggests that they should expand their understanding of how preservice teachers can leverage technology to augment the pedagogy of mathematical concepts. As a result, confident preservice educators may not employ specific teaching pedagogies with evolving digital technologies. The research findings suggest that preservice teachers would benefit from improving their proficiency in utilizing contemporary technological resources to teach mathematics. Preservice teachers can achieve this through participation in training programs and professional development opportunities that enhance their technological literacy and pedagogical strategies for optimal technology integration. The research established a foundation for a strategic intervention scheme that prioritizes the provision of preservice teachers with the essential knowledge and competencies to proficiently utilize contemporary technological resources in mathematics instruction during the current unprecedented circumstances.

Keywords: Pre-service teacher in Math, technological knowledge, technological pedagogical knowledge, technological content knowledge

Introduction
The fast advancement of technology has opened new possibilities for teaching and learning, particularly in mathematics education. However, preservice teachers may need help effectively integrating modern technological resources into their mathematics instruction, especially in the new normal. This study aims to assess preservice teachers' knowledge of using modern technological resources in teaching Mathematics in terms of their technological, technological content, and technological pedagogical knowledge that will serve as a basis for developing a strategic intervention plan.

Modern technological resources in mathematics instruction encompass various tools and applications, including educational software, online platforms, virtual manipulatives, interactive whiteboards, educational apps, and multimedia resources. However, preservice teachers must possess a solid foundation of knowledge to integrate these modern technological resources seamlessly into their teaching practice.

The effective integration of modern technological resources in teaching mathematics offers numerous benefits in the new normal of education. It enables preservice teachers to engage students through interactive and personalized learning experiences, facilitating a deeper understanding of mathematical concepts. Furthermore, these resources provide opportunities for collaborative learning, student-centered exploration, and differentiated instruction to meet the diverse needs of learners.

A comprehensive foundation of knowledge and skills is necessary to ensure preservice teachers' proficiency in utilizing modern technological resources in teaching mathematics. This foundation includes understanding the available technological tools, their functionalities, and their alignment with specific mathematical concepts and instructional objectives. Preservice teachers must also develop pedagogical strategies that effectively integrate technology, considering scaffolding techniques, collaborative learning environments, and authentic tasks that promote mathematical understanding.

In conclusion, integrating modern technological resources in teaching mathematics has become indispensable in the new normal of education. Preservice teachers play a critical role in harnessing the potential of these resources to enhance students' mathematical learning experiences. Therefore, it is vital to provide them with a good foundation of knowledge and skills to effectively leverage modern technological resources in the mathematics classroom. By doing so, we can empower future educators to navigate the digital landscape and provide high-quality instruction that meets the needs of 21st-century learners.

Literature Review

Educational professionals are held responsible for a wide array of duties daily, which encompasses tasks such as planning, instruction, assessment, management, and communication, among others. According to Armstrong, Henson, and Savage (2019) [2], the tasks above can be arduous and potentially deplete a teacher's energy reserves. The proliferation of digital technologies in educational settings has imposed novel and distinct demands on educators, which may exacerbate their difficulties (Hew & Brush, 2018; Hsu & Kuan, 2023; Ruggerio & Mong, 2020) [9, 11]. The widespread implementation of digital technology in all tiers of education, from primary to secondary levels, is prevalent. As a result, the instructors anticipated to integrate technology into their pedagogical and communicative methodologies within the educational environment (Ruggiero & Mong, 2020). Thus, incorporating technology has become an essential requirement for educators in contemporary times (Ruggerio & Mong, 2021).

In the current era of rapid technological advancement, commonly called the "new normal," it is crucial to effectively integrate modern technological tools into education, specifically in mathematics teaching. The significance of preservice teachers is paramount in molding the forthcoming education. Examining their aptitude in utilizing modern technological resources to instruct mathematics is crucial. The study explores the current state of preservice teachers' understanding and mastery in incorporating technology into teaching mathematics (Spector, 2022) [18].

The research underscores the importance of their readiness to adapt to the new normal. Presently, a vast majority of teacher education programs worldwide incorporate a standard teacher's comprehension teachers are better equipped to integrate technology into their pedagogical practices due to their training. The recently hired educators are not required to undergo the process of unlearning pedagogical practices that have been ingrained over an extended period. One potential approach is implementing novel pedagogical methods that facilitate technology integration in the classroom. It is imperative to emphasize the initial stage of a new teacher's career as it can determine their trajectory toward transformative teaching (Yuksel & Kavanoz, 2018). Gilakjani (2019) found that the extent to which technology is integrated into pedagogy is significantly influenced by the teaching proficiency level. The assumption that novice teachers possess an innate inclination towards utilizing technology and can seamlessly integrate it into their teaching methodologies lacks empirical support from research.

