A survey of pre-service teachers' acceptance of technology in Thailand

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Abstract In the recent decade, Thailand has launched many initiatives to ensure that technology is integrated into the school curriculum. Despite the investment and efforts of the government, few studies have been conducted to examine users' acceptance of technology. Given that educators are the change agents in many educational initiatives, it is important to gain insights into the factors that influence their uses of technology for teaching and learning. The aim of this study is to survey the level of technology acceptance among pre-service teachers in Thailand. In so doing, the level of technology acceptance among a national sample of 969 pre-service teachers was measured and whether their acceptance was significantly differentiated by gender, age, perceived technology competence, and computer experience was assessed. Using the Technology Acceptance Measure for Pre-service Teachers (Teo in Educ Psychol Meas 70(6):990–1006, 2010a; Multicult Educ Technol J 4(3):163–172, 2010b), the results provided preliminary evidence which suggests that pre-service teachers possess an above-average level of technology acceptance and that computer experience acted as a mediator of technology acceptance. To some degree, this study has contributed to the ensuing debates on technology acceptance in education and offered additional insights into the advancement of technology integration in Asia.

Keywords Thailand · Technology acceptance · Students · Structural equation modeling

Introduction

Technology acceptance refers to the adoption and use of technologies in the way they were designed for. Historically, studies on technology or user acceptance have been conducted by researchers in the information science (IS) and information technology (IT) disciplines (Agarwal and Karahanna 2000). In the majority of these studies, they were situated in the business contexts, involving participants who were end users or supervisors in organizations. Over the years, there has been a growing interest among educational researchers on the factors that affect technology acceptance in educational environments (Fusilier and Durlabhji 2005; Smarkola 2007; Teo 2009; Wong et al. 2012). To a large extent, such interest among educational researchers could be attributed to the recognition that the issues in the adoption and use of technology in education are not the same as those in businesses and commerce. A major difference lies in how business and educational users respond to technology. In an educational setting, teachers tend to possess greater autonomy over their choices of what technologies to use, and how and when they use technologies. Furthermore, users of technologies in education generally have different objectives from and face less competition in the use of technological resources compared to their counterparts in business organizations (Hu et al. 2003). From the literature, researchers are interested in understanding the factors that explain why users in education engage technologies for

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work and in their personal lives. Some examples include users' acceptance of e-learning (Teo and Wong 2013), an online course companion site of a textbook, and WebCT (Drennan et al. 2005; Gao 2005; Ngai et al. 2007).

Among the main users of technology in education are the teachers. It is generally accepted that teachers drive the way technology is employed and integrated into the curricula. In recent years, a group that has captured the attention of researchers is the pre-service teachers. Pre-service teachers are trainees enrolled at teacher education programs in universities or colleges of education. Because pre-service teachers are the future in the teaching profession, they are often exposed to the latest technologies that are designated for schools. This allows them to gain experience in the use of existing and new technological tools and equipment in order to function effectively as teachers in the future. For example, pre-service teachers would be trained to harness various technologies to teach, assess, and monitor their students' learning (Wong and Teo 2009).

However, despite the investments and emphasis on engaging technology for teaching and learning in teacher education, there is evidence to suggest that pre-service teachers may not use technology in their teaching practice or coursework despite possessing adequate technology skills (e.g., Cuckle et al. 2000). The authors also argued that, contrary to popular belief, it cannot be assumed that pre-service teachers would transfer their personal technology skills to using them for professional purposes. From the literature, the lack of use of technology for teaching and learning among pre-service may be attributed to factors related to the individual user, technology, and the environment. These include attitudes toward computers (Teo 2008), computer self-efficacy (Tsai et al. 2010), technological complexity (Teo 2009), and facilitating conditions (Ngai et al. 2007).

Technology acceptance among pre-service teacher in Thailand

In Thailand, all teachers are trained at either comprehensive government-funded universities or teacher training colleges (Rajabahts). In addition to learning the craft of teaching and other associated skills, technology is featured strongly in the curriculum to bring about significant shift in pedagogical approach in pre-service teacher education. This stemmed from the belief that, by engaging pre-service teachers in meaningful learning experiences using technology, they would realize the importance of effective technology integration for teaching and learning into their future classrooms. Despite the central role played by technology in the training of teachers in Thailand (Monsakul et al. 2007), few studies have been conducted to understand the technology acceptance among pre-service teachers in Thailand.

