Assessing Digital Technology Adoption in Mathematics Teaching: Attitudes, Beliefs and Usage among Training Teachers

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ABSTRACT

The integration of digital technology in mathematics education presents both opportunities and challenges. One major challenge is that training teachers often struggle to keep pace with technological advancements and effectively apply digital tools in the classroom. This study examines the impact of digital technology adoption. It investigates the relationships between attitudes, beliefs, and the frequency of usage among mathematics training teachers at the Institute of Teacher Education (IPG) in Malaysia. A quantitative research methodology was employed, involving 200 mathematics trainee teachers selected through simple random sampling. Data were analysed using descriptive statistics (frequency, mean, and standard deviation) and inferential statistics (one-way ANOVA and post-hoc Tukey HSD tests). Findings indicate that training teachers exhibit positive attitudes, strong beliefs, and a high frequency of digital technology usage in mathematics instruction. ANOVA results revealed significant differences between attitudes, beliefs, and frequency of usage. Post-hoc analysis further showed that while training teachers recognize the benefits of digitalization, their actual usage varies due to external barriers such as accessibility and training limitations. These findings suggest that enhancing access to digital technology, fostering positive attitudes, and providing targeted professional development programs can significantly improve digital integration in mathematics education. Future research should investigate additional factors, such as institutional support and policy interventions, to further facilitate the adoption of technology among training teachers.

Keywords: Digital technology, accessibility, attitude, frequency of usage, training teachers.

1. Introduction

Digital technology has experienced rapid growth in recent years (Yeo, 2020). Tools such as mobile phones, computers, tablets, artificial intelligence, websites, social media, and multimedia are commonplace and widely used across the globe. Concepts such as open online courses and touch technology have become integral to the daily lives of individuals with Internet access (Borba et al., 2017). The pervasive use of digital technology has profoundly influenced our everyday lives.

However, researchers are finding it challenging to keep up with the swift advancements in digital technology (Borba et al., 2017). The swift evolution in the educational landscape has made it challenging for studies to remain current with the latest issues. The extensive adoption of digital tools has transformed traditional classrooms into online learning environments, eliminating the need for physical attendance (Fransson et al., 2018). As many countries accelerate efforts to digitalize their education systems, concerns regarding the effectiveness of digital tools in education have become increasingly critical.

The rapid expansion of digital technology has reshaped education, driving a shift from traditional, face-to-face classrooms to online and blended learning environments. This transformation highlights the increasing reliance on digital tools for educational delivery. However, the rapid pace of technological advancements poses challenges for educators and researchers, who struggle to keep pace with emerging trends and innovations. As countries continue to push for greater digitalization in education, the need to assess the true impact of digital tools on instructional quality and learning outcomes has become increasingly urgent.

As the world advances towards the Fourth Industrial Revolution (IR4.0), Malaysia is actively striving to stay competitive by embracing digitalization in all sectors, including education. According to Rashvinjee (2021), the Prime Minister's Department has emphasized the importance of embracing IR4.0 to keep the country competitive and prepared for future changes. In response, the education sector has introduced Education 4.0, a paradigm shift driven by digitalization (Priya, 2019).

Mathematics classrooms have not been left behind in this digital transformation. Digital technology is transforming the landscape of mathematics education by offering interactive tools that enhance learning experiences. The integration of digital tools and resources has significantly impacted both teachers and students. According to Dunwill (2016), technological advancements are reshaping teaching methods and learning environments. Web-based learning platforms and interactive mathematics applications, often referred to as game-based learning, offer students engaging and immersive experiences. Popular examples include Minecraft, Roblox, and Prodigy, which utilize virtual reality (VR) to make mathematics learning more enjoyable. Additionally, digital tools like GeoGebra and Tinkercad enable students to explore 3D shapes online, fostering deeper engagement and understanding. Several studies have highlighted the positive impact of digitalization on student motivation in mathematics (Yong et al., 2016; Jannah, 2020; Marpa, 2021). By providing interactive and engaging learning experiences, digital tools can increase students' interest and enthusiasm for the subject. As a result, digitalizing mathematics education is an essential part of Malaysia's efforts to equip students for the challenges and opportunities of the 21st century. Despite its potential, many training teachers struggle with technology integration, often due to a lack of confidence, limited resources, or inadequate training. The rapid evolution of digital tools presents challenges for educators in adopting and effectively utilizing these technologies. Understanding teachers' attitudes, beliefs, and usage levels of digital technology is crucial for identifying barriers and facilitating effective integration strategies. This research, therefore, aligns with national goals under Malaysia's Education Blueprint and IR4.0 to equip educators with digital competencies.