Ertmer and Ottenbreit-Leftwich (2020) [7] assert that the present cohort of preservice teachers significantly comprehends diverse information and communication technology (ICT) tools. Even so, educators may need to improve in the requisite expertise to proficiently employ these resources to augment their students' educational encounters. According to the authors' assertion, educators need more knowledge or awareness of how to effectively utilize these tools to improve the learning outcomes of their students (p. 269). According to Gilakjani's (2019) research, the current body of literature indicates that experienced educators can critically evaluate a technological tool and utilize their knowledge of teaching methods to assess its potential effectiveness. Novice instructors need help in obtaining expertise in using innovative teaching tools, mastery of the curriculum's demands, and acquiring efficient classroom management abilities (Gilakjani, 2019). The above statement highlights a crucial obligation for teacher preparation programs to assist aspiring educators in developing the necessary expertise, skills, and attitudes for effective technology integration. Therefore, teacher education programs must develop effective strategies for acquainting their preservice teachers with educational technologies. Many methodologies are available for teacher educators to consider when demonstrating technology integration. Kay conducted a meta-analysis in 2019 on a compilation of scholarly articles that expounded on diverse approaches to devising technology integration plans for preservice educators. The analysis undertaken by Kay delineated ten discrete strategies that teacher preparation programs could employ. The tactics above encompass the incorporation of technology across all academic disciplines, the utilization of multimedia resources, such as video case studies, the enhancement of technological proficiency among Education faculty members to facilitate the integration of technology into their pedagogical practices, the establishment of a dedicated technology course, the demonstration of effective technology use, the promotion of collaboration between colleges and K-12 schools, experiential learning opportunities, focused workshops, the improvement of accessibility to educational technologies, and the pairing of preservice teachers with experienced mentor teachers. Kay noted that some institutions utilize a concurrent amalgamation of various strategies.

Despite the availability of multiple approaches to promote the adoption of technology among preservice teachers, it is noteworthy that some teacher preparation programs still depend on a solitary technology course to showcase the utilization of specific technologies (Kay, 2019; Ottenbreit-Leftwich *et al*., 2020; Wang & Chen, 2020) [12, 7, 19]. According to Kay's (2019) [12] assertion, the independent technology course is commonly utilized despite its inherent limitations. The primary concern is that acquiring technological competencies in isolation may only sometimes lead to effective implementation in practical situations. A rudimentary comprehension of computers and other educational technologies is insufficient for effectively equipping preservice teachers to incorporate technology and pedagogy in their teaching methodologies. According to Lambert and Gong's (2020) [14] findings, more than a computer lab and a specialized educational technology course in a teacher preparation program are needed to guarantee that educators will proficiently possess the requisite skills to integrate technology into their instructional practices.

According to recent research conducted by Brown and Green (2021), Davies and West (2021), and Project Tomorrow (2020), it is anticipated that the information and communication technology (ICT) tools that preservice teachers will have access to in their classrooms will significantly differ from the current tools within a few years of their career commencement. Consequently, attempting to instruct preservice teachers on utilizing modern tools is not logical. Teacher educators ought to emphasize the importance of acquiring the ability to address instructional challenges by integrating technology, as suggested by Ertmer and Ottenbreit-Leftwich (2020) [7], Kovalik *et al*. (2023), and Lambert and Gong (2020) [14]. According to Christensen and Knezek (2019) [5] and Mishra and Koehler (2006), it is more advantageous for preservice teachers to cultivate the aptitude for lifelong learning instead of concentrating on acquiring proficiency in specific technologies. According to Holden and Rada (2021) [10], developing cognitive skills to effectively choose appropriate technologies and pedagogical approaches for the subject matter taught can yield significant benefits in the future. It is imperative to re-envision the conventional technology course that solely instructs preservice teachers on utilizing ICT tools. The rationale is that preservice teachers must comprehend the correlation between the available technologies, the pedagogical methodologies they should adopt, and the content they expect to teach.