Sudsuang (2005) surveyed the use of the Internet in the training of teachers for English as a Foreign Language (EFL). The results showed that, despite some reservations due to the lack of and personal lack of knowledge on Internet use, these pre-service EFL teachers were generally positive about the use of the Internet for teaching and learning. Using a modified technology acceptance model (TAM), Kripanont (2007) sought to understand the factors affecting technology usage among 927 staff members in 20 business schools among several universities in Thailand. He found that perceived usefulness, perceived ease of use, and self-efficacy were significant predictors of technology usage in teaching. In a study on the effect of organizational culture on the acceptance of e-learning among higher education students and e-learning teachers in Thailand, Chanasuc and Praneetpolgrang (2008) found that while organizational culture can affect e-learning, personal characteristics such as motivation, interests, attitude, and relative cost of studying between e-learning and in classroom were significant influences on users' acceptance. This finding was corroborated by Phuangthong and Malisuwan (2008) who examined the individual-level factors affecting the adoption of Multimedia Mobile Internet by integrating technology acceptance model (TAM) and diffusion of innovation model (DOI), both of which were found to be adequate in explaining individual-level adoption of mobile internet.

The above-mentioned studies are consistent with the applications of the TAM in the international contexts (Teo 2012). For example, Will et al. (2005) found that an expanded TAM was valid in explaining the influence of Swedish student teachers' perceived usefulness and perceived ease on their intention to use technology. In Turkey, Kiraz and Ozdemir (2006) studied the relationship between educational ideologies and technology acceptance among pre-service teachers and found that an expanded technology acceptance model was useful in outlining the technology acceptance of teachers with different ideologies. Among the school teachers in Hong Kong, Paul et al. (2003) use the TAM to explain the determinants that drive the technology use among the former.

Rationale of this study

Given the increasing central and crucial role that technology plays in preparing future effective teachers, it is important to assess the level of pre-service teachers' acceptance of technology and understand the drivers that influence their usage. For example, while hardware and associated infrastructure are necessary to integrate technology in teaching and learning, user characteristics should not be ignored as they are no less important in determining the level of technology use (Teo 2009). The findings from this study have the potential to inform school leaders and policy makers on allocation of resources and curriculum planning.

Table 1 Sample distribution by location, gender, and computer experience

	North[a] (n = 174)	North East (n = 145)	South (n = 200)	East (n = 254)	West (n = 196)
Gender					
Male	55	46	58	50	20
Female	119	99	142	204	176
Perceived technology competence[a] (SD)	5.48	5.37	5.15	5.30	5.33
	(.82)	(.87)	(1.04)	(.87)	(.88)
Mean years of technology experience (SD)	6.14	5.87	6.55	5.91	9.70
	(1.41)	(1.53)	(1.18)	(1.21)	(1.91)

[a] This variable was measured using 1 = not competent at all and 7 = extremely competent

In addition, understanding the acceptance of technology among pre-service teachers in Thailand contributes to the literature by providing a cross-cultural perspective to the technology acceptance research, many of which have been conducted in non-Asian settings. As Thailand is one of the largest countries in Asia, the findings of this study may be generalized to other countries with similar demographic and economic profiles.

Finally, this study contributes to the continuing debate on technology acceptance in education. While the momentum of such research has gathered over the years, it is still trailing behind the IS and IT disciplines, and this may be due to the nature of technology use in non-educational contexts as being different from those within education. To a large extent, educational users, especially teachers, exercise greater autonomy in deciding what technology to use, when to use technology, and how to use technology in their daily activities more than their counterparts working in other professions (Teo 2011).

Aim of this study

The aim of this study is to survey the level of technology acceptance among pre-service teachers in Thailand. This will be guided by the following questions:

1. What is the level of technology acceptance among pre-service teachers in Thailand?
2. Are there significant differences in the technology acceptance of pre-service teachers by gender, age, perceived technology competence, and computer experience?

Methods

Participants

Participants were 969 pre-service teachers from five government-funded universities in Thailand. These universities were selected from the different zonal divisions in Thailand

with a view to achieve a representative sample in this study. All participants were enrolled in either the *Bachelor of Education* or *Diploma in Education* at their respective universities. Among them, 76.4 % (740) were females, and the mean year of computer usage was 6.84 (SD = 2.06). The perceived level of technology competence was 5.32 (SD = .91), with 1 representing "*not competent at all*" and 7 representing "*highly competent*." Table 1 shows the distribution of the sample by location, gender, and computer experience.

