International Journal of Education and Practice
2025 Vol. 13, No. 3, pp. 987-1006
ISSN(e): 2310-3868
ISSN(p): 2311-6897
DOI: 10.18488/61.v13i3.4351

Factors affecting primary school pre-service teachers' use of technology during teaching practice

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Article History
Received: 28 October 2024
Revised: 25 June 2025
Accepted: 10 July 2025
Published: 12 August 2025

Keywords
Pre-service teachers
Primary education
Teacher training
Teaching practicum
Technology in education
TPACK
UTAUT.

ABSTRACT

This study investigated the factors influencing the use of technology among primary school pre-service teachers in Vietnam during their teaching practice. The study highlighted the important role of technology integration in education, especially in teacher training and examined how different factors influence pre-service teachers' ability to effectively implement technology in the classroom. This study identified and validated key factors based on the TPACK and UTAUT frameworks using Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). A total of 44 independent variables measured on a 5-point Likert scale were analyzed to assess reliability using Cronbach's alpha coefficient. Data were collected from 658 third- and fourth-year teacher education students with 470 valid responses included in the analysis. Findings revealed five key factors influencing technology use during internships: educational policy, pedagogical content knowledge, facilitating conditions, performance expectancy and technological content knowledge. These factors were validated through CFA demonstrating their importance in shaping effective technology integration. This study highlights the need for teacher education programs to prioritize these factors to better prepare incoming teachers for technology-enhanced instruction. The study provides actionable recommendations for institutions and policymakers to enhance training programs and align resources to promote effective technology-supported instructional practices.

Contribution/Originality: This study is original in its combination of the TPACK and UTAUT frameworks to identify factors influencing technology use among pre-service primary teachers in Vietnam. It offers new insights into teacher education and practical tools for future research by integrating these models and validating context-specific scales.

1. INTRODUCTION

The growing reliance on technology and the Internet in education has amplified the need to integrate these tools into teaching (Butzin, 2001; Kong et al., 2014). Innovations from the Fourth Industrial Revolution such as artificial intelligence, robotics, the Internet of Things, virtual reality, augmented reality, and 3D printing are transforming every aspect of social life. As a result, technology integration has emerged as a central driver of global educational reform (Peeraer & Petergem, 2011). Technology not only supports innovative teaching methods but also provides a variety of tools to enhance the learning experience (Almekhlafi & Almeqdadi, 2010). In Vietnam, the digital transformation in education highlights the need to equip teachers and future teachers with the knowledge

and skills necessary to effectively implement technology in schools (Ministry of Education and Training (MOET), 2022). Circular No. 20/2018/TT-BGDDT issued by the MOET regulates the professional standards for general education teachers which emphasizes the application of information technology and the use of technological devices in teaching (Ministry of Education and Training (MOET), 2018b). Therefore, the integration of information and communication technology (ICT) into teacher training programs is essential to prepare teachers to address the challenges of the Fourth Industrial Revolution (Cabero-Almenara, Barroso-Osuna, Rodríguez, & Llorente-Cejudo, 2020).

Training in this area has become an important element of many teacher education programs to equip future teachers with the necessary skills to effectively use technology in teaching (Gulbahar, 2008). Several studies have examined how these programs prepare pre-service teachers to incorporate technology into their classrooms (Liu, 2012; Murley, Jukes, & Stobaugh, 2013). Research has recognized a variety of factors that influence pre-service teachers' use of technology during their internships. For instance, Venkatesh, Thong, and Xu (2012) applied the UTAUT model to explore social influences on technology use while Batane and Ngwako (2017) investigated pre-service teachers' technology adoption using a framework developed by Venkatesh, Morris, Davis, and Davis (2003). Their findings show that technology use is influenced by beliefs about the efficacy of technology, social expectations, and the availability of supporting technical infrastructure. Mishra and Koehler's (2006) study of the TPACK framework highlights the importance of understanding how technology can enhance pedagogical practices in specific subjects. Evidence suggests that teachers who are proficient in technology are more likely to incorporate technology into their teaching practices (Umugiraneza, Bansilal, & North, 2018). Numerous pre-service teachers report feeling inadequately prepared for using technology prior to their internships. This lack of preparation often stems from inadequate technology infrastructure at educational institutions, unclear plans for technology integration, and inadequate administrative support (Valtonen, Kukkonen, Kontkanen, Mäkitalo-Siegl, & Sointu, 2018). Therefore, researchers continue to investigate the factors that influence pre-service teachers' use of technology during their internships.

1.1. Research Questions

The purpose of this study is to investigate the factors influencing primary school pre-service teachers' use of technology during their teaching practice. To achieve this, the study will integrate two theoretical frameworks, TPACK and UTAUT to provide a comprehensive understanding of the factors involved.

The specific research questions are as follows:

RQ1. What factors influence primary school pre-service teachers' use of technology during their teaching practicum and what are the specific observed variables of each factor?

RQ2. How does each factor impact primary school pre-service teachers' use of technology in their teaching practicum?

1.2. Research Significance

Considering these factors is essential to improve the quality of teacher education programs. This study focuses on third- and final-year primary school pre-service teachers as they have undergone both university training and teaching internships equipping them with the knowledge and skills to use technology for teaching and learning. Addressing these factors will allow educational institutions, policymakers and training programs to better prepare primary school pre-service teachers with the technological competencies needed to improve the quality of instruction and primary education outcomes. Additionally, the validated scales developed through this study will serve as a valuable resource for future studies investigating the role of technology in teacher education.