Moreover, Baran *et Al* (2009) [3] suggested using Shulman's idea of Technological Pedagogical Content Knowledge (TPACK) to recognize the critical interplay between technology, pedagogy, and content knowledge in effective teaching and learning. It emphasizes the need for educators to deeply understand how these elements intersect and inform each other to promote meaningful educational experiences. The TPACK framework has seven (7) categories, namely, Content knowledge (CK), Pedagogical knowledge (PK), Pedagogical content knowledge (PCK), Technology knowledge (TK), Technological content knowledge (TCK), Technological pedagogical knowledge (TPK) and Technological pedagogical content knowledge (TPACK). However, this study focuses only on Technological Knowledge (TK), Technological content knowledge (TCK), and Technological pedagogical knowledge (TPK) to assess preservice teachers' understanding of using modern technological resources in teaching Mathematics.

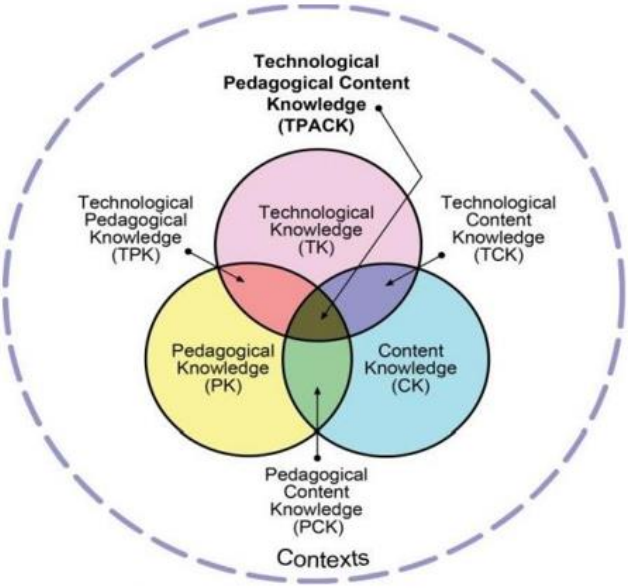

Fig 1: Graphic representation of technological pedagogical content knowledge (From http://tpack.org)

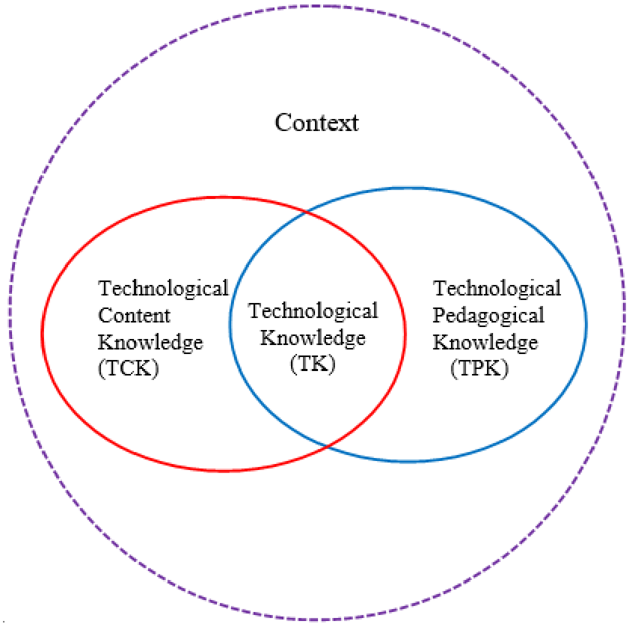

Fig 2: Graphic representation of technological, technological content and technological pedagogical knowledge

Methodology

Research Design

This study employed a descriptive survey design to gather comprehensive data on preservice teachers' knowledge of using modern technological resources in teaching mathematics. Quantitative data was collected through surveys and assessments, evaluating their familiarity with different technological tools, their perceived competence, and their self- efficacy in utilizing technology in mathematics instruction.

Respondents of the Study

The respondents of this study consisted of preservice teachers enrolled in BSED Mathematics programs at the University of

Cabuyao (Pamantasan ng Cabuyao) in the school year 2022 – 2023. These individuals were in the final stages of their teacher preparation, poised to enter the teaching profession in the new normal educational context. Selecting preservice teachers as respondents were crucial as they represented the future educators responsible for delivering mathematics instruction using modern technological resources.

The researcher determined the sample size through purposive sampling since only twenty-nine (29) preservice teachers were enrolled in BSED Mathematics this school year at the University of Cabuyao (Pamantasan ng Cabuyao).

