



TECHNOLOGICAL KNOWLEDGE AMONG MATHEMATICS PRE-SERVICE TEACHERS IN INDONESIA AND THE PHILIPPINES: A COMPARATIVE STUDY

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Abstract

This comparative study investigates the Technological Knowledge (TK) readiness of mathematics pre-service teachers in Indonesia and the Philippines. Using a structured online survey, data were collected from 136 participants in Indonesia and 93 in the Philippines. TK readiness was categorized into three levels: Ready, Moderately Ready, and Not Ready, with demographic factors such as age, sex, and school type examined as potential influences. The results indicate that Indonesian pre-service teachers demonstrate higher TK readiness compared to their Filipino counterparts. No statistically significant associations were found between TK readiness and demographic variables in either country. The findings suggest a need for targeted interventions in teacher education programs to enhance TK competencies and ensure effective technology integration in mathematics classrooms. Implications for curriculum design and future research are discussed.

Keywords: Technological Knowledge, Mathematics Pre-Service Teachers, Comparative Study, Indonesia, Philippine

Abstrak

Studi komparatif ini mengkaji kesiapan *Technological Knowledge* (TK) pada calon guru matematika di Indonesia dan Filipina. Dengan menggunakan survei daring terstruktur, data dikumpulkan dari 136 partisipan di Indonesia dan 93 partisipan di Filipina. Kesiapan TK dikategorikan ke dalam tiga tingkat: Siap, Cukup Siap, dan Belum Siap, dengan faktor demografis seperti usia, jenis kelamin, dan jenis sekolah dianalisis sebagai potensi yang memengaruhi. Hasil penelitian menunjukkan bahwa calon guru di Indonesia memiliki tingkat kesiapan TK yang lebih tinggi dibandingkan dengan rekan-rekan mereka di Filipina. Tidak ditemukan hubungan yang signifikan secara statistik antara kesiapan TK dan variabel demografis di kedua negara. Temuan ini menunjukkan perlunya intervensi yang ditargetkan dalam program pendidikan guru untuk meningkatkan kompetensi TK dan memastikan integrasi teknologi yang efektif dalam pembelajaran matematika. Implikasi terhadap desain kurikulum dan arah penelitian di masa depan turut dibahas.

Kata kunci: *Technological Knowledge*, Calon Guru Matematika, Studi Komparatif, Indonesia, Filipina

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INTRODUCTION

The very fast development of technology in educational spheres has changed the approach of teachers to the learning process and relationship with students. This change is very important in the sphere of mathematics education, where appropriate technological tools can

contribute to a better visual perception and understanding of complex concepts (Herrera et al., 2024; Ngabeni & Ngabeni, 2023; Saparbayeva et al., 2024; Serin, 2023a; Simbolon et al., 2024). Since the technology component of pedagogical activity is becoming more significant, future teachers should form a strong component of technological knowledge to meet the needs of educational activities in the modern education system. The presented research will allow an estimation and comparison of the readiness for information actions among mathematical pre-service teachers in Indonesia and the Philippines, which will make it possible to obtain a more complete picture regarding technological preparedness in Southeast Asia.

The research evidence has indicated that Technological Pedagogical Content Knowledge (TPACK) is very important in helping teachers to integrate technology effectively in their teaching (Mishra, 2019; Rakes et al., 2022; Santos & Castro, 2020; Sartika et al., 2025). TPACK is the knowledge base that emerges from the idea that effective teaching with technology requires an understanding of the complex relationships between technology, pedagogy, and content (Kara, 2021; Zhang, 2022). Some previous works have examined how much TPACK improves teaching and engagement with students (Daulay, 2024; Rakes et al., 2022; Raphael & Mtebe, 2024). However, a gap exists in the literature regarding TK readiness for math pre-service teachers in developing countries; this study aims to fill that gap.

The educational landscapes of Indonesia and the Philippines present unique contexts for examining TK readiness. Both countries have made significant strides in integrating technology into education, but face challenges related to infrastructure, access, and teacher training (Puspendari, 2023; Sofendi et al., 2021; Tomaro, 2018). Understanding the current state of TK among pre-service teachers in these countries can provide insights into how teacher education programs can be improved to better prepare future educators. This study compares the readiness levels of mathematics pre-service teachers in these two countries, providing a comparative analysis that is currently lacking in the literature.