2. LITERATURE REVIEW

2.1. Primary School Pre-Service Teachers' Teaching Practice

Teaching practice is an important stage in the development of pedagogical competence for primary education students. It is an important step in assessing the professional knowledge and teaching skills of pre-professional teachers and at the same time provides an environment for them to apply theoretical knowledge into practice. During this stage, pedagogical students demonstrate their competence, exchange ideas, gain experience, and prepare for a successful teaching career (Darling-Hammond, 2010; Mathew, Mathew, & Peechattu, 2017). Internships bridge the gap between teacher training institutions and the schools where graduates will eventually work especially teaching internships. Pre-service teachers enhance their lesson planning, classroom management, and assessment skills - essential components for their future success as teachers through hands-on experience (Ronfeldt & Reininger, 2012). Zeichner (2010) emphasizes that practical teaching experience is foundational for becoming a qualified teacher. Classroom practice during the practicum reflects teachers' pedagogical content knowledge and serves as a reflective tool for critically analyzing their experiences, particularly when adopting new teaching practices (Goodnough & Hung, 2009). Reflection on these experiences often leads to significant changes in pedagogical practice (Gaciu, Dalzell, Davis, Diamond, & Howard, 2017). The practicum also provides opportunities to practice using technology in teaching, informed by the educational realities of primary schools and the needs of students for primary school pre-service teachers. This experience allows teacher training institutions to assess the effectiveness of their technology integration training and make timely curriculum adjustments. According to Chapter 1, Article 3 of the Minister of Education and Training Decision No. 36/2003/QD-BGDDT (Ministry of Education and Training (MOET), 2003) the purpose of the teaching practicum is to give pre-service teachers early exposure to educational realities and frequent practice in pedagogical skills laying the foundation for their development as competent future teachers.

2.2. Primary School Pre-Service Teachers' Application of Technology in Teaching Practice

The use of technology in education has been a significant and evolving trend since the 1970s (Pollard & Pollard, 2004). Technology plays a central role (Batane & Ngwako, 2017) making it essential for teacher education programs to prepare pre-service teachers with the skills needed for effective technology integration in today's rapidly advancing educational landscape (Chai, Koh, & Tsai, 2016; Figg & Jaipal, 2012; National Council for the Accreditation of Teacher Education (NCATE), 2001). Research has highlighted the importance of equipping student-teachers to use technology effectively in future classrooms (Gulbahar, 2008; Lawless & Pellegrino, 2007; Pelgrum & Anderson, 1999). Norris, Sullivan, Poirot, and Soloway (2003) argued that effective integration of technology into education requires comprehensive training for students and teachers. Admiraal et al. (2017) found that students and teachers viewed teaching internships as an important opportunity to develop their technological knowledge and skills. Gill and Dalgarno (2008) further emphasized the importance of teacher modeling the use of technology identifying it as a key factor in preparing pre-service teachers to successfully integrate technology. Baran, Canbazoglu Bilici, Albayrak Sari, and Tondeur (2019) reinforced this view identifying modeling as the most commonly used strategy in teacher education programs to develop Technological Pedagogical Content Knowledge (TPACK).

Teachers in Vietnam are actively trying to incorporate technology into their lessons to improve education as part of continuous educational improvements (Peeraer & Van Petegem, 2012). The government emphasizes the importance of promoting ICT in education, improving the use of technology in education management, and supporting teaching and research activities to improve the overall quality of education and training (Peeraer & Van Petegem, 2012). The Ministry of Education and Training (MOET) underscores this with initiatives like Directive 55, promoting the slogan "Friendly School, Active Students" (Ministry of Education and Training (MOET), 2008) and Circular No. 20/2018/TT-BGDĐT which mandates the use of ICT in teaching as a core aspect of pedagogical

competence (Ministry of Education and Training (MOET), 2018b). The Vietnamese government has made significant investments in this area leading to substantial improvements in the country's global ranking in information technology development, positioning Vietnam among the top 10 developing countries in this field recognizing the transformative potential of technology (Peeraer & Petergem, 2011). Decision No. 117/QD-TTg promotes these initiatives by outlining ways to improve the use of technology in education, deal with obstacles, and encourage creativity in teaching approaches, evaluation, research, and management (Prime Minister's Office, 2017). This comprehensive approach aims to modernize Vietnam's education system and align it with global trends.

2.3. TPACK and UTAUT as Theoretical Frameworks

The study is grounded in two key theoretical frameworks: Technological Pedagogical and Content Knowledge (TPACK) by Mishra and Koehler (2006) and the Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh et al. (2012). Shulman (1986) introduced the concept of Pedagogical Content Knowledge (PCK). Mishra and Koehler (2006) expanded the model by adding Technological Knowledge (TK) resulting in the TPACK framework. This model highlights that effective teaching with the support of technology requires the integration of TK, PK (Pedagogical Knowledge) and CK (Content Knowledge). Notably, TPACK also considers emerging forms of knowledge at their intersections – PCK, Technological Content Knowledge (TCK), and Technological Pedagogical Knowledge (TPK) (Mishra, Koehler, & Henriksen, 2010). The TPACK framework serves as an important tool for assessing and developing teachers' technology integration competencies which directly impact their success in using technology. In contrast, the UTAUT emphasizes the social factors that influence teachers' technology adoption. The framework has been widely applied in various contexts, including virtual and augmented reality (Marto, Gonçalves, Martins, & Bessa, 2019) education (Abbad, 2021) and social media (Williams, Rana, & Dwivedi, 2015). UTAUT analyzes four main factors influencing technology use including performance expectancy, effort expectancy, social influence and facilitating conditions, providing a comprehensive understanding of motivations and barriers to technology adoption in teaching.