Instruments

The study utilized a validated survey instrument developed by Baran, Schmidt, and Thompson (2009) [3] in their publication entitled "Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers." The research objective was to assess the competency of preservice educators in effectively utilizing modern technological tools to instruct mathematics within the framework of the current situation. The survey instrument was designed to gather quantitative data on potential educators' familiarity and confidence levels in using various technological tools for teaching mathematics.

The survey instrument was segmented into various sections, focusing on distinct facets of preservice teachers' knowledge and readiness. The following areas evaluated preservice teachers' Technological, Pedagogical, and Content Knowledge. The study employed a standard survey instrument utilizing a five-point Likert scale to assess participants' responses. The electronic administration of the survey instrument was facilitated through online survey platforms, thereby streamlining the data collection and analysis process. The respondents received unambiguous guidelines on how to accomplish the survey, and an approximate duration for its completion was furnished to regulate expectations.

The survey instrument employed a Likert-type scale comprising five points, which ranged from "Strongly Agree" (SA) with a value of 5 to "Agree" (A) with a value of 4, "Uncertain" (U) with a value of 3, "Disagree" (D) with a value of 2, and "Strongly Disagree" (SD) with a value of 1. The decision to utilize the five-point Likert scale was informed by the suggestion put forth by McKelvie (as referenced in Owusu, 2014) that this specific scale exhibits more excellent reliability compared to alternative scales.

Data Collection

The principal approach for data collection in this study entailed the distribution of a conventional survey questionnaire to preservice teachers. The distribution of the questionnaire was conducted through electronic means utilizing online survey platforms. The participants received a distinctive hyperlink to access and complete the survey at their convenience.

A purposive sampling technique was employed to select preservice teachers enrolled in BSED Mathematics education programs at the University of Cabuyao (Pamantasan ng Cabuyao). The sample included undergraduate preservice teachers who had completed the academic requirements of their mathematics education coursework and had received exposure to integrating technology in teaching.

A formal invitation was given to the participants of the BSED Mathematics programs of the University of Cabuyao (Pamantasan ng Cabuyao). The invitation outlined the purpose of the study and provided details about the questionnaire. The researcher sought Institutional ethical clearance to ensure compliance with research ethics.

The survey questionnaire commenced with detailed guidelines regarding the study's objective, the voluntary aspect of participation, and the guarantee of anonymity and confidentiality. Before completing the questionnaire, participants were expected to give informed consent. Electronic consent was solicited by requesting participants to indicate their agreement to participate by checking a box.

The survey instrument comprised demographic data and evaluated preservice educators' technological, pedagogical, and content knowledge. The second section of the survey was formulated by Baran, Schmidt, and Thompson (2009) [3] in their research titled "Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers."

The researcher followed all ethical considerations to protect the rights and privacy of participants. The anonymity of the participants was maintained by assigning pseudonyms or codes to their responses. Data were securely stored and accessible only to the research team. Ethical clearance was obtained from relevant institutions, and informed consent was sought from all participants.

Data Analysis

Quantitative data from the survey instrument were analyzed using descriptive statistics, the mean. The Likert scale developed by Pimentel (2019) was used to interpret the mean of each indicator for statistical analysis. The five-point Likert-type scale ranged from 4.20 – 5.00 (Very High Extent), 3.40 – 4.19 (High Extent), 2.60 – 3.39 (Average Extent), 1.80– 2.59 (Low Extent), and 1.00 – 1.79 (Very Low Extent). Data analysis was conducted using appropriate statistical software.

The findings of quantitative analyses were integrated to provide a comprehensive understanding of preservice teachers' knowledge of using modern technological resources for teaching mathematics in the new normal. The results were interpreted and synthesized to form the foundation for developing a strategic intervention plan. The identified areas of strength and weakness informed the design of targeted interventions to enhance preservice teachers' competence in integrating technology effectively into their mathematics teaching practices.

Results and Discussion

Assessment of Pre-service Teachers' Knowledge of Modern Technological Resources

This section focuses on the examination of the field data to address the research questions formulated for the study. The analysis of the administered five-point Likert scale questionnaire involved calculating the means of each indicator. The mean result was interpreted by the Pimentel (2019) developed scale.

Technological Knowledge of Pre-service Teachers

The technological knowledge of preservice teachers plays a crucial role in preparing them for the ever-evolving landscape of education in the digital age. This knowledge encompasses their understanding of various digital tools, devices, and software applications and their ability to integrate technology into their pedagogical practices effectively. Table 1 served as a valuable resource for assessing the technological knowledge of preservice teachers, highlighting their familiarity with digital tools, devices, and software applications.

