ISRG Journal of Education, Humanities and Literature (ISRGJEHL)

ISRG PUBLISHERS
Abbreviated Key Title: ISRG J Edu Humanit Lit
ISSN: 2584-2544 (Online)
Journal homepage: https://isrgpublishers.com/isrgjehl/
Volume – I Issue- V (September-October) 2024
Frequency: Bimonthly

Technology Acceptance in Primary Mathematics Education: A Study of Teacher Perspectives in Vietnam

Quoc Anh Vuong[1*], Trung Thanh Le[2], Van Luan Vu[3], Trung Thanh Nguyen[4]

[1, 2] The Vietnam National Institute of Educational Sciences, Vietnam
[3] Green Education Technology Joint Stock Company, Vietnam
[4] High School of Education Sciences, University of Education, VNU, Vietnam

| **Received:** 09.09.2024 | **Accepted:** 13.09.2024 | **Published:** 15.09.2024

***Corresponding author:** Quoc Anh Vuong
The Vietnam National Institute of Educational Sciences, Vietnam

Abstract

This study investigates the acceptance and integration of technology in primary school mathematics education in Vietnam, guided by the Technology Acceptance Model (TAM). The research draws on a comprehensive survey conducted with 11,811 primary school teachers across ten provinces, focusing on the key areas: teacher background, views on technology's role, practical implementation in classrooms, self-assessment of technology effectiveness. The findings reveal insights into teachers' perceptions of advanced technologies such as Augmented Reality (AR), detailing the tools and instructional methods employed. This study underscores the importance of aligning technology development with teachers' practical needs and capabilities, highlighting the necessity for targeted professional development and policy support. The insights offer valuable guidance for policymakers, educational administrators, and technology developers aiming to enhance the quality of mathematics education through effective technology integration.

Keywords: *Technology Acceptance Model (TAM), Primary school mathematics education, Technology integration, Augmented Reality (AR), Teacher perspectives, Educational technology*

1. Introduction

The integration of technology in education has become a critical area of focus for enhancing teaching and learning processes globally. In the context of primary school mathematics education, technology offers promising tools to support instructional strategies, engage students, and improve learning outcomes. Particularly in developing countries like Vietnam, the effective use of technology in education is seen as a key factor in advancing educational quality and equity. However, the successful integration

DOI: 10.5281/zenodo.13764778

of technology into classrooms largely depends on teachers' acceptance and readiness to embrace these new tools (Christensen, 2002).

The Technology Acceptance Model (TAM) has been widely used to understand the factors that influence individuals' adoption of technology. According to TAM, perceived ease of use and perceived usefulness are primary determinants of technology acceptance. In educational settings, teachers' beliefs about the benefits and challenges of technology play a crucial role in shaping their willingness to integrate it into their teaching practices. This is especially pertinent in the field of mathematics education, where the use of technology, including advanced applications like Augmented Reality (AR), can transform traditional teaching methods and offer new ways to visualize and understand complex concepts(Davis, 1989).

In Vietnam, the push towards digital transformation in education has gained momentum, with various initiatives aimed at incorporating technology into classrooms. However, the extent to which these efforts have been successful, particularly in primary mathematics education, remains underexplored (Peeraer & Van, 2015). Understanding teachers' perspectives on technology integration is essential for identifying the barriers they face, the support they need, and the potential impact on student learning.

This study aims to investigate the acceptance and integration of technology in primary school mathematics education in Vietnam, focusing on teachers' perspectives. By surveying 11,811 primary school teachers across ten provinces, this research provides a comprehensive overview of the current state of technology use in mathematics classrooms. The study examines key factors influencing teachers' acceptance of technology, including their background, views on technology's role, practical implementation in classrooms, self-assessment of technology effectiveness, and the conditions under which they teach.

The findings of this study are expected to offer valuable insights for policymakers, educational administrators, and technology developers. By understanding the factors that influence technology acceptance among primary school mathematics teachers, stakeholders can better align technology development with teachers' practical needs and capabilities, ultimately enhancing the quality of mathematics education in Vietnam.

2. Literature Review

The integration of technology in education has been extensively studied across various contexts, with a significant focus on its potential to enhance teaching and learning processes. The use of technology in mathematics education, particularly in primary schools, has garnered attention due to its ability to facilitate more interactive and engaging learning environments. This literature review explores the key theoretical frameworks, previous studies on technology integration in education, the role of technology in mathematics teaching, and the specific challenges and opportunities related to technology use in developing countries like Vietnam.

Theoretical Framework: Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), developed by Davis (1989), has been one of the most influential models in understanding technology adoption across various domains, including education. TAM posits that two key factors—perceived ease of use and perceived usefulness—determine an individual's intention to use technology, which subsequently influences actual usage. In educational settings, TAM has been widely applied to explore how teachers' beliefs about the usefulness and ease of using technology influence their adoption of digital tools in the classroom (Teo, 2011).

Venkatesh and Davis (2000) expanded TAM to include additional constructs such as subjective norms and perceived behavioral control, further refining the model's applicability to different contexts. In the realm of education, TAM has been adapted to study the factors influencing teachers' acceptance of various technologies, including Learning Management Systems (LMS), interactive whiteboards, and more recently, Augmented Reality (AR) and Virtual Reality (VR) tools (Scherer, Siddiq, & Tondeur, 2019). The model's robustness in predicting technology acceptance has led to its widespread use in educational technology research.