The integration of the TPACK and UTAUT frameworks in this study provides a comprehensive view of the factors influencing primary school student-teachers in their teaching practices. TPACK recognizes essential knowledge domains and the relationships between them while UTAUT provides insights into the social and contextual factors influencing technology acceptance. These frameworks facilitate the exploration of how primary school students and teachers in Vietnam integrate technology into their teaching practices. The study constructed a 7-factor and 44-item survey based on the above theoretical foundations and existing studies to examine the factors influencing technology use among primary school pre-service teachers in Vietnam. The study's aim is to provide a comprehensive analysis that can inform teacher education programs and improve the effective integration of technology into instruction by understanding these factors.

Pedagogical Content Knowledge (PCK) refers to the teaching methods and instructional strategies that primary school students and teachers use with their ability to design engaging lesson plans. In this study, PCK consisted of six questions that addressed the methods used in primary school student-teachers' teaching practice. It was hypothesized that it positively influenced the use of technology during practicum.

Technological Content Knowledge (TCK) refers to the basic understanding of technology including the Internet and digital tools as well as the skills needed to use them effectively. It also reflects the interaction between content and technology. Teachers may be reluctant to use technology if they lack the necessary knowledge and skills (Chigona & Chigona, 2010). In this study, TCK consisted of 6 questions that addressed the knowledge that primary school students and teachers applied during their internship. It was hypothesized that it positively influenced their use of technology during their teaching practicum.

Technological Pedagogical Knowledge (TPK) refers to the understanding of how technology can be effectively integrated into teaching and learning and how instructional practices develop with this integration (Schrum, 1999).

In this study, TPK with 7 questions refers to the knowledge that primary school pre-service teachers possess about the application of technology during their internship including the advantages and disadvantages of different technologies. It is hypothesized that it positively impacts their use of technology during their teaching practicum.

Performance Expectancy (PE) refers to the belief that using technology will help primary school pre-service teachers achieve their teaching goals (Venkatesh et al., 2003). In this study, PE consists of 5 questions that address the belief that technology will enhance their teaching performance. It is hypothesized that it positively influences the use of technology during their teaching practicum.

Effort Expectancy (EE) refers to the perceived ease of using technology (Venkatesh et al., 2003) and has been validated in a variety of contexts including blended learning (Azizi, Roozbahani, & Khatony, 2020). In this study, EE consists of 5 questions that address how primary school pre-service teachers perceive the ease of using technology during the internship. It is hypothesized that it positively influences the use of technology during their teaching practicum.

Facilitating Conditions (FC) refers to the availability and adequacy of technological and organizational resources that support the use of technology (Venkatesh et al., 2003; Venkatesh et al., 2012). This includes the quality and availability of technology as well as technical support and guidance (Dexter & Riedel, 2003). Six questions measure FC which is hypothesized to have a positive impact on technology use during practicum.

Educational Policy in University (EP) refers to the supportive and organizational environment for the use of technology (Venkatesh et al., 2003). Workshops and seminars have a positive impact on pre-service teachers' practice preparing them to use technology during practicum (DiBella, Williams, & Glover, 2015). Additionally, technology training helps build capacity (Batane & Ngwako, 2017). Nine questions measured EP with the hypothesis that it positively influences technology use during the practicum.

3. METHODOLOGY

3.1. Design

The study used a questionnaire to survey factors affecting the use of technology in the teaching practice of primary school pre-service teachers based on the theoretical frameworks TPACK and UTAUT.

This study developed a 47-item survey questionnaire with two sections. The first section collected demographic data (gender, university and year of study). The second section had 44 Likert-scale questions across seven groups exploring factors influencing technology use in primary teacher practicum including pedagogical content knowledge, technological content knowledge, technological pedagogical knowledge, performance expectancy, effort expectancy, facilitating conditions and educational policy in university. The 5-point Likert scale ranged from " strongly agree" to " strongly disagree". No personal information was collected, so ethical approval was not required.

3.2. Participants

The study used a non-probability sampling technique, selecting respondents based on accessibility and specific criteria (Etikan, Musa, & Alkassim, 2016). The researchers developed a Google Forms questionnaire and distributed the link through Zalo or Facebook to primary school pre-service teachers in their third and fourth years at Hanoi Metropolitan University, University of Education - Vietnam National University, and Thai Nguyen University of Education. These participants were in the final stages of their primary teacher training program and had completed teaching practice in primary schools, gaining specialized coursework, teaching methodologies and information technology knowledge.

3.3. Analyzing of Data

This study employed Exploratory Factor Analysis (EFA) to identify the underlying factors influencing technology use during the teaching practicum of primary school pre-service teachers. EFA is a statistical method of grouping discrete observed variables into larger representative factors detecting main effects (Costello & Osborne, 2019; Fabrigar, Wegener, MacCallum, & Strahan, 1999). In this study, the analysis arranged these factors into seven groups from 44 independent variables rated on a 5-point Likert scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree. EFA facilitates the grouping and testing of these factors to identify key representative variables and assess their impact on the expected outcome. It also examines the relationships between variables in different groups highlighting any variables that load on multiple factors or are different from initial expectations. Confirmatory factor analysis (CFA) is often followed by EFA (Hair, Anderson, Tatham, & Black, 2014) with the aim of building appropriate measurement models to test the structural model.

In this study, data were collected from 658 participants. After excluding statistically insignificant responses, 470 samples were included in the final analysis using the Statistical Package for the Social Science (SPSS). Reliability was assessed through percentages, frequencies, and Cronbach's alpha coefficient with a value above 0.60 considered moderately reliable. EFA was used to select factors with significant eigenvalues as independent variables for multivariate regression analysis aiming to determine the relationship between key factors and the effectiveness of technology use by primary school pre-service teachers during their practicum. The multivariate regression model used was as follows:

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \ldots + \beta nXn$$

Where :

Y represents the dependent variable (effectiveness of technology use).