Table 1: Technological Knowledge of Pre-service Teachers

Statement	Mean	Verbal Interpretation
I have the technical skills I need to use technology.	3.79	High Extent
I have the knowledge to learn technology easily.	4.07	High Extent
I can solve the problems that I encounter when using technology.	3.48	High Extent
I know different types of technology.	3.79	High Extent
I can install a new program that I would like to use.	3.83	High Extent
I can create and edit a video clip.	2.93	Average Extent
I can create my own website.	2.55	Low Extent
I can save an image from a website to the hard drive of my computer.	4.00	High Extent
I can send an email with an attachment.	4.03	High Extent
I can create a basic presentation using PowerPoint or a similar program.	4.07	High Extent
I can create a document with text and graphics in a word processing program.	4.03	High Extent
Mean of Means/Average Standard Deviation	3.69	High Extent

Legend: 4.20 – 5.00 (Very High Extent), 3.40 – 4.19 (High Extent), 2.60 – 3.39 (Average Extent), 1.80 – 2.59 (Low Extent), 1.00 – 1.79) (Very Low Extent)

As indicated in Table 1, the most prominent indicator (M = 4.07) is the respondents' confidence in their aptitude to acquire technological skills effortlessly and produce a fundamental presentation utilizing PowerPoint or comparable software. This discovery is significant as technology is in a constant state of evolution, similar to the environment. The statement underscores the significance of student-teachers, who are prospective educators, being equipped and receptive to acquiring knowledge on novel and evolving technologies. Furthermore, novice educators can derive multiple advantages from developing a fundamental PowerPoint presentation, particularly in designing lessons and imparting knowledge.

Further analysis revealed that the indicator with the least mean (M = 2.55) pertains to creating their website. This suggests that the preservice teacher from the University of Cabuyao (Pamantasan ng Cabuyao) may need more knowledge in website creation due to their newness to web development.

The study's overall findings indicate that preservice teachers possess a high level of technological knowledge in utilizing various modern technological resources for teaching mathematics, as reflected by the grand mean score of 3.69. It also reveals that preservice teachers have an advanced understanding and proficiency in using technology to support mathematics instruction. This high level of technological knowledge suggests that preservice teachers can effectively leverage modern technological resources, enhancing their teaching practices and promoting student engagement and learning in the mathematics classroom. Njoku *et al*. (2020) posit that educators who exhibit a heightened sense of self-efficacy in integrating technology tend to demonstrate greater proficiency in integrating technological tools into their pedagogical practices. Given this circumstance, exploring and establishing innovative approaches and collaborating with emerging digital technologies is imperative.

While preservice teachers possess technological knowledge, they must receive adequate support to engage and experiment with technology. According to Farjon *et al*. (2019), their study demonstrated that their self-efficacy significantly impacts the degree of technology integration in teachers' lessons in effectively utilizing technology within the classroom.

Technological Content Knowledge of Pre-service Teachers

Technological Content Knowledge (TCK) of preservice teachers involves their ability to effectively integrate technology into specific subject matter, enriching students' understanding and engagement. Table 2 showcased the Technological Content Knowledge (TCK) of Preservice Teachers, which provide a comprehensive overview of preservice teachers' proficiency in integrating technology into subject-specific content, encompassing the identification of relevant digital resources and the creation of engaging digital content aligned with the curriculum.

Table 2: Technological Content Knowledge of Pre-service Teachers

Statements	Mean	Verbal Interpretation
I know how my subject matter can be represented with the application of technology.	2.90	Average Extent
I know about technologies that I can use for enhancing the understanding of specific concepts in my subject matter.	2.45	Average Extent
I know about the technologies that I have to use for the research of the content of the subject matter.	2.41	Average Extent
I can use appropriate technologies (eg. multimedia resources, simulation) to represent the content of my teaching subject.	2.76	Average Extent
I know about technologies that I can use for enhancing the understanding of specific concepts in my subject matter.	2.79	Average Extent
I can use technology representations (i.e., multimedia, visual demonstrations, etc.) to demonstrate specific concepts in my subject matter.	2.66	Average Extent
Mean of Means/Average	2.67	Average Extent

Legend: 4.20 – 5.00 (Very High Extent), 3.40 – 4.19 (High Extent), 2.60 – 3.39 (Average Extent), 1.80 – 2.59 (Low Extent), 1.00 – 1.79) (Very Low Extent)

As seen in Table 2, the preservice teachers' content knowledge is reflected by the highest mean score of 2.90. This score indicates the average level of knowledge regarding the representation of subject matter using technology. The statement suggests that aspiring educators comprehend how technology can represent and convey the content knowledge of the subject matter. In addition, having a moderate level of comprehension indicates that potential educators have a comprehensive understanding of the possible uses of technology to enhance the presentation of academic material.