Technology Integration in Education

Technology integration in education is defined as the use of technology resources—such as computers, mobile devices, digital tools, and the internet—in daily classroom practices, as well as in the management of schools and administrative operations (Ertmer & Ottenbreit-Leftwich, 2010). Effective technology integration is often characterized by its ability to enhance the learning process, making it more engaging, efficient, and personalized (Voogt, Knezek, Cox, Knezek, & ten Brummelhuis, 2013).

The integration of technology in education has been studied from multiple perspectives, including the role of teachers, the design of instructional materials, and the impact on student learning outcomes (Rosen & Beck-Hill, 2012). Research indicates that teachers are pivotal to the successful integration of technology in the classroom. Their beliefs, attitudes, and competencies significantly influence how technology is utilized to support teaching and learning (Ertmer, 2005).

Several studies have highlighted the barriers to technology integration in education. These barriers are often categorized into first-order barriers, such as lack of access to resources and inadequate infrastructure, and second-order barriers, including teachers' attitudes, beliefs, and resistance to change (Hew & Brush, 2007). Addressing these barriers requires a comprehensive approach that includes professional development, technical support, and a supportive school culture that encourages innovation and experimentation (Inan & Lowther, 2010).

The Role of Technology in Mathematics Education

Mathematics education has been at the forefront of technology integration due to the subject's abstract nature and the potential of digital tools to make complex concepts more accessible (Li & Ma, 2010). Research has shown that technology can support mathematics teaching in various ways, such as through interactive simulations, dynamic geometry software, and tools for visualizing mathematical concepts (Kong, Kwok, & Fang, 2020).

Augmented Reality (AR) is an emerging technology that has shown promise in mathematics education. AR can overlay digital information on the physical world, providing students with immersive and interactive experiences that can enhance their understanding of mathematical concepts (Ibáñez & Delgado-Kloos, 2018). Studies have demonstrated that AR can improve students' spatial reasoning, problem-solving skills, and engagement in learning mathematics (Cai, Chiang, & Wang, 2013).

DOI: 10.5281/zenodo.13764778

However, the integration of advanced technologies like AR in mathematics education is not without challenges. Teachers often face difficulties in understanding how to effectively incorporate these tools into their teaching practices (Bacca, Baldiris, Fabregat, Graf, & Kinshuk, 2014). Additionally, the lack of adequate training and support for teachers can hinder the effective use of AR and other technologies in the classroom (Akçayır & Akçayır, 2017).

Technology Integration in Developing Countries

The integration of technology in education presents unique challenges in developing countries, where resources are often limited, and the digital divide is more pronounced (Unwin, 2009). In many developing countries, including Vietnam, the adoption of educational technologies is still in its nascent stages, with significant disparities in access to digital tools and the internet between urban and rural areas (Trucano, 2012).

Research in developing countries has identified several barriers to technology integration, including inadequate infrastructure, lack of funding, and insufficient professional development opportunities for teachers (Pelgrum, 2001). Despite these challenges, there is growing recognition of the potential of technology to improve educational outcomes and reduce inequalities in access to quality education (Hooker, Mwiyeria, & Verma, 2011).

In Vietnam, the government has made concerted efforts to promote the use of technology in education through various initiatives and policies (Vu, 2019). However, the success of these initiatives depends largely on the readiness and willingness of teachers to adopt and integrate technology into their teaching practices (Huong, 2020). Studies have shown that Vietnamese teachers face significant challenges in using technology, including a lack of confidence in their digital skills, limited access to training, and insufficient support from school leadership (Nguyen, 2021).

Teacher Professional Development and Technology Integration

Teacher professional development is crucial for successful technology integration in education. Effective professional development programs should focus not only on enhancing teachers' technical skills but also on building their pedagogical competencies to use technology to support student learning (Desimone & Garet, 2015). Research has shown that sustained, collaborative, and context-specific professional development is more likely to lead to meaningful changes in teachers' practices and attitudes toward technology (Darling-Hammond, Hyler, & Gardner, 2017).

In the context of mathematics education, professional development programs that focus on integrating technology into the curriculum have been found to improve teachers' confidence and competence in using digital tools (Niess, 2005). Such programs often include hands-on training, opportunities for peer collaboration, and ongoing support to help teachers overcome challenges and refine their instructional practices (Lawless & Pellegrino, 2007).

Policy Implications and Future Directions

The findings from existing literature highlight the need for comprehensive policies that support technology integration in education. These policies should address both the infrastructural and human resource needs of schools, ensuring that teachers have access to the necessary tools and training to effectively integrate technology into their teaching (Selwyn, 2011).

In developing countries like Vietnam, policymakers must consider the unique challenges faced by schools in rural areas, where access to technology may be more limited. Targeted interventions are needed to bridge the digital divide and ensure that all students have equal opportunities to benefit from technology-enhanced education (Fisser, Voogt, & Knezek, 2013).

Moreover, future research should continue to explore the impact of emerging technologies, such as AR, on teaching and learning in mathematics education. There is a need for more empirical studies that examine the long-term effects of these technologies on student outcomes, as well as the factors that influence their successful integration into the classroom (Mishra & Koehler, 2006).

3. Methodology

Research Design

This study employed a quantitative research design grounded in the Technology Acceptance Model (TAM) to explore primary school teachers' perspectives on technology integration in mathematics education in Vietnam. The research focused on the key aspects: (a) Teacher Background Information, (b) Teachers' Views on the Role of Technology, (c) Practical Implementation of Technology, and (d) Teachers' Self-assessment of Technology Integration Effectiveness.

Sampling Strategy

The study targeted primary school teachers (grades 1 through 5) for the 2023-2024 academic year. To ensure a diverse and representative sample, the study employed a purposive sampling strategy that included teachers from various geographic regions and locality types in Vietnam, such as urban, rural, and mountainous areas. Participants were recruited through educational networks, professional associations, and direct invitations distributed widely among primary school teachers across the country.