4 Problem Statement

Recent reviews have highlighted the potential, challenges, and obstacles to integrating digital technology in mathematics education (Yerushalmy & Botzer, 2011). According to Doe (2023), one significant obstacle is the difficulty teachers face in keeping pace with the rapid advancements in digital technology and effectively incorporating it into their teaching practices. Studies have identified several challenges in this regard, including the need for teachers to transition from traditional instructor roles to more facilitative ones and the importance of adopting a structured, research-based approach to technology integration (Bray & Tangney, 2017).

In Malaysia, the readiness of educators to integrate technology into teaching and learning remains a significant challenge, despite the Ministry of Education's initiatives outlined in the Malaysia Education Blueprint (MEB) 2013-2025. Although the integration of technology in classrooms remains limited, the outlines a roadmap for leveraging ICT in education through three waves. Many teachers, however, continue to rely on traditional teaching methods without integrating technology. Research supports studies by Umar and Hassan (2015), which report low levels of technology integration among Malaysian teachers, and Cheok et al. (2020), who highlight the limited use of digital tools in some schools. Additionally, research conducted by Nikian et al. (2013) found that Malaysian teachers face challenges in integrating technology into their classroom practices, contributing to the low usage. While some institutions have organized workshops to train teachers in using technology, teachers still struggle with readiness due to factors such as insufficient training, inadequate resources, and low marks from mentor teachers during their practicum for using technology effectively. Despite the extensive research on the impact of technology in education, studies on teachers' perceptions, particularly those related to teacher training, are limited (Tiba & Condy, 2021). Although digital technology is increasingly emphasized in education policies, its integration into mathematics teaching remains inconsistent. Research has shown that training teachers' attitudes and beliefs significantly impacts their willingness to adopt technology. However, a knowledge gap persists regarding the relationship between attitudes, beliefs, and frequency of usage in the Malaysian context. Moreover, limited studies provide a systematic analysis linking constructs to research design and instrumentation, especially in Malaysian teacher training institutions.

This study aims to 1. Assess the attitudes, beliefs, and frequency of use of digital technology among training teachers in mathematics teaching. 2. Examine the relationship between training teachers' attitudes, beliefs, and frequency of digital technology usage. and 3. Determine the key factors affecting the integration of digital tools in mathematics instruction among training teachers regarding the digitalization of Mathematics learning in Malaysian primary schools.

The rapid advancement of technology has presented challenges for teachers in effectively integrating digital tools into mathematics instruction. Many educators may be unfamiliar with the potential benefits of digital technology in teaching mathematics, which can lead to a reluctance to adopt new tools and strategies. However, research suggests that effective and appropriate use of technology can increase student learning in mathematics (Perienen, 2020). Despite the potential benefits of digital technology, comprehensive research on its use in mathematics education remains limited (Mulenga & Marbán, 2020).

3. Literature Review & Research Model

The rapid evolution of digital technology continues to reshape mathematics education, creating both opportunities and challenges. Numerous studies have emphasized the positive impact of digital tools on student engagement, mathematical understanding, and interactive learning environments (Borba et al., 2017; Yong et al., 2016; Djidu & Retnawati, 2022). However, a recurring theme across the literature is that successful integration depends not solely on access to technology, but significantly on teachers' internal factors, particularly their attitudes, beliefs, and frequency of usage (Ertmer et al., 2012; Admiraal et al., 2017).