Meanwhile, the table also shows that the lowest mean score of 2.41 indicates a low extent of knowledge among individuals regarding the technologies that should be utilized for researching the content of the subject matter in terms of content knowledge. This finding suggests a significant gap in understanding and familiarity with the appropriate technological tools and resources for conducting research related to the subject matter. In addition, a low extent of knowledge in this indicator implies that individuals may need more awareness of the available technologies specifically tailored for researching and exploring the content of the subject matter.

The study results, with a grand mean score of 2.67, indicating that the individuals involved have an average extent of technological content knowledge. This suggests that preservice teachers possess a moderate level of understanding and familiarity with the subject matter being assessed, specifically related to technology. While the average score may not be exceptionally high, it signifies a foundational level of knowledge and competence in the subject's technological aspects. Furthermore, the study's findings can inform curriculum design, instructional strategies, and technology integration in teaching practices. By incorporating pedagogical approaches that leverage technology effectively, educators can support individuals in further developing their technological content knowledge while enhancing their overall learning experiences.

Apau (2017) [1] conducted a study that yielded similar findings to the present study, indicating that student-teachers possess relatively low technological content knowledge. Apau also highlighted that technologies have emerged as tools to aid teachers in their professional development and teaching practices. In the classroom, effective teaching involves explanations, questioning, and demonstrations to foster understanding. However, teachers needing more content knowledge and pedagogical skills, especially when using technology (as addressed in research question three), can lead to dull and ineffective classrooms, ultimately hindering students' in-depth understanding of concepts. These findings emphasize the responsibility of teacher educators to integrate technology into the teacher education curriculum, thereby enabling prospective teachers to develop their skills and capabilities fully.

Technological Pedagogical Knowledge of Pre-service Teachers

Technological Pedagogical Knowledge (TPK) of Preservice Teachers encompasses their understanding and ability to effectively integrate technology into instructional practices, fostering engaging and meaningful learning experiences in digital environments. Table 3 presents the Technological Pedagogical Knowledge (TPK) of Preservice Teachers, which provide a comprehensive overview of the preservice teachers' proficiency in integrating technology seamlessly into pedagogical practices, including the design of technology- enhanced instructional strategies, assessment techniques, and classroom management in digital learning environments.

Table 3: Technological Pedagogical Knowledge of Pre-service Teachers

Statements	Mean	Verbal Interpretation
I can use technologies that enhance the teaching approaches for a lesson.	2.93	Average Extent
I can use technologies that enhance students' learning of a lesson.	2.86	Average Extent
My teacher education program has stimulated me to think more deeply about how technology could influence the teaching approaches I use in the classroom.	2.93	Average Extent
I can use technologies that are appropriate for my teaching.	2.93	Average Extent
I can apply technologies to different teaching activities.	3.03	Average Extent
I can use technologies to assess students learning.	3.10	Average Extent
I can use technology to introduce my students to real-world scenarios.	3.03	Average Extent
I can assist my students to use technology to plan and monitor their learning.	3.00	Average Extent
I can assist my students to use technology to construct different forms of knowledge representations.	3.00	Average Extent
I can assist my students to collaborate with each other using technology.	3.07	Average Extent
I can use technology to motivate students.	3.07	Average Extent
I can use technologies to improve communication with students.	2.93	Average Extent
I can use technologies to improve my teaching skills	3.07	Average Extent
I can use technologies to improve the presentation of information to learners.	3.03	Average Extent
Mean of Means/Average Standard Deviation	3.00	Average Extent

Legend: 4.20 – 5.00 (Very High Extent), 3.40 – 4.19 (High Extent), 2.60 – 3.39 (Average Extent), 1.80 – 2.59 (Low Extent), 1.00 – 1.79) (Very Low Extent)

According to Table 3, the indicator with the highest mean score (M = 3.10) reflects an average level of confidence among participants in using modern technologies to assess students learning. This implies that preservice teachers can use modern technological resources to assess learners' output regarding tests and performance tasks.