β denotes the standardized regression coefficients.

X represents the key factors identified and retained for analysis.

Table 1. Characteristics of the research sample (N=470).

Research sample and characteristics		Quantity	Percentage (%)
Gender	Female	470	100
	Male	0	0
University	Hanoi Metropolitan university	443	94.26
	Thai Nguyen University of Education	11	2.34
	University of Education and Vietnam National University	16	3.40
Year	Third year	307	65.32
	Fourth year	163	34.68

Table 1 presents the survey results showing that all 470 respondents are female with no male respondents. Among them, 65.32% are third-year students and 34.68% are final-year students. Most of the respondents (94.26%) come from Hanoi Metropolitan University while 2.34% come from Thai Nguyen University of Education and 3.40% come from University of Education - Vietnam National University. The high representation from Hanoi Metropolitan University may reflect the affiliation of the researchers which facilitated access to the survey.

4. DATA COLLECTION AND FINDINGS

4.1. The Results of Testing the Reliability of the Scale and the Correlation Indicators

Table 2 presents the Cronbach's alpha coefficients obtained from the survey on factors influencing the use of technology during the teaching practicum of primary school pre-service teachers.

Table 2. Cronbach's alpha values obtained in the pilot study.

No.	Variables	Cronbach's alpha values
1	Pedagogical content knowledge	0.901
2	Technological content knowledge	0.887
3	Technological pedagogical knowledge	0.887
4	Performance expectancy	0.885
5	Effort expectancy	0.842
6	Facilitating conditions	0.881
7	Educational policy in university	0.932

The quantitative analysis using SPSS confirmed high reliability with Cronbach's alpha coefficients above 0.8 and corrected item total correlation values exceeding 0.3 for all factors. Reliability standards indicate that scales with Cronbach's alpha values of 0.7 or higher are acceptable (Hair, Black, Babin, & Anderson, 2009; Nunnally, 1978). This analysis confirmed that the measurement scales used in the study met the reliability requirements ensuring consistency in measuring the research factors. The identified factors are essential for enhancing the effectiveness of technology use during the teaching practicum of primary school pre-service teachers.

4.2. The Results of Exploratory Factor Analysis (EFA)

The initial EFA was conducted on 44 observed variables using Varimax rotation. Of the 470 observations, only variables with factor loadings greater than 0.3 were retained. The Kaiser-Meyer-Olkin (KMO) coefficient was used to assess the suitability of the data for factor analysis with values between 0.5 and 1 indicating adequacy. The KMO measure of sampling adequacy was 0.956 significantly exceeding the minimum thresholds recommended by Kaiser (1974) at 0.7 and by Kim and Mueller (1978) at 0.6 confirming that the data were suitable for factor analysis.

Table 3. KMO and Bartlett's test.

Kaiser-Meyer-Olkin measure of sampling adequacy		**0.969**
Bartlett's test of sphericity	Approx. chi-square	13483.189
	Df	946
	Sig.	0.000

Table 3 presents Bartlett's test of sphericity which yielded a significant result (χ^2 (946) = 13,483.189, $p < 0.000$) confirming that the variables are sufficiently correlated for EFA. All observed variables have extraction values greater than 0.5 indicating their appropriateness. The EFA identifies seven factors with eigenvalues greater than 1 accounting for 65.288% of the variance in the effectiveness of technology use during the teaching practicum. The percentage of variance explained by each factor ranged from 42.369% for factor 1 to 2.368% for factor 7 (see Table 4).

Table 4. Total variance explained in the 1st EFA.

Component	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	18.642	42.369	42.369	18.642	42.369	42.369	5.664	12.873	12.873
2	3.114	7.078	49.447	3.114	7.078	49.447	4.277	9.720	22.593
3	1.705	3.876	53.323	1.705	3.876	53.323	4.196	9.537	32.130
4	1.558	3.540	56.863	1.558	3.540	56.863	4.066	9.240	41.370
5	1.371	3.115	59.979	1.371	3.115	59.979	3.933	8.938	50.307
6	1.294	2.940	62.919	1.294	2.940	62.919	3.625	8.238	58.546
7	1.042	2.368	65.288	1.042	2.368	65.288	2.967	6.742	65.288
8	0.801	1.821	67.108						

Note: Extraction method: Principal component analysis.

Table 5. Total variance explained in the 2nd EFA.

Component	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	12.101	43.219	43.219	12.101	43.219	43.219	4.088	14.599	14.599
2	2.425	8.659	51.879	2.425	8.659	51.879	4.004	14.300	28.899
3	1.614	5.764	57.643	1.614	5.764	57.643	3.906	13.951	42.851
4	1.467	5.238	62.881	1.467	5.238	62.881	3.450	12.321	55.172
5	1.254	4.477	67.358	1.254	4.477	67.358	3.412	12.186	67.358
6	0.688	2.457	69.815						
…..									

Note: Extraction method: Principal component analysis.

The results of the rotated factor matrix indicated that the initial 44 observed variables were grouped into seven factors with all variables having factor loadings greater than 0.3. A stricter factor loading threshold of 0.6 was applied resulting in the elimination of five variables to ensure high-quality variables (Q16, Q28, Q29, Q42, and Q43). An additional 11 poorly performing variables were identified and removed (Q7, Q13-15, Q17-19, Q25-27, Q44) through an iterative EFA process. This rigorous selection process led to a final set of 28 observed variables for the EFA analysis as detailed in Table 5.