Data Collection and Participant Demographics

The survey was distributed to teachers in 10 selected provinces across Vietnam, chosen for their diverse geographic representation, which included Northern, Central, and Southern regions. The provinces involved in the study were Hanoi, Can Tho, Ca Mau, Dak Lak, Dong Thap, Kon Tum, Ninh Thuan, Thai Binh, Thua Thien Hue, and Tuyen Quang. These provinces were selected to ensure that the sample reflected a broad spectrum of local contexts, including different locality types such as urban, rural, and mountainous areas. The study received responses from a diverse group of teachers, covering various ages, work experiences, and educational backgrounds. A total of 12,232 responses were initially collected. After data cleaning and the exclusion of 421 incomplete or invalid responses, the final dataset comprised 11,811 valid responses.

Data Analysis

The collected data were analyzed using IBM SPSS Version 26. Descriptive statistics were used to summarize the demographic characteristics of the respondents and their overall perceptions of technology integration in mathematics education. Inferential statistics, including correlation analysis and regression models, were employed to explore the relationships between teachers' background variables and their perceptions of technology use, as well as to assess the effectiveness of technology integration as perceived by the teachers. The analysis provided insights into the key factors influencing teachers' acceptance and implementation of technology in their teaching practices.

DOI: 10.5281/zenodo.13764778

This methodology ensured that the study captured a comprehensive and representative understanding of primary school teachers' perspectives on technology integration in mathematics education in Vietnam, providing valuable data to inform educational policies and practices.

4. Research results

4.1. Teacher Demographics

A total of 11,811 primary school teachers from ten provinces in Vietnam participated in the survey. Regarding the location of the schools, 43.8% (5,173) of the teachers reported working in schools located in cities, while 56.2% (6,638) were in the countryside. In terms of gender, the sample was predominantly female, with 73.7% (8,709) of the respondents identifying as female and 26.3% (3,102) identifying as male. The age distribution of the respondents showed a significant concentration in the 45 to under 55 years old category, accounting for 43.2% (5,097) of the participants. The age groups were further distributed as follows: under 25 years old (292, 2.5%), 25 to under 35 years old (2,910, 24.6%), 35 to under 45 years old (2,802, 23.7%), and 55 years old and above (710, 6%). In terms of teaching experience, the majority of teachers had over 20 years of experience, comprising 53% (6,258) of the sample. Other experience categories included less than 5 years (1,499, 12.7%), 5 to under 10 years (1,303, 11%), 10 to under 15 years (1,522, 12.9%), and 15 to under 20 years (1,229, 10.4%). The educational qualifications of the participants revealed that the majority held a Bachelor's degree, accounting for 87.3% (10,310) of the sample. Teachers with an Associate degree comprised 9.8% (1,156), while those with a Diploma made up 2% (231). A small proportion of the teachers held a Master's degree or higher, accounting for just 1% (114). These demographic insights provide a contextual understanding of the teachers' perspectives on technology integration in primary school mathematics education across different regions of Vietnam.

Table 1. Teacher Demographic Information

	School located		**Gender**	
Total 11811	City	Countryside	Male	Female
	5173 (43.8%)	6638 (56.2%)	3102 (26.3%)	8709 (73.7%)

	Age					**Teaching experience**				
Total 11811	Under 25 years old	From 25 to under 35 years old	From 35 to under 45 years old	From 45 to under 55 years old	From 55 years old and above	Less than 5 years	From 5 to under 10 years	From 10 to under 15 years	From 15 to under 20 years	20 years or more
	292 (2.5%)	2910 (24.6%)	2802 (23.7%)	5097 (43.2%)	710 (6%)	1499 (12.7%)	1303 (11%)	1522 (12.9%)	1229 (10.4%)	6258 (53%)

4.2. Evaluation of Educational Technology in Primary Education

The survey results indicate a high valuation of educational technology in primary teaching and learning. The mean rating for the role of educational technology was 4.21 (SD = 0.689), signifying that most teachers perceive it as "Important" to "Strongly important." Specifically, 51.9% of respondents rated it as "Important," and 35.4% rated it as "Strongly important." Statistical analysis revealed a significant difference in perceptions based on gender. Male teachers (mean = 4.27, SD = 0.698) rated the importance of educational technology higher than female teachers (mean = 4.20, SD = 0.685). The independent samples t-test confirmed this difference ($t(11809) = 4.894$, $p < 0.001$), indicating that male teachers view the role of educational technology as more crucial compared to their female counterparts.

Table 2. Importance of Educational Technology in Primary Level Teaching and Learning

	Mean	**SD**	**Not important**	**Slightly important**	**Moderately important**	**Important**	**Strongly important**
Evaluate the role of educational technology in teaching and learning at the primary level	4.21	.689	27 (0.8%)	87 (0.7%)	1388 (11.8%)	6131 (51.9%)	4178 (35.4%)

Group Statistics

Sex		N	Mean	Std. Deviation	Std. Error Mean
How do you evaluate the role of educational technology in teaching and learning at the primary level?	Male	3102	4.27	.698	.013
	Female	8709	4.20	.685	.007

Independent Samples Test		
	Levene's Test for Equality of	t-test for Equality of Means

DOI: 10.5281/zenodo.13764778

		Variances								
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
How do you evaluate the role of educational technology in teaching and learning at the primary level?	Equal variances assumed	15.312	.000	4.894	11809	.000	.070	.014	.042	.099
	Equal variances not assumed			4.850	5367.581	.000	.070	.015	.042	.099