Meanwhile, indicators such as using technologies that enhance students' learning of a lesson have the least value of mean (M = 2.86) that can be interpreted as an average extent of knowledge among the preservice teachers of the University of Cabuyao (Pamantasan ng Cabuyao). The finding shows that preservice teachers may encounter challenges in utilizing technologies to enhance students' learning during a lesson, like lack of familiarity and training, limited access to resources, pedagogical challenges, or time constraints that affect their pedagogical knowledge of using modern technological resources in teaching Mathematics.

The technical pedagogical knowledge, with a grand mean score of 3.00, signifies an average extent of understanding among preservice teachers regarding using modern technological resources for teaching mathematics. The study's findings suggest that there is room for improvement in preservice teachers' knowledge and skills of effectively integrating technology into their mathematics instruction. It is important to note that even though the average extent of understanding could be a lot higher, these results serve as a baseline measure and provide valuable insights into the current state of preservice teachers' knowledge in this area. Consequently, these findings serve as a starting point for further enhancements in teacher education programs, aiming to better equip future teachers with the necessary competencies in utilizing modern technological resources effectively in mathematics teaching.

The results of this investigation exhibit a partial alignment with the conclusions drawn by Apau (2017) [1], wherein it was noted that student-teachers showed a comparatively low degree of technological pedagogical awareness. The observation as mentioned earlier suggests a disparity between the technological proficiency of students and their capacity to apply said proficiency to augment their pedagogical approaches proficiently. Apau observed that student-teachers could have benefited from incorporating technology in their teaching methodologies. Hence, it can be inferred that student-teachers might not have employed technological aids like Excel and other software to evaluate and furnish prompt and statistically meaningful feedback to students concerning their academic progress. The absence of amalgamation between technological expertise and pedagogical practices impedes classroom engagement and is a matter of apprehension.

In contrast to the abovementioned conclusions, Oz (2015) reported contradictory findings, indicating that preservice teachers exhibited proficiency in assessing software, tasks, and student performance within a technologically-focused learning environment. According to Smith's (2012) research, educators were exposed to various technological tools during their educational program, including Smartboards, science probes, clickers, PowerPoint presentations, digital portfolios, photo stories, learning objects, and websites. The experience mentioned earlier acted as a catalyst for their integration of technological tools in the pedagogical process, which differs from the findings of the current investigation.

Conclusions and Recommendations

The results of the study about preservice teachers' knowledge of how to use modern technological resources in teaching mathematics highlight the existing gaps and deficiencies in the technological content knowledge and pedagogical knowledge of preservice teachers. Using survey instruments and data analysis has enabled preservice teachers to acquire valuable insights about their familiarity and understanding of technological resources, as well as their confidence levels in diverse areas of technology integration.

In conclusion, the study's findings present a mixed picture regarding preservice teachers' technological knowledge and proficiency. On the one hand, the results indicate a high extent level of technological knowledge among preservice teachers, showcasing their advanced understanding and mastery in using modern technological resources for teaching mathematics. This positions them well to leverage technology and enhance mathematics instruction, fostering meaningful learning experiences for their students.

However, on the other hand, the study also reveals a need for more proficiency in both technological content knowledge and technological pedagogical knowledge among some preservice teachers. This suggests a need for further development and improvement in these areas. There needs to be greater understanding and familiarity with the subject matter related to technology integration in teaching and limited expertise in utilizing technology as a pedagogical tool effectively.

To address deficiencies in preservice teachers' technological content knowledge and technological pedagogical knowledge, targeted training programs should focus on enhancing technological understanding and integrating technology effectively. This would enable preservice teachers to utilize technology to support teaching and to improve student learning outcomes. The study's findings can inform curriculum development and foster innovation in technology integration, particularly in the Bachelor of Secondary Education major in Mathematics, positioning the university as a leading institution in preparing teachers with the necessary technological competencies and suggest to revise teacher education programs to include specialized courses or modules that focus on building technological content and technological pedagogical knowledge specifically for teaching mathematics. This ensures that preservice teachers graduate with the necessary competencies to integrate technology effectively in their future classrooms. Collaboration with schools, districts, and government agencies can facilitate benchmarking and sharing findings, leading to collective efforts to improve mathematics education through effective technology integration.