In Indonesia, the government's push for digital literacy and technology integration in education has led to various initiatives aimed at improving teacher competencies (Ayu et al., 2024; Damanik & Widodo, 2024; Erviana et al., 2022; Tafrihah et al., 2024). Despite these efforts, there is still a need for empirical data to evaluate the effectiveness of these initiatives. Similarly, the Philippines has implemented programs to enhance ICT integration in schools, but disparities in access and quality remain significant barriers (Aguinaldo, 2013; Celeste & Osias, 2024; Kyne et al., 2022; Mastul et al., 2023). By comparing the TK readiness of pre-service teachers in these two countries, this study aims to highlight areas of strength and

opportunities for development.

Previous studies have often focused on the technological adoption and integration practices of in-service teachers, leaving a gap in understanding the readiness of pre-service teachers who are on the brink of entering the profession (Farjon et al., 2019; Tiba & Condry, 2021; Wah & Hashim, 2021). This research addresses this gap by examining the TK levels of mathematics pre-service teachers, providing a baseline understanding of their preparedness to integrate technology into their future classrooms. Additionally, the study explores demographic factors such as age, sex, and type of school, offering a nuanced view of how these variables may influence TK readiness.

The novelty of this research lies in its comparative approach, examining TK readiness across two distinct educational contexts in Southeast Asia. This comparative analysis not only provides insights specific to Indonesia and the Philippines but also contributes to the broader discourse on technological preparedness in developing regions. By identifying similarities and differences in TK readiness, the study offers valuable implications for policy makers, teacher educators, and researchers aiming to enhance the quality of mathematics education through technology.

The primary objective of this study is to assess the TK readiness of mathematics pre-service teachers in Indonesia and the Philippines. Specifically, it aims to determine the proportion of pre-service teachers who are ready, moderately ready, or not ready in terms of their TK. Additionally, the study seeks to identify any significant relationships between TK readiness and demographic factors such as age, sex, and type of school. These insights will inform the development of targeted interventions to support pre-service teachers in acquiring the necessary technological competencies.

A key aspect of this study is its focus on mathematics education, a field where technology can play a transformative role. Technologies such as dynamic geometry software, graphing calculators, and online learning platforms have been shown to enhance student understanding and engagement in mathematics (Serin, 2023b; Sunzuma, 2023). By assessing the TK readiness of mathematics pre-service teachers, this study aims to ensure that future educators are equipped to leverage these technologies effectively.

METHODS

This study employed a descriptive comparative research design to assess and compare the technological knowledge (TK) readiness of mathematics pre-service teachers in Indonesia

and the Philippines. A descriptive design was chosen to provide a detailed account of the current state of TK readiness, while the comparative element allowed for the identification of differences and similarities between the two countries. By utilizing this approach, the study aimed to generate comprehensive insights into the factors influencing TK readiness and to provide a basis for developing targeted interventions to improve technological competencies among future educators.

The population for this study comprised mathematics pre-service teachers from Indonesia and the Philippines. The sample included 93 respondents from the Philippines and 136 from Indonesia, selected through a convenience sampling method. This method was deemed appropriate given the logistical constraints and the aim to gather preliminary insights into TK readiness across different educational contexts. The demographics of the participants, including age, sex, and type of school (public or private), were documented to facilitate a nuanced analysis of how these factors might influence TK readiness.

Data were collected using a structured survey designed to measure the TK readiness of mathematics pre-service teachers. The survey included items that categorized respondents into three levels of readiness: "Ready," "Moderately Ready," and "Not Ready." The survey also gathered demographic information to explore potential correlations between these variables and TK readiness. The survey instrument was piloted to ensure reliability and validity before being administered online to the participants. The use of an online survey facilitated efficient data collection across the two countries, ensuring a diverse and representative sample.

Data analysis involved both descriptive and inferential statistical techniques. Descriptive statistics, including frequencies and percentages, were used to summarize the TK readiness levels of the respondents. Inferential statistics, such as Gamma and Cramer's V tests, were employed to examine the relationships between TK readiness and demographic factors (age, sex, and type of school). The Gamma test was used to analyze ordinal data, while Cramer's V was applied to nominal data. A significance level of 0.05 was set for all statistical tests to determine the presence of significant relationships. The results of these analyses provided insights into the factors influencing TK readiness and informed the discussion on the implications for teacher education programs in Indonesia and the Philippines.

RESULT AND DISCUSSION

Demographics of Participants

The demographic characteristics of the participants are summarized in Table 1. The

majority of respondents in both Indonesia and the Philippines were aged 22 and above, with 80.6% of the Filipino participants and 80.9% of the Indonesian participants falling into this age group. Additionally, the gender distribution showed a higher proportion of female respondents in both countries, with 72.0% of Filipino and 77.9% of Indonesian pre-service teachers being female. Notably, there was a significant difference in the type of schools attended by the respondents; 91.4% of Filipino participants were from public schools, whereas 86.0% of Indonesian participants were from private schools.