The results in Table 5 indicate that five factors were extracted based on the criterion of eigenvalues greater than 1, suggesting that these factors best summarize the information from the 28 observed variables included in the analysis. Specifically, these five factors account for 67.358% of the total variance associated with the factors influencing the effectiveness of information technology use during the teaching practicum of primary school pre-service teachers.

Table 6. Rotated component matrix[a] in the 2nd EFA.

Item	Component				
	1	2	3	4	5
Q39	0.787				
Q41	0.783				
Q38	0.752				
Q37	0.727				
Q40	0.686		0.337		
Q36	0.675		0.361		
Q1		0.770			
Q2		0.766			
Q5		0.722			
Q4		0.719			
Q3		0.713			
Q6		0.666			
Q31			0.750		
Q32			0.739		
Q30			0.710		
Q33			0.709		
Q35			0.652		
Q34			0.630	0.310	
Q24				0.759	
Q20				0.758	
Q21				0.691	
Q23				0.687	
Q22				0.682	
Q10					0.769
Q12					0.757
Q11					0.742
Q9					0.723
Q8					0.657

Note: Extraction method: Principal component analysis.
Rotation method: Varimax with Kaiser normalization.
Rotation converged in 7 iterations.

According to Table 6, the 28 observed variables are effectively grouped into five factors, each with factor loadings exceeding 0.5, leaving no low-quality variables. The factors are named based on the observed variables within each group with those exhibiting higher loadings serving as the primary basis for naming the factor groups (Hair et al., 2014). A scale should achieve a Cronbach's alpha of 0.7 or higher to ensure consistency and reliability. However, in exploratory research, a Cronbach's alpha threshold of 0.6 is also considered acceptable (Hair et al., 2014).

Table 7. Naming factors.

Code	Observable variables	Load factor
Factor 1: Educational policy in university (EP) (Cronbach's alpha = 0.909)		
EP1	The university has a plan to train students in technology skills aimed at enhancing their competitiveness in the job market after graduation.	0.787
EP2	The university provides clear guidelines and policies on technology use making it easy for students to implement them.	0.783
EP3	The university has developed a detailed plan for assessing the use of technology in student teaching practices.	0.752
EP4	The university has a strategy to improve students' technology skills through hands-on teaching practice.	0.727
EP5	Students receive instruction on how to use technology in teaching practice in a safe, responsible, ethical and legally compliant manner.	0.686
EP6	The university is committed to enhance the effective integration of technology within its teacher training programs.	0.675
Factor 2: Pedagogical content knowledge (PCK) (Cronbach's alpha = 0.901)		
PCK1	I am proficient in using effective teaching methods to guide students in their learning process.	0.770
PCK2	I can employ various teaching methods to help students understand lesson content.	0.766
PCK3	I have the skills to design and facilitate learning activities for students such as group discussions, project-based learning and problem solving.	0.722
PCK4	I demonstrate consideration for the diverse learning styles of primary school students.	0.719
PCK5	I am capable of creating lesson plans that promote active and engaged learning among students.	0.713
PCK6	I continually update my knowledge with the latest and the most important advancements in teaching methods.	0.666
Factor 3. Facilitating conditions (FC) (Cronbach's alpha = 0.881)		
FC1	The primary school where I did my teaching internship provided facilities to support the use of technology in teaching such as access to computers, interactive whiteboards, projectors, and Internet connections.	0.750
FC2	I find that the facilities at the primary school are modern and adequate and facilitate the use of technology in teaching.	0.739
FC3	At the university, I am provided with facilities to support the use of technology in learning, including access to computers, interactive whiteboards, projectors, and Internet connections.	0.710
FC4	I find that the facilities at the university are modern and adequate and facilitate the use of technology in learning.	0.709
FC5	I consistently receive positive and constructive feedback on my use of technology during teaching practice.	0.652
FC6	I am always encouraged by my university lecturers or mentor teachers at the primary school to integrate technology into my teaching practices.	0.630
Factor 4: Performance expectancy (PE) (Cronbach's alpha = 0.885)		
PE1	I believe that using technology effectively organizes learning activities.	0.759
PE2	I believe that using technology enhances the quality of teaching and learning.	0.758
PE3	I believe that using technology increases students' interest and engagement in learning.	0.691
PE4	I believe that using technology contributes to the development of students' skills and competencies.	0.687
PE5	I believe that using technology improves students' understanding of lesson content.	0.682
Factor 5: Technological content knowledge (TCK) (Cronbach's alpha = 0.874)		
TCK1	I can design various digital resources to effectively support teaching and learning.	0.769
TCK2	I consistently update my knowledge about new and important educational technologies.	0.757
TCK3	I know how to troubleshoot technical issues that arise during the use of technology in primary school teaching.	0.742
TCK4	I can effectively use technological resources to support teaching and learning activities.	0.723
TCK5	I can select and use technology appropriately to design and organize teaching and learning activities for primary school students.	0.657

Table 7 presents the observable variables and their corresponding load factors for five factors: Educational policy in university (EP), Pedagogical content knowledge (PCK), Facilitating conditions (FC), Performance expectancy (PE), and Technological content knowledge (TCK).

4.3. The Results of Confirmatory Factor Analysis (CFA)

The research data were analyzed using SPSS with principal axis factoring and promax rotation resulting in a rotated matrix of independent scales (Hair et al., 2014). Common indices include chi-square/df, GFI (Goodness of Fit Index), AGFI (Adjusted Goodness of Fit Index), CFI (Comparative Fit Index), and RMSEA (Root Mean Square Error of Approximation) to assess model fit. A good fit is indicated by CMIN/df < 3, GFI, AGFI, and CFI values between 0.9 and 1, and RMSEA < 0.08 (Hair et al., 2014).