Procedure

Participants responded to an invitation issued by their lecturers during the study term. All participants were volunteers, and they were briefed on the purpose of this study and informed of their rights not to participate or withdraw from completing the questionnaire at anytime during the data collection. No reward was given in monies or kind. Participants completed the paper-based questionnaire in groups and spent no more than 20 min for this task.

Measure

The instrument used in this study was the Technology Acceptance Measure for Pre-service Teachers (TAMPST) (Teo 2010a). The TAMPST was a response to a lack of an instrument in the literature to assess the level of technology acceptance among pre-service teachers. Teo reviewed various intention-attitude models that were originally developed in the psychology and information sciences disciplines. Among these were the theory of reasoned action (Ajzen and Fishbein 1980), theory of planned behavior (Ajzen 1991), technology acceptance model (Davis 1989), and the unified theory of acceptance and use of technology (Venkatesh et al. 2003). Following, various constructs in these models that were found to significantly influence technology acceptance were adopted and validated to develop the 16-item TAMPST. It purports to measure technology acceptance of pre-service teachers using five factors: perceived usefulness (four items),

Table 2 Descriptive statistics of the 16-item TAMPST

Item	Mean	SD	Skewness	Kurtosis
Perceived usefulness (PU)				
Using computers will improve my work	5.36	.69	−1.04	3.03
Using computers will increase my productivity	5.41	.71	−1.09	3.80
Using computers will enhance my effectiveness	5.39	.73	−1.37	4.26
I find computers a useful tool in my work	5.50	.66	−1.08	2.12
Perceived ease of use (PEU)				
My interaction with computers is clear and understandable	5.39	.71	−1.12	2.33
I find it easy to get computers to do what I want it to do	5.44	.69	−1.10	2.91
I find computers easy to use	5.41	.69	−1.34	4.32
Attitude toward computer use (ATCU)				
Computers make work more interesting	5.33	.71	−1.02	1.82
Working with computers is fun	5.40	.70	−1.19	3.18
I like using computers	5.36	.72	−1.02	1.79
I look forward to those aspects of my job that require me to use computers	5.33	.66	−.65	1.53
Facilitating conditions (FC)				
When I need help to use computers, specialized instruction is available to help me	5.41	.68	−.87	1.29
When I need help to use computers, a specific person is available to provide assistance	5.37	.73	−1.35	3.57
When I need help to use computers, guidance is available to me	5.36	.69	−.98	3.15
Subjective norm (SN)				
People whose opinions I value will encourage me to use computers	5.39	.77	−1.31	4.53
People who are important to me will support me to use computers	5.31	.83	−1.28	2.60

perceived ease of use (three items), attitude toward computer use (four items), facilitating conditions (three items), and subjective norm (two items). Although the TAMPST was originally developed and validated with three separate samples of pre-service teachers in Singapore, it has been subsequently validated with a sample of pre-service teachers from another culture (Teo 2010b) and in-service teachers (Teo 2014). The results of this validation study showed acceptable levels of alpha reliability for the factors, ranging from 0.79 to 0.86 (Henson 2001).

In this study, the original English version of the TAMPST was translated into Thai by a professor and her colleagues who were experienced the use of the English and Thai languages. They held doctorates in educational technology and were familiar with the translation standard required in academic research. Each item was measured on a 7-point scale with 1 = strongly disagree and 7 = strongly agree. A higher score in the TAMPST indicates a higher level of technology acceptance. The items in English are shown in Table 2.

Approach to MIMIC modeling

In this study, MIMIC (multiple indicators, multiple causes) modeling was used to assess whether there are significant differences of technology acceptance by the users' gender,

age, perceived competence, and computer experience. A MIMIC modeling is used when it is believed that the observed variables are manifestations of an underlying unobserved latent variable which is affected by other exogenous variables that "cause" and influence the latent factor(s) (Joreskog and Goldberger 1975).

In most studies, group comparisons (e.g., between male and female) are made using the traditional t test. MIMIC modeling is employed in this study because it contains two advantages over the use of t tests. First, MIMIC allows simultaneous analysis of a model with latent variables and observed indicators, and second, measurement error are modeled and computed to facilitate more precise estimation of item reliability. Measurement in MIMIC modeling involves an estimation of two parts: the measurement part (which displays the causal link among the latent variables and the observed causes) and the structural part (which shows how the latent variables are estimated through the observed variables or indicators). An advantage of a MIMIC model is that it allows for a dichotomous group comparison to be made (e.g., male vs. female) using cause indicators as exogenous variables.