Table 1. Characteristics of Participants

Characteristics	Philippines	Indonesia
Age 21 and below	18 (19.4%)	26 (19.1%)
Age 22 and above	75 (80.6%)	110 (80.9%)
Male	26 (28.0%)	30 (22.1%)
Female	67 (72.0%)	106 (77.9%)
Public School	85 (91.4%)	19 (14.0%)
Private School	8 (8.6%)	117 (86.0%)

Technological Knowledge Readiness

The TK readiness of mathematics pre-service teachers is presented in Table 2. Among the Filipino respondents, 50.5% were categorized as "Ready," 48.4% as "Moderately Ready," and 1.1% as "Not Ready." In contrast, 66.9% of Indonesian respondents were "Ready," 32.4% were "Moderately Ready," and 0.7% were "Not Ready." These results suggest that Indonesian pre-service teachers exhibit higher levels of TK readiness compared to their Filipino counterparts.

Table 2. Characteristics of Participants

Level of Readiness	Philippines	Indonesia
Ready	47 (50.5%)	91 (66.9%)
Moderately Ready	45 (48.4%)	44 (32.4%)
Not Ready	1 (1.1%)	1 (0.7%)

Age and Technological Knowledge Readiness

Table 3 explores the relationship between age and TK readiness. For Filipino respondents aged 21 and below, 23.4% were "Ready" and 15.6% were "Moderately Ready." Among those aged 22 and above, 76.6% were "Ready" and 84.4% were "Moderately Ready."

The Gamma value of -0.267 and P-value of 0.563 indicate no significant relationship between age and TK readiness in the Philippines. Similarly, for Indonesian respondents aged 21 and below, 18.7% were "Ready" and 20.5% were "Moderately Ready." Among those aged 22 and above, 81.3% were "Ready" and 79.5% were "Moderately Ready." The Gamma value of 0.035 and P-value of 0.861 also indicate no significant relationship in Indonesia.

Table 3. The Relationship Between Age and TK Readiness

Age	Philippines (Ready)	Philippines (Moderately Ready)	Philippines (Not Ready)	Indonesia (Ready)	Indonesia (Moderately Ready)	Indonesia (Not Ready)
21 and below	11 (23.4%)	7 (15.6%)	0 (0%)	17 (18.7%)	9 (20.5%)	0 (0%)
22 and above	36 (76.6%)	38 (84.4%)	1 (100%)	74 (81.3%)	35 (79.5%)	1 (100%)
Total	47 (100%)	45 (100%)	1 (100%)	91 (100%)	44 (100%)	1 (100%)

Sex and Technological Knowledge Readiness

Table 4 examines the relationship between sex and TK readiness. Among Filipino male respondents, 27.7% were "Ready," 26.7% were "Moderately Ready," and 100% of the "Not Ready" category were male. Among females, 72.3% were "Ready" and 73.3% were "Moderately Ready." The Cramer's V value of -0.051 and P-value of 0.270 suggest no significant relationship between sex and TK readiness in the Philippines. For Indonesian male respondents, 22% were "Ready" and 20.5% were "Moderately Ready." Among females, 78% were "Ready" and 79.5% were "Moderately Ready." The Cramer's V value of -0.031 and P-value of 0.165 indicate no significant relationship in Indonesia.

Table 4. The Relationship Between Sex and TK Readiness

Sex	Philippines (Ready)	Philippines (Moderately Ready)	Philippines (Not Ready)	Indonesia (Ready)	Indonesia (Moderately Ready)	Indonesia (Not Ready)
Male	13 (27.7%)	12 (26.7%)	1 (100%)	20 (22%)	9 (20.5%)	1 (100%)
Female	34 (72.3%)	33 (73.3%)	0 (0%)	71 (78%)	35 (79.5%)	0 (0%)
Total	47 (100%)	45 (100%)	1 (100%)	91 (100%)	44 (100%)	1 (100%)

Type of School and Technological Knowledge Readiness

Table 5 analyzes the relationship between the type of school and TK readiness. Among Filipino respondents from public schools, 93.6% were "Ready" and 88.9% were "Moderately Ready." Among those from private schools, 6.4% were "Ready" and 11.1% were "Moderately Ready." The Cramer's V value of -0.264 and P-value of 0.688 indicate no significant relationship between type of school and TK readiness in the Philippines. For Indonesian respondents from public schools, 14.3% were "Ready" and 13.6% were "Moderately Ready." Among those from private schools, 85.7% were "Ready" and 86.4% were "Moderately Ready." The Cramer's V value of 0.046 and P-value of 0.917 indicate no significant relationship in Indonesia.