Table 8. Model fit.

CMIN					
Model	**NPAR**	**CMIN**	**DF**	**P**	**CMIN/DF**
Default model	66	625.677	340	0.000	1.840
Saturated model	406	0.000	0		
Independence model	28	8387.323	378	0.000	22.189
RMR, GFI					
Model	RMR	GFI	AGFI	PGFI	
Default model	0.021	0.908	0.890	0.760	
Saturated model	0.000	1.000			
Independence model	0.248	0.172	0.111	0.160	
Baseline comparisons					
Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	0.925	0.917	0.965	0.960	0.964
Saturated model	1.000		1.000		1.000
Independence model	0.000	0.000	0.000	0.000	0.000
RMSEA					
Model	RMSEA	LO 90	HI 90	PCLOSE	
Default model	0.042	0.037	0.048	0.993	
Independence model	0.213	0.209	0.217	0.000	

Table 8 presents the results of the CFA model. The table shows that the model fit indices are within acceptable ranges with CMIN/DF = 1.840 (< 3), GFI = 0.908 (> 0.9), CFI = 0.964 (> 0.9), TLI = 0.960 (> 0.9), RMSEA = 0.042 (< 0.06), and PCLOSE = 0.993 (> 0.05). These values indicate a good model fit. The regression weights analysis demonstrates that all observed variables are significant ($p < 0.05$). The standardized regression weights are all greater than 0.5 suggesting strong consensus among the observed variables. Overall, the CFA results support the measurement model's reliability and validity.

Table 9. Model validity measures.

Factors	**CR**	**AVE**	**MSV**	**MaxR(H)**	**EP**	**PCK**	**FC**	**PE**	**TCK**
EP	0.909	0.626	0.506	0.910	0.791				
PCK	0.901	0.604	0.494	0.903	0.573***	0.777			
FC	0.881	0.553	0.506	0.882	0.711***	0.560***	0.743		
PE	0.886	0.609	0.483	0.889	0.641***	0.659***	0.695***	0.780	
TCK	0.876	0.585	0.494	0.879	0.543***	0.703***	0.566***	0.602***	0.765

Note: Validity concerns.
No validity concerns here.
Significance of correlations: *** $p < 0.001$.

Table 9 shows that all Composite Reliability (CR) values exceed 0.7 and Average Variance Extracted (AVE) values are above 0.5 confirming convergent validity (Hair et al., 2009). The square root of AVE is greater than latent variable correlations, and the Maximum Shared Variance (MSV) is smaller than the AVE ensuring discriminant validity (Fornell & Larcker, 1981). The CFA identifies five factors influencing technology use in

teaching practicum: EP, PCK, FC, PE, and TCK comprising 28 observed variables. All variables meet the essential reliability and validity standards.

4.4. Regression Model Test Results

Five factors were identified as influencing the effectiveness of technology use in teaching practice among primary school pre-service teachers after conducting the CFA analysis. These factors were subsequently used for regression analysis with the results presented in Table 10.

Table 10. Model summary[b].

Model	R	R square	Adjusted R square	Std. error of the estimate	Durbin-Watson
1	1.000[a]	1.000	1.000	0.000	0.598

Note: a. Predictors: (Constant), EP, TCK, PE, PCK.
b. Dependent variable: UTTP.

The regression analysis results in Table 10 show that the adjusted R square is 1.000 indicating that the model explains 100% of the variance in the dependent variable, the effectiveness of training primary school pre-service teachers in the use of technology during teaching practice. This suggests that the regression model is robust and fulfills the necessary conditions for drawing reliable research conclusion.

Table 11. Coefficients[a].

Model		Unstandardized coefficients		Standardized coefficients	T	Sig.	Collinearity statistics	
		B	Std. error	Beta			Tolerance	VIF
1	(Constant)	-3.760E-015	0.000		0.000	1.000		
	PCK	0.200	0.000	0.225	153032724.153	0.000	0.496	2.018
	TCK	0.200	0.000	0.262	186788549.617	0.000	0.546	1.833
	PE	0.200	0.000	0.262	176318880.007	0.000	0.484	2.068
	FC	0.200	0.000	0.250	168945218.172	0.000	0.488	2.050
	EP	0.200	0.000	0.245	169131385.654	0.000	0.511	1.957

Note: a. Dependent variable: UTTP.

According to Table 11, all predictor variables exhibit a statistical significance level of sig = 0.000 which is below the conventional threshold of 0.05. This implies that each of these variables significantly contribute to the regression model meaning they all have a substantial impact on the dependent variable, "training effectiveness" (use of technology during teaching practice (UTTP)) in the context of technology use during teaching practice. The standardized multiple regression equation can be formulated as follows: UTTP = 0.225 * PCK + 0.262 * TCK + 0.262 * PE + 0.250 * FC + 0.245 * EP. UTTP represents the dependent variable, "training effectiveness"; PCK, TCK, PE, FC and EP are the independent predictor variables. The coefficients 0.225, 0.262, 0.262, 0.250 and 0.245 are the standardized regression coefficients quantifying the influence of each predictor variable on the dependent variable "training effectiveness," with other variables held constant.