Necessity of Applying Educational Technology in Primary School Mathematics

Teachers rated the necessity of applying educational technology in teaching primary school mathematics with a mean of 4.21 (SD = 0.669). This indicates a strong consensus that educational technology is "Necessary" to "Strongly necessary" for teaching mathematics. Specifically, 54.8% of teachers rated it as "Necessary," and 33.8% rated it as "Strongly necessary. There was a significant difference in the necessity ratings between male and female teachers. Male teachers (mean = 4.26, SD = 0.671) viewed the application of educational technology in mathematics as more necessary compared to female teachers (mean = 4.19, SD = 0.667). The independent samples t-test ($t(11809) = 4.830$, $p < 0.001$) confirms this difference, indicating that male teachers perceive a greater need for educational technology in mathematics instructions. Regarding **regional differences,** urban teachers (mean = 4.31, SD = 0.671) rated the necessity of educational technology in teaching mathematics higher than their rural counterparts (mean = 4.13, SD = 0.656). The t-test results ($t(11809) = 14.840$, $p < 0.001$) highlight that urban teachers place a higher value on the use of educational technology in mathematics education compared to rural teachers.

Table 3. Perceived Necessity of Applying Educational Technology in Teaching Primary School Mathematics

	Mean	**SD**	**Not necessary**	**Slightly necessary**	**Moderately necessary**	**Necessary**	**Strongly necessary**
Evaluate the necessity of applying educational technology in teaching primary school mathematics	4.21	.669	25 (0.2%)	90 (0.8%)	1235 (10.5%)	6467 (54.8%)	3994 (33.8%)

Familiarity with Augmented Reality (AR) Applications/Software

The average familiarity with AR applications/software among teachers was 2.43 (SD = 1.205), indicating that most teachers have "Heard of but never used" AR technology. A significant gender difference was found in familiarity with AR technology. Male teachers (mean = 2.57, SD = 1.211) reported higher familiarity with AR applications compared to female teachers (mean = 2.38, SD = 1.199). The independent samples t-test ($t(11809) = 7.363$, $p < 0.001$) indicates that male teachers are more acquainted with AR technology than female teachers. Regarding **regional differences:** Urban teachers (mean = 2.71, SD = 1.298) were more familiar with AR applications compared to rural teachers (mean = 2.21, SD = 1.077). The t-test results ($t(11809) = 23.033$, $p < 0.001$) confirm that urban teachers have a higher level of familiarity with AR technology than their rural peers.

4.3. Application of Educational Technology in Mathematics Teaching

The analysis of the frequency of educational technology application in teaching mathematics reveals a generally positive trend among teachers. The mean score for the frequency of using educational technology is 3.83 (SD = 1.013), indicating that teachers frequently apply technology in their mathematics instruction. Specifically, 35.6% of teachers reported using technology frequently, and 30.1% always use it. In contrast, only 1.9% of teachers never use technology, and a small proportion (8.6%) use it rarely. An examination of gender differences in the application of educational technology shows that female teachers use technology more frequently than their male counterparts. The mean score for female teachers is 3.91 (SD = 0.994), compared to 3.62 (SD = 1.034) for male teachers. The independent samples t-test confirms this difference as statistically significant ($p < 0.05$), with female teachers applying technology more often than male teachers. This finding highlights a gender disparity in technology integration in mathematics teaching, with female teachers demonstrating a higher frequency of use.

Table 4. Statistics for Frequency of Applying Educational Technology in Teaching Mathematics by Sex

	Mean	**SD**	**Never**	**Rarely**	**Occasionally**	**Frequently**	**Always**
How frequently do you apply educational technology in teaching mathematics?	3.83	1.013	224 (1.9%)	1015 (8.6%)	2808 (23.8%)	4209 (35.6%)	3555 (30.1%)

Group Statistics

DOI: 10.5281/zenodo.13764778

Sex		N	Mean	Std. Deviation	Std. Error Mean
How frequently do you apply educational technology in teaching mathematics?	Male	3102	3.62	1.034	.019
	Female	8709	3.91	.994	.011

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
How frequently do you apply educational technology in teaching mathematics?	Equal variances assumed	52.749	.000	-13.808	11809	.000	-.290	.021	-.331	-.249
	Equal variances not assumed			-13.554	5276.809	.000	-.290	.021	-.332	-.248

Usage of Specific Technology Applications

In terms of specific technology applications used in teaching mathematics, teachers report varying frequencies of use:

- **Specialized software on computers** is used most frequently, with a mean score of 3.48 (SD = 0.928).
- **Online teaching support applications** and **specialized apps on smartphones/tablets** are used less frequently, with mean scores of 2.73 (SD = 1.041) and 2.52 (SD = 1.144), respectively.
- **Learning management systems** and **general software/applications/games** are also used occasionally, with mean scores of 2.91 (SD = 1.153) and 2.65 (SD = 1.096).
- **High-tech applications like AR** are rarely used, with a mean score of 1.54 (SD = 1.078).