Table 5. The Relationship Between Type of School and TK Readiness

Type of School	Philippines (Ready)	Philippines (Moderately Ready)	Philippines (Not Ready)	Indonesia (Ready)	Indonesia (Moderately Ready)	Indonesia (Not Ready)
Public	44 (93.6%)	40 (88.9%)	1 (100%)	13 (14.3%)	6 (13.6%)	0 (0%)
Private	3 (6.4%)	5 (11.1%)	0 (0%)	78 (85.7%)	38 (86.4%)	1 (100%)
Total	47 (100%)	45 (100%)	1 (100%)	91 (100%)	44 (100%)	1 (100%)

Interpretation of Findings

The analysis indicates that Indonesian pre-service teachers demonstrate higher levels of TK readiness compared to their Filipino counterparts. This could be attributed to the different levels of investment and emphasis on technology integration in teacher education programs in the two countries. Previous studies have highlighted the importance of comprehensive teacher training programs in developing technological competencies (Irwanto et al., 2022; Rafiq et al., 2022).

The lack of significant relationships between age, sex, and type of school with TK readiness suggests that these demographic factors do not play a pivotal role in determining the technological preparedness of pre-service teachers in these contexts. This finding aligns with research by (Irwanto et al., 2022; Kerimbayeva et al., 2024; Sastria, 2023), which indicated that intrinsic factors such as personal attitudes towards technology and prior experience are more influential.

Previous research has shown that the successful integration of technology in education

is influenced by multiple factors, including teacher attitudes, access to resources, and institutional support (Ivanishchenko et al., 2024; Kerimbayeva et al., 2024; Li, 2023; Mohebi, 2021). The higher TK readiness observed among Indonesian pre-service teachers might reflect better access to technological resources and more supportive institutional environments compared to the Philippines.

Moreover, the results of this study contribute to the understanding of technological readiness in developing countries, a relatively under-researched area. The findings underscore the need for targeted interventions to support pre-service teachers in developing TK, particularly in contexts where access to technology and resources is limited (Kisalama & Kafyulilo, 2012; Ngao & Xiaohong, 2020).

The findings of this study have important implications for teacher education programs in both Indonesia and the Philippines. Enhancing TK among pre-service teachers requires comprehensive training that goes beyond basic technological skills to include pedagogical strategies for effective technology integration (Diamah et al., 2022; Musyaffa et al., 2023; Oktaviani & Utami, 2024; Setyosari et al., 2020; Zara, 2021). Teacher education programs should also focus on providing continuous support and professional development opportunities to ensure that pre-service teachers remain current with technological advancements.

Future research should explore the specific factors that contribute to higher TK readiness among Indonesian pre-service teachers. Longitudinal studies could provide insights into how TK develops over time and the long-term impact of teacher education programs on technological preparedness. Additionally, qualitative research could explore the experiences and perceptions of pre-service teachers to identify barriers and enablers of TK development.

CONCLUSION

This study offers a comparative analysis of the Technological Knowledge (TK) readiness of mathematics pre-service teachers in Indonesia and the Philippines. The findings reveal that Indonesian participants generally exhibit higher levels of TK readiness compared to their Filipino counterparts. Interestingly, demographic variables such as age, sex, and type of school did not show significant associations with TK readiness in either context, suggesting that institutional and curricular factors may play a more pivotal role than individual characteristics.

The implications of this study are particularly relevant for curriculum designers, teacher educators, and policymakers. To foster greater TK readiness, teacher education programs

should embed structured digital literacy components aligned with the TPACK framework. These programs must go beyond tool familiarity and emphasize pedagogical strategies for integrating technology meaningfully into mathematics instruction. For policymakers, the results highlight the need for equitable access to technological infrastructure and targeted investments in teacher preparation—especially in regions with limited digital resources.

Future research should explore the qualitative dimensions of TK readiness by examining pre-service teachers' attitudes, experiences, and perceived barriers in integrating technology into teaching. Larger and more diverse samples across Southeast Asia and other developing regions would help validate the generalizability of the findings. Longitudinal studies may also offer insights into how TK develops throughout teacher training and into early teaching practice.

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