5. DISCUSSION

This study aimed to explore the factors influencing primary school pre-service teachers' use of technology during their teaching practice contributing to a deeper understanding of technology integration in education. A rigorous statistical approach was employed to develop and validate the measurement of identified constructs based on previous research. Five key factors were identified: (i) EP, (ii) PCK, (iii) FC, (iv) PE, and (v) TCK. These factors provide valuable insights for improving teacher education policies and programs. Among them, EP emerged as a central factor highlighting the importance of integrating technology into teacher education programs. This finding

is consistent with previous research such as Tondeur et al. (2012) which emphasized the important role of policies in successful technology integration.

As technology increasingly becomes an integral part of the 21st-century classroom, there is a need for supportive educational policies to integrate technology into teacher education programs as the inclusion of technology in training programs can contribute to better preparing future teachers to use technology effectively in their future classrooms (Afshari, Bakar, Luan, Samah, & Fooi, 2009). Scherer, Siddiq, and Tondeur (2019) also emphasized the need for institutional support in technology integration including technology-focused curricula and professional development (Cullen & Greene, 2011). Furthermore, Koh and Frick (2009) and Niederhauser and Perkmen (2010) found that self-efficacy was a significant predictor of pre-service teachers' intention to use technology. This study looks at primary school student-teachers throughout their teaching practicum providing a unique perspective while previous studies have focused on students and teachers.

PCK is recognized as an important element of effective teaching (Ertmer, 1999). This study reinforced the importance of PCK in integrating technology into teaching across subjects and disciplines consistent with the findings of Mishra and Koehler (2006) on the TPACK framework. Effective teachers not only have deep subject matter expertise but are also proficient in using a variety of pedagogical methods to effectively deliver content.

Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, and Sendurur (2012) identified inadequate subject matter knowledge and inadequate professional training as barriers to integrating technology into teaching. The National Education Association (NEA) (2008) emphasizes that teachers are increasingly confident in using technology such as software and conducting internet searches. They have to continually update and improve their technology skills due to the rapid advances. Studies have shown that providing teacher education students with technology skills increase their ability to use technology in their teaching practice and their future teaching practice after graduation (Hammond et al., 2009; Paraskeva, Bouta, & Papagianni, 2008; Wozney, Venkatesh, & Abrami, 2006). Most teacher education institutions now offer courses designed to help prospective teachers acquire the necessary technology knowledge and skills for teaching (Polly, Mims, Shepherd, & Inan, 2010).

This study highlights the important role of FC in supporting the use of technology in the teaching practices of primary schools students and teachers. Effective integration of technology into teaching requires many factors including adequate infrastructure, resources and support (Jo, Johan, Peggy, & Anne, 2017; Yeung, Taylor, Hui, Lam-Chiang, & Low, 2012). Access to reliable technology, appropriate training opportunities, and accessible and adequate technical support is essential to help students and teachers integrate technology into their teaching practice smoothly and effectively. Specifically, technology implementation into teaching becomes difficult without powerful computers and fast internet access (Ertmer et al., 2012). These findings are consistent with previous studies by Gill and Dalgarno (2008) and İşler and Yıldırım (2018) which also identified difficulties and limitations in internet access and hardware issues as barriers to the use of technology in teaching by pre-service teachers. Previous research by Scherer et al. (2019) emphasized the importance of FC, their study mainly focused on technical and organizational aspects. In contrast, our study expanded the scope to include the school's technology-supportive culture emphasizing the role of the overall learning environment in integrating technology.

This study provides a comprehensive perspective on the factors influencing the use of technology by prospective primary school teachers during their internship. Understanding these factors will help educational administrators and policymakers design effective training programs and policies that support successful technology integration in the classroom better preparing future teachers. This study also makes unique contributions by focusing on a specific research population and examining a broader range of FC although there are similarities with related studies on key factors such as EP, PCK, and PE. These differences highlight the need for further research into specific contexts to develop appropriate strategies and policies for integrating technology into education in general and teaching in particular. Future research could explore how these factors interact within specific

educational settings and conduct cross-cultural comparisons to refine technology integration strategies across diverse educational environments.