The research contribution focuses on enhancing the curriculum for the Bachelor of Science in Education (BSED) Math program by incorporating global connections. Traditionally, math education has often been limited to theoretical concepts and problem- solving skills without sufficient emphasis on real-world applications and global perspectives. This research aims to bridge this gap by introducing a curriculum that integrates global connections into math education, enabling students to develop a broader understanding of the subject and its relevance in a global context.

Incorporating global connections into the BSED Math program has several significant benefits. Firstly, it helps students recognize the applicability of mathematical concepts beyond the classroom, fostering a deeper appreciation for the subject. By exploring real- world examples and case studies from different cultures and contexts, students gain a more comprehensive understanding of how math is utilized in various fields and industries worldwide. Secondly, incorporating global connections promotes cultural awareness and diversity in math education. Students are exposed to different mathematical practices and problem-solving approaches from diverse cultures, encouraging them to think critically and adapt their learning to other contexts. This prepares them to become global citizens who can apply their mathematical knowledge in a multicultural and interconnected world. Overall, the research contribution of enhancing the BSED Math program by incorporating global connections enriches students' learning experiences and equips them with a well-rounded education that is relevant and applicable on a worldwide scale.

Finally, the results mentioned above can be utilized as a foundation for developing a strategic intervention plan that targets preservice educators' identified inadequacies and needs. The proposed strategy entails the execution of targeted professional development initiatives that seek to involve experienced mathematics educators and technology specialists in conducting regular workshops focused on incorporating technology in mathematics instruction. It is advisable to invite skilled mathematics educators and technology specialists, arrange regular professional development workshops that focus on the integration of technology in mathematics instruction, include technology-enhanced lesson plans in their field experiences or practicum settings, and engage in action research projects to investigate the impact of technology integration on mathematics learning outcomes.

Implications / Action Plan

Table 4

Proposed Action Plan	Person/Department Responsible	Resources	Timeframe	Success Indicator	Monitoring and Evaluation Scheme
Invite experienced mathematics educators and technology specialists to conduct regular professional development workshops focused on technology integration in mathematics instruction.	OVPAA Dean Department Chair	Expert Speaker/specialist Fund Technological Tools Workshop Materials Hands-on Activities Pre- and post-test questionnaires Evaluation and	Prelim First Semester SY 2023-2024	Increased participation and attendance in professional development workshops Positive feedback from participants Enhanced technological pedagogical knowledge	Attendance numbers before and after the workshops Activity evaluation and feedback form Pre- and post-assessments
Proposed Action Plan	**Person/Department Responsible**	**Resources**	**Timeframe**	**Success Indicator**	**Monitoring and Evaluation Scheme**
		feedback form			
Provide opportunities for pre-service teachers to design and implement technology- enhanced lesson plans in their field experiences or practicum settings.	OVPAA Dean Department Chair	Technology Tools and Devices Curriculum and Lesson Plan Templates Technology Integration Guidelines Assessment and Evaluation Tools Classroom Observation Reflection, feedback or self- evaluation form	Midterm First Semester SY 2023-2024	Quality of Technology-Enhanced Lesson Plans Student Learning Outcomes, Engagement, and Participation Reflection and Self-Assessment	Rubric or evaluation tool that measures the effective integration of technology Classroom observations, student feedback, or anecdotal evidence Written reflections, peer feedback, or self-evaluations
Encourage pre- service teachers to engage in action research projects to investigate the impact of technology integration on mathematics learning outcomes.	OVPAA Dean Department Chair	Research Workshops and Seminars Research Funding and Support Ethical Considerations and Consent Forms Data Analysis Software Research Guidelines and Templates Research Mentors and Advisors	Second Semester SY 2023-2024	Completion and Quality of Action Research Projects Improvement in Mathematics Learning Outcomes Reflection and Professional Growth	Number of completed research project Pre- and post-assessments, student work samples Written reflections on the research process, self- assessment of their research skills and knowledge
Conduct benchmarking between the	OVPAA Dean Department Chair	Financial investments	Second Semester SY 2023-2024	Improved Student Performance	Surveys Interviews
Proposed Action Plan	**Person/Department Responsible**	**Resources**	**Timeframe**	**Success Indicator**	**Monitoring and Evaluation Scheme**
University and other educational		Personnel		increased Teacher	Observations

stakeholders to address the identified gaps and challenges together of the pre-service teachers in integrating modern technological resources in teaching methodologies.		Technology Access to relevant data and information		Satisfaction Enhanced Technological Integration Positive Changes in Teaching Practices	Analysis of performance metrics.

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