Table 5. Frequency of Use of Various Technology Applications in Teaching Mathematics

	Mean	**SD**	**Never**	**Rarely**	**Occasionally**	**Frequently**	**Always**
Specialized software on computers	3.48	.928	415 (3.5%)	982 (8.3%)	4299 (36.4%)	4727 (40%)	1388 (11.8%)
Online teaching support applications	2.73	1.041	1821 (15.4%)	2508 (21.2%)	4870 (41.2%)	2206 (18.7%)	406 (3.4%)
Specialized apps on smartphones/tablets	2.52	1.144	3002 (25.4%)	2541 (21.5%)	3778 (32%)	2108 (17.8%)	382 (3.2%)
Learning management systems	2.91	1.153	1833 (15.5%)	2098 (17.8%)	3935 (33.3%)	3145 (26.6%)	800 (6.8%)
General software/applications/games	2.65	1.096	2284 (19.3%)	2625 (22.2%)	4318 (36.6%)	2145 (18.2%)	439 (3.7%)
Hightech applications like AR in math lessons	1.54	1.078	9125 (77.3%)	454 (3.8%)	1111 (9.4%)	814 (6.9%)	307 (2.6%)

Gender differences in the use of specific technology applications show that male teachers use specialized software on computers more frequently than female teachers (mean difference = -0.204, $p < 0.05$). However, female teachers use online teaching support applications and specialized apps on smartphones/tablets more frequently than their male counterparts (mean differences = 0.093 and 0.153, respectively, $p < 0.05$). Male teachers also use high-tech applications like AR more frequently than female teachers (mean difference = 0.133, $p < 0.05$). These results indicate nuanced differences in technology use based on gender, with female teachers more engaged with certain types of technology, while male teachers show higher engagement with others.

DOI: 10.5281/zenodo.13764778

Table 6. Use of Various Technology Applications in Teaching Mathematics by sex

Group Statistics

	Sex	N	Mean	Std. Deviation	Std. Error Mean
Specialized software on computers	Male	3102	3.33	.940	.017
	Female	8709	3.54	.918	.010
Online teaching support applications	Male	3102	2.80	1.030	.018
	Female	8709	2.71	1.044	.011
Specialized apps on smartphones/tablets	Male	3102	2.63	1.126	.020
	Female	8709	2.48	1.148	.012
Learning management systems	Male	3102	2.95	1.133	.020
	Female	8709	2.90	1.159	.012
General software/applications/games	Male	3102	2.69	1.091	.020
	Female	8709	2.63	1.098	.012
Hightech applications like AR in math lessons	Male	3102	1.64	1.145	.021
	Female	8709	1.50	1.051	.011

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Specialized software on computers	Equal variances assumed	.012	.912	-10.559	11809	.000	-.204	.019	-.242	-.166
	Equal variances not assumed			-10.447	5350.754	.000	-.204	.020	-.242	-.166
Online teaching support applications	Equal variances assumed	11.884	.001	4.254	11809	.000	.093	.022	.050	.135
	Equal variances not assumed			4.281	5521.260	.000	.093	.022	.050	.135
Specialized apps on smartphones/ tablets	Equal variances assumed	14.379	.000	6.424	11809	.000	.153	.024	.107	.200
	Equal variances not assumed			6.484	5551.712	.000	.153	.024	.107	.200
Learning management systems	Equal variances assumed	13.686	.000	2.316	11809	.021	.056	.024	.009	.103

DOI: 10.5281/zenodo.13764778

	Equal variances not assumed			2.341	5569.229	.019	.056	.024	.009	.103
General software/ applications/ games	Equal variances assumed	2.434	.119	2.618	11809	.009	.060	.023	.015	.105
	Equal variances not assumed			2.625	5484.952	.009	.060	.023	.015	.105
Hightech applications like AR in math lessons	Equal variances assumed	93.201	.000	5.891	11809	.000	.133	.023	.088	.177
	Equal variances not assumed			5.657	5079.412	.000	.133	.023	.087	.179

Overall, the results indicate that while technology is frequently used in mathematics teaching, there are notable differences based on gender. Female teachers tend to use technology more frequently than male teachers in certain applications.

D. Effectiveness of Educational Technology in Teaching Mathematics

The analysis of teachers' opinions on the effectiveness of educational technology in teaching primary school mathematics revealed several significant insights. Overall, teachers agreed that educational technology provides numerous benefits. The mean scores for various benefits were as follows: enhancing students' interest in mathematics (mean = 3.83), improving students' math performance (mean = 3.79), developing communication and cooperation skills (mean = 3.78), fostering autonomy and self-regulation (mean = 3.79), and promoting problem-solving and creativity (mean = 3.78). The results showed some notable gender differences in perceptions of educational technology. Female teachers generally rated the benefits of educational technology higher than their male counterparts across all dimensions. For instance, female teachers reported a higher mean score for enhancing students' interest in math (3.84 vs. 3.78), improving math performance (3.80 vs. 3.76), and developing communication, cooperation, autonomy, and problem-solving skills. Statistical tests indicated that these differences were significant ($p < 0.05$), suggesting that female teachers perceive more benefits from educational technology compared to male teachers.

Effectiveness of AR Technology in Teaching Mathematics

Regarding augmented reality (AR) technology, teachers rated its overall effectiveness in teaching primary school mathematics as moderately effective (mean = 3.76). The distribution of responses was predominantly in the "Effective" (44.8%) and "Moderately effective" (30.6%) categories. There were significant gender differences in the perception of AR technology's effectiveness. Male teachers rated AR technology more favorably (mean = 3.85) compared to female teachers (mean = 3.71), with the difference being statistically significant ($p < 0.05$). This suggests that male teachers view AR technology as more effective in teaching mathematics than their female counterparts. When comparing AR technology to other conventional technologies in teaching mathematics, teachers rated AR technology as equally effective (mean = 3.21). The responses were spread across the "Same effectiveness" (65.4%) and "More effective" (20%) categories, with no significant differences between genders or regions ($p > 0.05$).