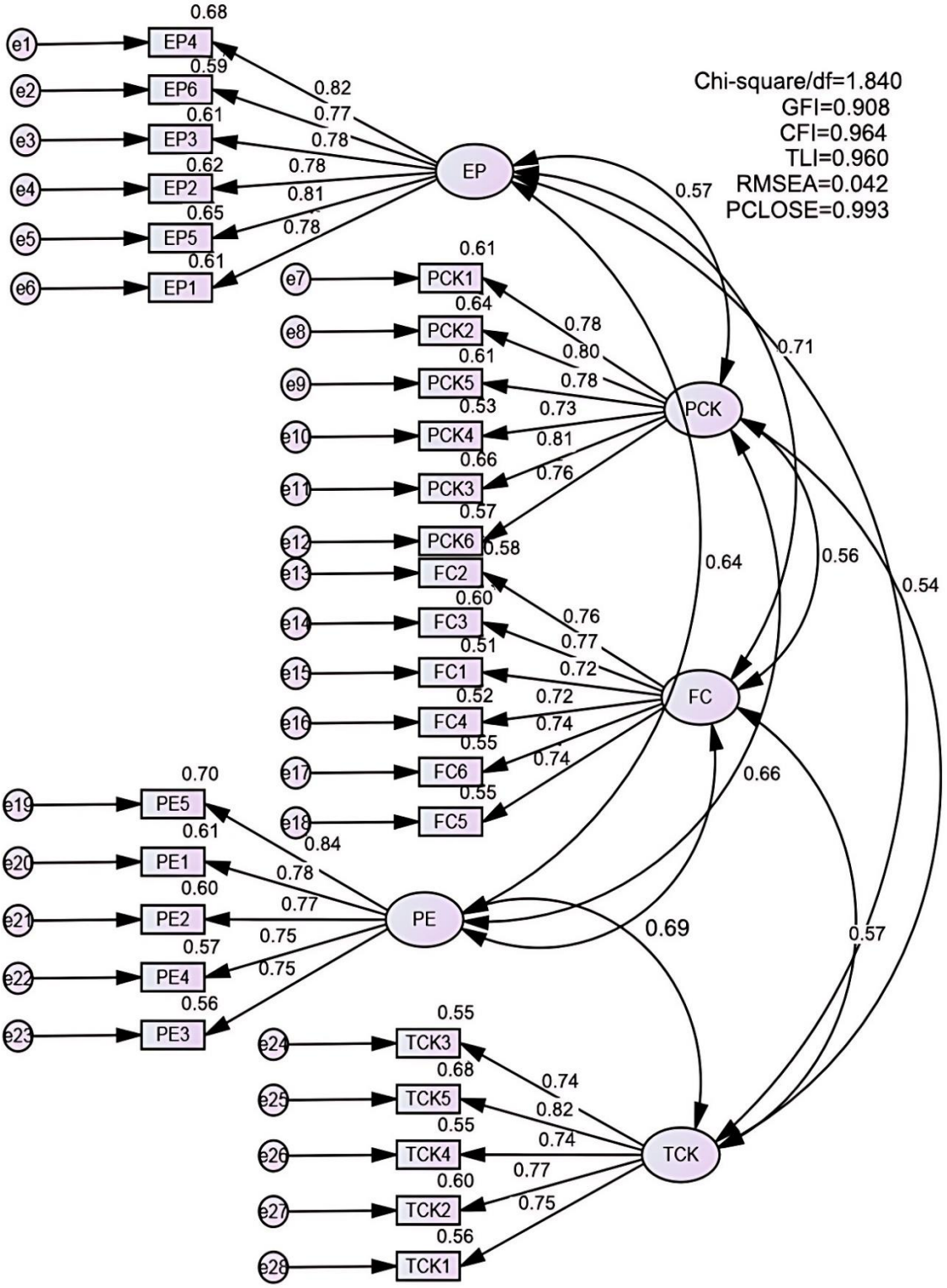

Figure 1. Measurement model of factors affecting the effectiveness of technology use by primary school pre-service teachers during their teaching practicums.

Figure 1 illustrates the measurement model of factors influencing primary school pre-service teachers' use of technology during their teaching practice. The model shows the relationships between the factors (EP, PCK, FC,

PE, and TCK) and their corresponding observed variables. The figure also shows the model fit indices indicating a good fit of the model to the data.

6. CONCLUSION

Several limitations of the study should be acknowledged despite employing reliable scale development techniques based on Churchill Jr (1979) and Hinkin (1998). First, the study focused solely on 28 questionnaire items related to factors influencing technology use among primary school pre-service teachers during their teaching practicum which narrows the scope of the investigation. Second, although both Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were used to optimize the scale, these methods depend heavily on sample size. Future studies should consider larger samples to enhance both accuracy and generalizability. Third, the use of a non-probability sampling method while common in educational research limits the generalizability of the findings beyond the study's specific context. Fourth, the theoretical framework was based exclusively on the selected factors, potentially omitting other mediating and moderating variables that could provide a more comprehensive understanding. Lastly, the study used a five-point Likert scale to measure five factors. Future research might explore additional constructs, different scaling methods, and comparing shared variance between constructs to ensure discriminant validity.

In the context of primary school pre-service teacher education in Vietnam, equipping students with the skills to effectively use technology during their teaching practicums is essential for their future careers. This preparation is facilitated through specialized university courses and hands-on teaching experiences in schools.

This study used exploratory factor analysis and confirmatory factor analysis to explore the factors influencing the use of teaching practice by primary school pre-service teachers based on the TPACK and UTAUT frameworks. The reliability of the survey was confirmed through Cronbach's alpha coefficient. 658 third- and fourth-year students of the primary school teacher education program were invited to participate in the survey with 470 responses analyzed.

This study presents a 28-item scale to explore the multidimensional factors influencing the use of technology in the teaching practice of primary school pre-service teachers. Five key factors were identified including (i) Educational Policy in Universities (EP), (ii) Pedagogical Content Knowledge (PCK), (iii) Facilitating Conditions (FC), (iv) Performance Expectancy (PE), and (v) Technological Content Knowledge (TCK). These factors provided valuable information that serves as a basis for developing more effective and quality teacher training policies and programs.

The EP factor emerged as the central factor influencing the other factors. The above five factors were successfully extracted and validated through rigorous statistical analysis demonstrating the reliability and validity of the scale in measuring the dimensions influencing the use of technology.

This study is the first comprehensive measure to validate their combined significance in this context although these five constructs have been extensively explored in related empirical studies. The findings from this study provide a foundation for future researchers to further explore factors associated with technology use in primary school student-teachers teaching practice in the future.

7. IMPLICATIONS

Future studies should aim to include larger and more diverse samples to enhance the validity and generalizability of the findings across different educational contexts. Researchers should also explore additional factors that may mediate or moderate the relationship between technology use and instructional effectiveness, providing a more comprehensive understanding of the complexities of technology integration in education in general and teaching in particular. Finally, expanding research includes cross-cultural comparisons could provide valuable insights into how different educational contexts affect the integration of technology in teaching practices.

Funding: This study received no specific financial support.
Institutional Review Board Statement: The Ethical Committee of the Hanoi Metropolitan University, Vietnam has granted approval for this study (Ref. No. C2020-13).
Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: Both authors contributed equally to the conception and design of the study. Both authors have read and agreed to the published version of the manuscript.

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