To build a robust research framework and instrument, this study adopted a construct-driven approach, guided by a focused review of empirical and theoretical literature. The search strategy involved selecting peer-reviewed sources published between 2011 and 2023, using keywords such as *"technology acceptance in education"*, *"beliefs and ICT use"*, *"teacher digital attitudes"*, and *"technology integration in mathematics education"*. Studies were selected based on their relevance to training teacher contexts, alignment with quantitative design, and operational clarity of the constructs.

The study is grounded in the Technology Acceptance Model (TAM), which postulates that perceived usefulness and ease of use influence technology adoption. Prestridge (2012) emphasizes how beliefs about ICT shape instructional practice, while qualitative studies by Tiba and Condy (2021) and O'Neal et al. (2017) reveal how environmental, psychological, and pedagogical beliefs frame digital integration in teacher training. All these factors contribute to the development of a conceptual research model that illustrates the interplay between attitudes, beliefs, and the frequency of digital technology usage adopted and operationalized by this study.

The proposed research model is based on the TAM, emphasizing three key constructs influencing digital technology adoption among training teachers: Attitudes towards Digital Technology, Beliefs about Digital Technology, and Frequency of Digital Technology Usage. These constructs interact to determine how effectively training teachers integrate digital tools into their mathematics teaching.

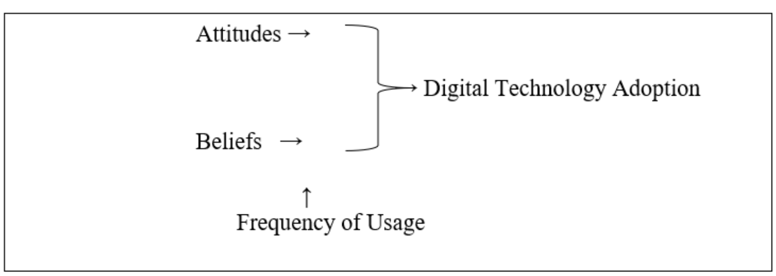

Figure 1: Conceptual framework

TAM posits that attitude, defined as individuals' favourable or unfavourable evaluations of using technology, significantly influences intention and behaviour (Venkatesh & Davis, 2000). In this research, *attitude* refers to how teachers perceive the utility and desirability of using digital tools in the mathematics classroom.

Beliefs**,** while related, refer to deeper cognitive and pedagogical assumptions that influence how teachers interpret the role of digital technology in learning. Prestridge (2012) argues that teachers' underlying beliefs shape whether they use ICT in a merely supportive or truly transformative way. Accordingly, belief constructs in this study were adapted from Prestridge's validated items, with modifications to fit the Malaysian IPG context.

The frequency of usage refers to how often teachers employ digital tools during lesson planning, instruction, and assessment. Previous research (Hsu, 2011; Ghavifekr et al., 2016; Shah & Empungan, 2015) has operationalized this construct using Likert-scaled survey items that focus on the types and regularity of use. This study synthesizes those approaches to develop a localized usage scale.

To ensure theoretical coherence and empirical relevance, each construct is mapped to specific sources, definitions, and adapted instruments (see Table 1). This construct-oriented synthesis directly informed the development of the research model and survey instrumentation. In contrast to descriptive literature summaries, this method ensures a systematic link between theoretical underpinnings and empirical application.

Table 1: Construct Synthesis and Instrument Mapping

Construct	Definition	Source(s)	Instrument Basis	Example Item
Attitude	Teachers' evaluative stance toward technology use in math teaching	Venkatesh & Davis (2000)	TAM-based scale	"I enjoy using digital tools in my teaching."
Beliefs	Teachers' perceptions of how digital tools affect learning and teaching	Prestridge (2012)	Adapted belief items	"I believe ICT improves student mathematical understanding."
Usage Frequency	Frequency of digital tool usage in lesson planning or teaching	Hsu (2011); Ghavifekr et al. (2016)	Modified frequency scale	"I use digital tools in most of my mathematics lessons."