Table 7. Perceived Benefits of Educational Technology in Teaching Mathematics for Primary School Students

	Mean	**SD**	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
Enhances students' interest in math	3.83	.775	98 (0.8%)	617 (5.2%)	2310 (19.6%)	7002 (59.3%)	1784 (15.1%)
Improves students' math performance	3.79	.779	109 (0.9%)	668 (5.7%)	2450 (20.7%)	6981 (59.1%)	1603 (13.6%)
Develops communication and cooperation skills	3.78	.782	113 (1%)	673 (5.7%)	2474 (20.9%)	6959 (58.9%)	1592 (13.5%)
Develops autonomy and self-regulation skills	3.79	.779	113 (1%)	665 (5.6%)	2435 (20.6%)	7013 (59.4%)	1585 (13.4%)
Develops problem-solving and creativity skills	3.78	.778	113 (1%)	664 (5.6%)	2478 (21%)	6989 (59.2%)	1567 (13.3%)

DOI: 10.5281/zenodo.13764778

5. Discussion

5.1. Evaluation of Educational Technology in Primary Education

The survey results demonstrate a strong consensus among primary school teachers regarding the importance of educational technology in teaching and learning, with an overall mean rating of 4.21. The majority of respondents view educational technology as either "Important" or "Strongly important." This widespread acknowledgment of its importance underscores the growing recognition of technology's role in enhancing the teaching and learning experience at the primary level. Given that educational technology can facilitate differentiated instruction, enhance student engagement, and provide access to a broader range of resources, its high valuation by teachers is consistent with the global trends in education (Bebell & O'Dwyer, 2010). The data also reveal a statistically significant gender difference in how teachers evaluate the importance of educational technology. Male teachers rated its importance higher than female teachers (mean difference = 0.07, $p < 0.001$). This difference may reflect varying levels of comfort or experience with technology between genders, with male teachers possibly having more exposure or confidence in using technological tools in the classroom. This finding suggests the need for targeted professional development that addresses these gender disparities, ensuring that all teachers feel equally empowered to integrate technology into their teaching practices.

The necessity of applying educational technology in teaching primary school mathematics was also rated highly, with a mean rating of 4.21, indicating a strong consensus among teachers that it is "Necessary" to "Strongly necessary." The emphasis on mathematics is particularly noteworthy given the subject's foundational importance and the potential for technology to aid in the teaching of complex mathematical concepts through interactive and visual tools (Li & Ma, 2010). Again, significant gender differences emerged, with male teachers rating the necessity of educational technology in mathematics higher than female teachers (mean difference = 0.07, $p < 0.001$). Additionally, a significant regional difference was found, with urban teachers assigning a higher necessity rating than rural teachers (mean difference = 0.18, $p < 0.001$). These disparities could be attributed to differences in access to technological resources, with urban schools typically having more advanced infrastructure and greater exposure to innovative teaching tools compared to rural schools (Wang, 2008). The regional gap highlights the need for equitable resource distribution and training opportunities to ensure that rural teachers can equally benefit from educational technologies.

Familiarity with AR technology among teachers was relatively low, with an average rating of 2.43, indicating that most teachers have "Heard of but never used" AR applications. This result points to a significant gap between the recognized importance of educational technology and the actual usage or familiarity with more advanced tools like AR. Given AR's potential to create immersive learning experiences and enhance student engagement, increasing teachers' familiarity with and access to AR technology could be a valuable focus for future professional development initiatives (Billinghurst & Duenser, 2012). The data also reveal significant differences in AR familiarity based on both gender and region. Male teachers reported higher familiarity with AR technology than female teachers (mean difference = 0.19, $p < 0.001$), and urban teachers were more familiar with AR than their rural counterparts (mean difference = 0.50, $p < 0.001$). These findings further emphasize the need for targeted training and support, particularly for female teachers and those in rural areas, to bridge the gap in technology usage and familiarity.

5.2. Application of Educational Technology in Mathematics Teaching

The integration of educational technology in mathematics teaching has become increasingly prominent, as evidenced by the frequent application reported by teachers in this study. However, this general trend masks significant gender differences in how various technologies are utilized, revealing complex patterns of technology adoption in primary education.

Frequency of Educational Technology Application, The results indicate that the overall frequency of using educational technology in mathematics instruction is high, with a mean score of 3.83. A substantial proportion of teachers (65.7%) reported that they use technology frequently or always in their teaching. This high level of technology integration aligns with the broader push towards digitization in education, which has been shown to enhance student engagement and support differentiated learning (Li & Ma, 2010). However, it is concerning that a small but significant portion of teachers (10.5%) still use technology rarely or never. This gap suggests the presence of barriers, whether they be access-related, technical, or attitudinal, that need to be addressed to ensure more consistent technology use across the board.

Gender Differences in Technology Application, A noteworthy finding is the significant gender disparity in the frequency of technology application. Female teachers reported a higher mean score (3.91) compared to their male counterparts (3.62), with the difference being statistically significant ($p < 0.05$). This contradicts some traditional expectations that male teachers might be more frequent users of technology due to stereotypical associations with technical proficiency (Cooper, 2016). Instead, these findings suggest that female teachers are more proactive or perhaps more adept at integrating technology into their daily teaching practices. This could be due to various factors, including differences in teaching styles, professional development experiences, or even institutional support that encourages technology use among female educators. Further research could explore the underlying reasons for this gender difference and investigate how male teachers might be further supported to increase their use of educational technology.

Usage of Specific Technology Applications, The study also highlights variations in the usage of specific technology applications in mathematics teaching. Specialized software on computers was the most frequently used, with a mean score of 3.48, indicating regular use by a significant number of teachers. This is unsurprising given that specialized educational software is often designed specifically to support curriculum goals and enhance student understanding of mathematical concepts (Baker et al., 2015). However, other technologies, such as online teaching support applications and specialized apps on smartphones/tablets, were used less frequently, with mean scores of 2.73 and 2.52, respectively. This suggests that while traditional computer-based tools are well-integrated, there is less adoption of more mobile or flexible technologies that could support learning in diverse environments.