Digital Technology Adoption (Outcome Variable): The dependent variable represents the extent to which training teachers integrate digital technology into mathematics education. The design of the instrument is intended to achieve the objectives of this study.

4. Methodology

This study adopts a quantitative survey design to investigate the attitudes, beliefs, and frequency of digital technology usage among mathematics training teachers in Malaysia. The research design aligns with the study's objectives, which aim to quantify and compare perceptions and usage patterns using validated constructs grounded in the TAM and supporting literature. The research framework is informed by three key constructs: attitudes, beliefs, and usage frequency, all of which are operationalized through a structured questionnaire. These constructs were developed and validated through a literature synthesis (see Table 1 in the Literature Review) and subsequently used to design an instrument that captures the digital technology adoption behaviours of training teachers. Descriptive analysis has been used to analyze the collected data, which includes percentages, frequencies, means, and standard deviations, in order to achieve the first objective. Inferential analysis, specifically one-way ANOVA and Post-Hoc Tests, has been used to investigate the relationship between the aspects and answer the second and third objectives.

Sampling is the process of selecting a subset of the population for research purposes (Turner, 2020). The target population consists of approximately 334 mathematics trainee teachers from various Institutes of Teacher Education (IPG) in Malaysia who have undergone teaching practice. To ensure representative sampling across institutions, disciplines (including Mathematics majors/minors), and training levels, the study employed simple random sampling using a complete list of eligible trainees from IPG registries. According to Krejcie and Morgan's (1970) table for determining sample size, a minimum of 190 responses is sufficient for a population of this size. This study achieved a sample of 200 respondents, exceeding the recommended threshold to ensure statistical power and generalizability.

In this research, the questionnaire items were adapted from several studies to align with the research objectives. The instrument is divided into four sections, starting with the demographic information of the respondents, followed by attitude items (adapted from the Technology Acceptance Model, or TAM), belief items (from Prestridge, 2012), and usage frequency items (from Hsu, 2011; Shah & Empungan, 2015; and Ghavifekr et al., 2016). All items were rated on a 4-point Likert scale, ranging from 1 (strongly disagree) to 4 (strongly agree). The instrument comprises a total of 55 items and was reviewed by three experts in mathematics education and educational technology to establish content validity. Validity refers to the accuracy with which a concept is measured in quantitative research (Heale & Twycross, 2015).

A pilot study was conducted with 30 respondents. The results indicated excellent internal consistency, with Cronbach's alpha = 0.942 overall and subscale values above the 0.80 threshold, confirming the instrument's reliability. (Table 2)

Table 2: Cronbach's Alpha Result Value

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of items
.942	.976	55

The attitude aspect assesses respondents' perceptions regarding the utilization of digital technology in classroom instruction. For the belief aspect, the instrument assesses training teachers' beliefs regarding the use of digital technologies. The usage aspect focuses on the respondents' level of engagement with various digital technologies, whether during lesson preparation or in the actual teaching process. Additionally, the instrument also gauges the training teachers' confidence in using these technologies.

Data was collected through a web-based survey using Google Forms, which allowed for broad, asynchronous participation across different IPG campuses. Participation was voluntary, and informed consent was obtained from all respondents. The collected data were analyzed using both descriptive and inferential statistics via SPSS version 27. Descriptive statistics (mean, standard deviation, frequency) were used to summarize training teachers' attitudes, beliefs, and usage.

To test for significant differences across the three constructs, a one-way Analysis of Variance (ANOVA) was employed. ANOVA is appropriate when comparing the means of three or more independent groups, as was the case for this study's constructs. Prior to analysis, key assumptions were tested for normality, which was assessed using the Shapiro-Wilk test. Homogeneity of variance was checked using Levene's test.