Interestingly, high-tech applications like Augmented Reality (AR) are rarely used, with a mean score of just 1.54. This

DOI: 10.5281/zenodo.13764778

underutilization of AR technology, despite its potential to create immersive learning experiences, points to a significant gap in both familiarity and implementation. The low usage could be attributed to a lack of training, resources, or confidence in using such advanced tools. Given the positive impact that AR can have on student engagement and understanding, efforts should be made to increase teachers' exposure to and comfort with AR applications (Billinghurst & Duenser, 2012).

5.3. Gender Differences in Specific Technology Applications,

The data also reveal nuanced gender differences in the use of specific technology applications. Male teachers were found to use specialized software on computers more frequently than female teachers, which may reflect traditional gender norms that associate men with more technical or computer-based tasks. On the other hand, female teachers reported higher usage of online teaching support applications and specialized apps on smartphones/tablets. This suggests that female teachers might be more open to or comfortable with using a broader range of digital tools, possibly because these tools are often designed to be user-friendly and accessible (Cooper, 2016). Conversely, male teachers reported higher use of high-tech applications like AR. This could indicate that male teachers, while less frequent users of technology overall, are more likely to experiment with or adopt cutting-edge technologies when they do engage with digital tools. These findings highlight the importance of providing diverse professional development opportunities that cater to different interests and proficiencies among teachers, ensuring that all educators can effectively incorporate a wide range of technologies into their teaching.

5.4. Effectiveness of Educational Technology in Teaching Mathematics

Perceived Benefits of Educational Technology: The results indicate that teachers recognize multiple benefits of educational technology in enhancing various aspects of students' learning experiences. High mean scores were reported across several dimensions, including enhancing students' interest in mathematics (mean = 3.83), improving math performance (mean = 3.79), and fostering skills like communication, cooperation, autonomy, self-regulation, problem-solving, and creativity (mean scores around 3.78 to 3.79). These findings align with previous literature that highlights the potential of educational technology to engage students more deeply in learning, improve their academic outcomes, and develop essential 21st-century skills (Cheung & Slavin, 2013). The high agreement on these benefits underscores the growing acceptance of educational technology as a valuable tool in primary education. However, the distribution of responses suggests some variability in how strongly these benefits are perceived. For example, a small percentage of teachers remained neutral or even disagreed with the benefits, indicating that there may still be reservations or challenges in effectively integrating technology into teaching practices.

Gender Differences in Perceptions of Educational Technology: A significant finding from the study is the gender differences in teachers' perceptions of the benefits of educational technology. Female teachers consistently rated the benefits higher than their male counterparts across all dimensions, with statistically significant differences ($p < 0.05$). This suggests that female teachers may perceive educational technology as more impactful in enhancing students' learning experiences, possibly due to differences in teaching styles, attitudes toward technology, or experiences in the classroom. These findings raise important questions about the underlying factors contributing to these gender differences. It could be that female teachers are more likely to see the relational and interactive potential of educational technology, such as its ability to foster communication and cooperation among students. Alternatively, male teachers might be more critical or selective in their evaluation of technology's benefits, potentially due to different expectations or experiences with technology in education. Understanding these gendered perceptions can inform targeted professional development and support, ensuring that all teachers can effectively harness the potential of educational technology in their classrooms.

Effectiveness of AR Technology in Mathematics Teaching: The study also examined teachers' perceptions of AR technology's effectiveness in teaching mathematics. The overall rating of AR technology was moderately high, with a mean score of 3.76, and a majority of teachers categorized it as "Effective" or "Moderately effective." These results suggest that while AR technology is viewed positively, there is still some hesitation or uncertainty about its full potential in the classroom. Notably, male teachers rated the effectiveness of AR technology higher than female teachers (mean = 3.85 vs. 3.71), with the difference being statistically significant ($p < 0.05$). This contrasts with the general trend observed in perceptions of educational technology, where female teachers rated other forms of technology more favorably. This difference might reflect varying levels of familiarity or comfort with AR technology, with male teachers potentially being more inclined to experiment with or adopt new, cutting-edge tools in their teaching practices (Cheung & Slavin, 2013). The finding that AR technology is perceived as equally effective as conventional technologies (mean = 3.21) further suggests that while AR holds promise, it is not yet viewed as a game-changer in mathematics education. The majority of teachers rated AR technology as having the "Same effectiveness" as other technologies, indicating that it is seen as a complementary tool rather than a superior alternative. This could be due to a lack of widespread implementation, limited access to AR resources, or insufficient training on how to effectively integrate AR into the curriculum. Future research and professional development efforts should focus on addressing these barriers and exploring the unique advantages that AR technology can offer in enhancing mathematical understanding.

6. Conclusion and recommendation

This study examines the acceptance and integration of technology in primary school mathematics education in Vietnam, guided by the Technology Acceptance Model (TAM). The research involved a comprehensive survey of 11,811 primary school teachers from ten provinces, focusing on teacher backgrounds, views on technology's role, practical classroom implementation, and self-assessment of technology effectiveness. The findings provide valuable insights into teachers' perceptions of advanced technologies like Augmented Reality (AR), highlighting the tools and methods used in instruction.