Both assumptions were met, confirming the suitability of ANOVA. A Tukey's post-hoc test was also performed to identify specific group differences. This rigorous statistical process ensures the findings are scientifically valid, grounded in accepted quantitative research methodology, and suitable for drawing evidence-based conclusions that support the study's aims and research questions.

5. Findings and Discussions

This study aimed to examine the attitudes, beliefs, and frequency of usage of mathematics trainee teachers regarding digital technology adoption, and to explore the relationships between these constructs. The results are now discussed in relation to the research questions and the underlying theoretical framework (TAM).

5.1 Research Question 1: What are the attitudes, beliefs, and usage levels of digital technology in mathematics teaching among training teachers?

A total of 200 respondents answered the questionnaire. The exploratory data analysis showed that the data collected is normally distributed. For descriptive analysis, the overall mean for attitude, beliefs and level of usage of digital technology in teaching Mathematics among training teachers is at a high level. Inferential analysis revealed a significant difference in attitudes, beliefs, and usage levels. Post-hoc Tukey HSD tests identified specific group differences.

Table 2: Digital Technology in Teaching Mathematics based on Attitudes, Beliefs and Level of Usage

	N	Mean	Std. Deviation
Attitudes	200	3.2970	.3960
Beliefs	200	3.2200	.3530
Level of Usage	200	3.3570	.3700
Influence		3.2904	.3770

Descriptive analysis (Table 2) revealed high mean scores across all three constructs: attitudes (M = 3.297), beliefs (M = 3.220), and usage (M = 3.357), indicating overall positive perceptions of digital technology adoption. These findings align with previous research (Singh & Chan, 2014; Subramanian et al., 2018), suggesting that training teachers are generally open to digital transformation, especially when they perceive the technology as beneficial to student learning shows the positive attitudes observed among the training teachers in this study are supported by Singh and Chan (2014), who found that most respondents believe digital tools enhance teaching effectiveness and facilitate students' understanding of concepts. Training teachers recognize the numerous benefits of digitalization in education and demonstrate favourable attitudes toward its implementation. A significant number of them expressed that lacking digital tools would hinder teaching and learning, while some argued they could still meet learning objectives without them. These findings align with Umar and Hassan's study (2015), which revealed that teachers generally hold positive perceptions of technology use despite facing challenges. Additionally, Shtepura's research (2018) indicates that digital resources enhance the learning experiences of today's students (often referred to as digital natives), who typically have a favourable view of technology in the classroom (Balkan, 2018). These results (M = 3.2970) showed that digital technology promotes interaction between teachers and pupils in mathematics teaching and learning activities more effectively. There is also research that shows that the quality of the learning process and learning outcomes will improve by using mathematical software (Djidu & Retnawati, 2022). These results affirm TAM's core proposition that positive attitudes influence intention and usage. When they are able to learn Mathematics more easily, their confidence and attitude towards using digital technology will improve too. Therefore, training teachers are encouraged to integrate these tools in line with 21st-century learning frameworks such as PAK-21 and Transformation School 2025 (TS25).

In terms of beliefs, as shown in Table 2, the majority of training teachers assert that digital technologies motivate students, enhance their learning, and transform their approach to learning Mathematics (M = 3.2200). This is supported by O'Neal et al. (2017), who found that digital educational tools boost student engagement and interest. The training teachers in this study believe that digitalization has a positive impact on student learning. However, some also expressed concerns that digitalization can be mentally taxing and frustrating. Singh and Chan (2014) noted that many teachers experience stress related to ICT, likely due to technology constraints that lead to technostress. This is corroborated by Ly and Ly's study (2022) in Cambodia, which identified technological challenges and time constraints as common contributors to teacher technostress. There are also training teachers who find digital technology very confusing, and they face challenges when trying to incorporate it into their mathematics teaching. The reason could be that they lack the skills and knowledge to use digital technology effectively. This statement can be supported by the research of Subramanian et al. (2018), which indicates that students face problems such as a lack of time, inadequate technical support, and a lack of knowledge in integrating digital technology into their study courses. Therefore, it is crucial to plan the implementation of digital tools effectively to mitigate these challenges. Further investigation by educational planners is needed to address these issues, making digitalization a key component of training programs for all teachers.