Implications for Policy and Practice

The study's findings suggest several important considerations for policymakers and educational leaders:

1. **Inclusive Professional Development**: While perceptions of educational technology are generally positive, there are notable gender and regional disparities. This indicates

DOI: 10.5281/zenodo.13764778

a need for more inclusive and targeted professional development programs. These programs should aim to improve technology fluency among all teachers, with particular focus on those less familiar with advanced tools like AR.

2. **Equitable Resource Allocation**: The higher valuation of educational technology by urban teachers compared to their rural counterparts highlights the need for more equitable distribution of technological resources. Ensuring that rural schools have access to the same resources as urban schools is crucial for closing the educational gap and providing equal opportunities for technology-enhanced learning.

3. **AR Technology Integration**: As AR technology gains prominence, introducing teachers to its applications and benefits could significantly enhance teaching and learning experiences. Future research should explore barriers to AR adoption and develop strategies to overcome these challenges, ensuring effective integration into primary education.

Implications for Practice and Future Research

The findings have several implications for educational practice and future research:

1. **Support for Less Frequent Users**: Despite high overall integration of technology in mathematics teaching, a small percentage of teachers do not use technology frequently. Professional development programs should address the specific barriers faced by these teachers, such as access, skills, or attitudes.

2. **Gender-Specific Professional Development**: The observed gender differences in technology use suggest the need for nuanced professional development approaches. Tailored support and resources should be provided to meet the specific needs and preferences of male and female teachers. Further research could investigate the reasons behind these gender differences and how various factors contribute to the observed patterns.

3. **Exploring AR Technology**: The low usage of advanced technologies like AR presents an opportunity for growth. Schools and educational leaders should consider integrating these tools into the curriculum through pilot programs or targeted training sessions. Future studies should investigate the conditions under which AR technology is most effective, barriers to its adoption, and its long-term impact on student learning outcomes.

This study underscores the need to align technology development with teachers' practical needs and capabilities, emphasizing the importance of targeted professional development and policy support. The insights offer practical guidance for policymakers, educational administrators, and technology developers aiming to enhance the quality of mathematics education through effective technology integration.

Acknowledgements

We extend our gratitude to all the educational managers and teachers, who generously gave their time and insights to participate in this research.

This article is supported by the Project " Research on Evaluating the Effectiveness of Augmented Reality (AR) Technology in Teaching Mathematics at the Primary School Level", Code: B2023.VKG.25 funded by the Vietnam Ministry of Education and Training.

References

1. Cheung, A. C., & Slavin, R. E. (2013). The effectiveness of educational technology applications for enhancing mathematics achievement in K-12 classrooms: A meta-analysis. *Educational research review*, *9*, 88-113.
2. Akçayır, M., & Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review of the literature. *Educational Research Review*, *20*, 1-11.
3. Bacca, J., Baldiris, S., Fabregat, R., Graf, S., & Kinshuk. (2014). Augmented reality trends in education: A systematic review of research and applications. *Educational Technology & Society*, *17*(4), 133-149.
4. Cai, S., Chiang, F. K., & Wang, T. (2013). Using the augmented reality 3D technique for a convex imaging experiment in a physics course. *International Journal of Engineering Education*, *29*(4), 856-865.
5. Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). Effective teacher professional development. *Learning Policy Institute*.
6. Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, *13*(3), 319-340.
7. Desimone, L. M., & Garet, M. S. (2015). Best practices in teachers' professional development in the United States. *Psychology, Society, & Education*, *7*(3), 252-263.
8. Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research and Development*, *53*(4), 25-39.
9. Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education*, *42*(3), 255-284.
10. Fisser, P., Voogt, J., & Knezek, G. (2013). Educational policies on ICT in education. In J. Voogt & G. Knezek (Eds
11. Means, B., Bakia, M., & Murphy, R. (2014). *Learning online: What research tells us about whether, when and how*. Routledge.
12. Baker, T. R., Battersby, S., Bednarz, S. W., Bodzin, A. M., Kolvoord, B., Moore, S., ... & Uttal, D. (2015). A research agenda for geospatial technologies and learning. *Journal of Geography*, *114*(3), 118-130.
13. Cooper, B. (2016). Empathy, emotion, technology, and learning. In *Emotions, technology, and learning* (pp. 265-288). Academic Press.
14. Billinghurst, M., & Duenser, A. (2012). Augmented reality in the classroom. *Computer*, *45*(7), 56-63.
15. Wang, Q. (2008). A generic model for guiding the integration of ICT into teaching and

DOI: 10.5281/zenodo.13764778

learning. *Innovations in education and teaching international*, *45*(4), 411-419.

16. Li, Q., & Ma, X. (2010). A meta-analysis of the effects of computer technology on school students' mathematics learning. *Educational Psychology Review*, *22*, 215-243.
17. Bebell, D., & O'Dwyer, L. (2010). Educational outcomes and research from 1: 1 computing settings. *The journal of technology, learning and assessment*, *9*(1).
18. Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of research on Technology in Education*, *42*(3), 255-284.
19. Scherer, R., Siddiq, F., & Tondeur, J. (2019). The technology acceptance model (TAM): A meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology in education. *Computers & education*, *128*, 13-35.
20. Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management science*, *46*(2), 186-204.
21. Teo, T. (2011). Factors influencing teachers' intention to use technology: Model development and test. *Computers & Education*, *57*(4), 2432-2440.
22. Peeraer, J., & Van Petegem, P. (2015). Integration or transformation? Looking in the future of Information and Communication Technology in education in Vietnam. *Evaluation and program planning*, *48*, 47-56.
23. Christensen, R. (2002). Effects of technology integration education on the attitudes of teachers and students. *Journal of Research on technology in Education*, *34*(4), 411-433.

DOI: 10.5281/zenodo.13764778