The high level of digital tool usage (M = 3.3570) among training teachers contrasts with findings from local studies by Ahmad (2014), Umar and Hassan (2015), and Cheok et al. (2020), which suggest a lower level of digital integration among in-service teachers. This suggests that teachers who have received training may have a higher usage rate due to their training and greater familiarity with digital technologies. Siaw (2018) found that training teachers perceive the Digital Innovation course at the Institute of Teacher Education Campus (IPG) as more beneficial than detrimental. This suggests that training teachers acquire significant expertise in digitalization during their training, leading to a high level of application throughout their practicum. In the study, some training teachers are reluctant to explore new software that can help them teach mathematics more effectively. A similar research result suggests that this could be due to a lack of knowledge in using digital technology (Subramanian, 2018). Furthermore, another reason could be due to a lack of access to digital technology. However, this problem can be addressed through the training program at IPG. The theory of Blended Learning can support it as it concentrates on incorporating digital technology into teaching and learning activities.

The study revealed that teachers hold positive attitudes toward digital technology, strong beliefs in its effectiveness, and frequently use digital tools in the digitalization of Mathematics teaching and learning. The overall mean for the three aspects of training teachers' perceptions is 3.2904, indicating a strong positive perception towards the digitalization of Mathematics education in primary schools. This aligns with findings from a study in Indonesia by Djidu and Retnawati (2022), which reported that while most teachers held positive perceptions of digitalization, they faced challenges and barriers that prevented them from fully implementing technology.

5.2 Research Question 2: Are there significant differences between attitudes, beliefs, and frequency of usage?

The one-way ANOVA results showed statistically significant differences among these three aspects [$F(2, 597) = 0.940$, $p = 0.001$ (< 0.05), $\eta^2 = 0.02$]. Notably, beliefs scored slightly lower than usage, suggesting that even when usage is frequent, underlying pedagogical beliefs may not always be deeply formed. This finding aligns with the results of Ertmer et al. (2012), who discovered that frequent tool use does not always lead to transformative integration, often due to incomplete shifts in beliefs.

Table 3: Results of One-Way ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.881	2	.940	6.737	.001
Within Groups	83.332	597	.140		
Total	85.212	599			

Table 3 displays the sum of squares and degrees of freedom for both between-group and within-group variations. Although the actual differences in mean scores among the groups were small (Cohen, 1988), the significance level of less than 0.05 indicates notable differences across the three aspects. Consequently, the null hypothesis is rejected. This suggests that there are significant differences in attitudes, beliefs, and levels of usage concerning the digitalization of Mathematics education among training teachers in Malaysia.

5.3 Research Question 3: What are the key factors affecting the integration of digital tools in mathematics instruction among training teachers regarding the digitalization of Mathematics learning in Malaysian primary schools?

Table 4: Results of Multiple Comparison (Post-hoc Tests)

(I) Aspects	(J) Aspects	Mean Differences (I-J)	Std. Error	Sig.
Attitude	Beliefs	.072	.037	.132
	Level of Usage	-.065	.037	.190
Beliefs	Attitude	-.072	.037	.132
	Level of Usage	-.137*	.037	.001
Level of Usage	Attitude	.065	.037	.190
	Beliefs	.137*	.037	.001

Post-hoc Tukey HSD tests revealed significant differences in the mean scores for beliefs and level of usage regarding digitalizing mathematics teaching and learning among training teachers. Specifically, beliefs were found to be significantly lower than the level of usage ($\eta^2 = 0.02$), indicating a small but statistically significant difference, as per Cohen's (1988) benchmark for interpreting variance; the lack of skills explained. This suggests that while training teachers recognize the benefits of technology, external barriers may limit their application. These findings align with existing research (Ertmer et al., 2012; Badia et al., 2013; Kubiatko, 2013; Admiraal et al., 2017), which emphasizes the interconnectedness of teachers' beliefs, attitudes, and technology usage. This implies a potential surface-level adoption, which requires deeper engagement through reflection, mentoring, and exposure to pedagogical models of technology integration.

6. Conclusion

This study contributes to the understanding of training teachers' readiness for digital integration in mathematics education. The findings confirm that while attitudes and usage are high, beliefs about the value of digital technology in pedagogy are still evolving. This calls for holistic training that nurtures both the technical skills and belief systems necessary for meaningful and sustained digital integration. By aligning the discussion with the research questions and grounding the implications in both the data and theory, this study provides a robust foundation for advancing teacher education practices in a digital age.

This study highlights the importance of attitudes, beliefs, and frequency of digital technology usage among training teachers. Findings suggest that while teachers are inclined to adopt digital tools during training, structural barriers, such as limited training resources and accessibility issues, impact their overall integration. Addressing these issues through curriculum enhancement, institutional support, and policy initiatives will be key to fostering effective digital technology adoption in mathematics education.

The findings indicate that the integration of digital technologies during the training of teachers at the Institute of Teacher Education has successfully shaped their beliefs, attitudes, and readiness for teaching in schools following the completion of the training. To further promote digitalization in education, the Ministry of Education (MOE) could implement offline programs that allow rural schools to access digital learning without requiring a Wi-Fi connection. Additionally, the MOE could organize initiatives focused on teaching students the ethical use of technology to prevent misuse. The Institute of Teacher Education (IPG) should expand digital literacy courses to improve teachers' confidence in using technology. Motivational talks are also vital for boosting the confidence of training teachers and fostering a positive mindset. Policymakers should implement targeted initiatives to address infrastructure gaps, especially in rural schools. Therefore, several implications are as follows:

6.1 Practical Implications

Teacher Training Programs should embed structured reflection activities to strengthen beliefs about the pedagogical value of technology, beyond technical skills. Professional development should go beyond tool use and focus on pedagogical reasoning, emphasizing how digital tools can meaningfully enhance mathematical understanding. Findings suggest that beliefs lag behind usage, indicating a need for mentorship programs during the practicum to help bridge this gap through real classroom experience.

6.2 Policy Implications

The Ministry of Education (MOE) should consider institutionalizing digital competency assessments as part of teacher exit requirements. Training programs must ensure equitable access to digital infrastructure, especially for rural IPG campuses, to sustain high-frequency usage habits into professional teaching life.

6.3 Theoretical Implications

The findings provide empirical support for the Technology Acceptance Model in a teacher education context, particularly affirming the link between attitudes and usage. The observed gap between beliefs and usage highlights the need to expand TAM with belief-specific sub-constructs in future educational technology studies.

7. Recommendations

Acknowledging the study's limitations, future research should explore the long-term effects of digital training programs on technology adoption among in-service teachers. This research aims to compare the attitudes, beliefs, and frequency of digital technology usage in this study. Investigating both urban and rural schools could also reveal contrasting views on technology integration. Future studies might also explore additional dimensions of teachers' perceptions, such as their Technological Pedagogical and Content Knowledge (TPACK). Employing qualitative methods, such as case studies or experimental designs, would enable researchers to delve deeper into real-world scenarios for more nuanced insights.

The study can further include reflective practice modules in digital education courses to strengthen pedagogical beliefs. Introduce simulation tools that enable trainees to observe the impact of technology on real-world learning scenarios. Encourage cross-campus digital tool showcases where IPG students share experiences and build confidence in new tech platforms. And future studies could explore longitudinal changes in beliefs and attitudes from practicum to full-time teaching to track sustained integration.

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