The exogenous variables in this study that are assumed to explain technology acceptance (PU, PEU, ATCU, FC, and SN) are gender, age, perceived competence, and technology experience. This part of the model can be
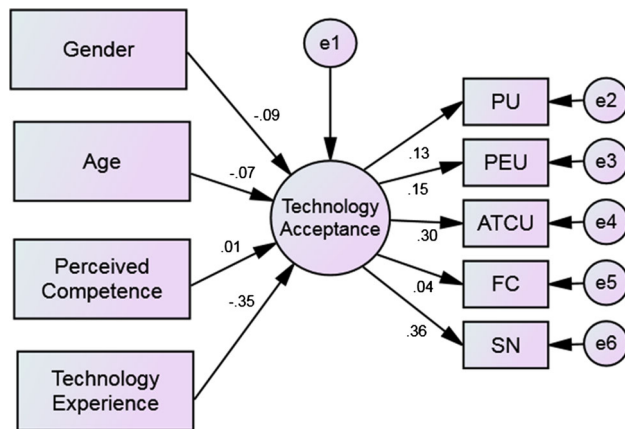
Fig. 1 MIMIC model of technology acceptance and its covariates. *PU* perceived usefulness, *PEU* perceived ease of use, *ATCU* attitude toward computer use, *FC* facilitating conditions, *SN* subjective norm

viewed as five multiple regressions: PU, PEU, ATCU, FC, and SN on gender, age, perceived competence, and technology experience. For example, if gender is coded such that males are 0 and females 1, a negative coefficient for the regression of PU on gender would indicate that females have lower level of perceived usefulness than males. Hence, there are multiple indicators, which reflect the underlying factors, and multiple causes, which affect the underlying factors. For the purpose of this study, the median mean score for each variable (age, perceived competence, and technology experience) was used and converted into 0 and 1 to represent the lower and higher thresholds, respectively. The modeling process in this study follows established procedures recommended by Kline (2010). Figure 1 shows the MIMIC model that represents the effects of gender, age, perceived competence, and technology experience which are represented by arrows from these variables to the latent factor (technology acceptance) that is explained by PU, PEU, ATCU, FC, and SN.

Results

Descriptive statistics

Table 2 shows the means, standard deviations, skewness, and kurtosis indices for each of the 16 items in the TAMPST. The mean values of all items were above the midpoint of 4.00 and ranged from 5.31 to 5.50. The standard deviations ranged from 0.66 to 0.83, reflecting a fairly narrow spread of scores around the mean. The skewness and kurtosis indices ranged from −1.35 to −0.65 and 1.29 to 4.53, respectively. Following Kline's (2010) recommendations, the data in this study were considered to be

univariate normal. According to Teo (2010a), the total score for TAMPST ranges from 16 to 112, with scores toward 112 indicating a higher level of technology acceptance. The sample mean score for this study is 86.12, suggesting a high level of technology acceptance.

MIMIC modeling

The fit of the MIMIC model was estimated using the maximum likelihood (MLE) procedure and assessed using a number of fit indices representing the absolute, comparative, and parsimonious aspects of model fit (Hair et al. 2010). They were as follows: χ^2, χ^2/df, Tucker–Lewis index (TLI), Comparative Fit Index (CFI), root mean squared error of approximation (RMSEA), and standardized root mean residual (SRMR). To achieve an acceptable model fit, the χ^2/df ratio should be less or equal to 3.0, while the TLI and CFI should be equal or greater than .90. The RMSEA and SRMR should be equal or smaller than .08 (Hair et al. 2010).

The fit of this model was good ($\chi^2 = 27.103$, $df = 21$, $p = .167$, $\chi^2/df = 1.291$, TLI = .90, CFI = .94, RMSEA = .017, SRMR = .024). The item parameter estimates revealed that ATCU and FC were significant in explaining technology acceptance ($\beta = .303$ and $\beta = .362$, respectively). Together, the five variables (PU, PEU, ATCU, FC, and SN) explained 15.3 % of the variance in pre-service teachers' technology acceptance. The regression part (left side) of the model showed that there were significant differences in technology acceptance only by technology experience ($\beta = -.345$; $p < .05$). The other three variables (gender, age, and perceived competence) did not influence the technology acceptance of the pre-service teachers significantly.

Discussion

This study aims to examine the technology acceptance among 969 pre-service teachers drawn from five public universities in Thailand. The results revealed that participants in this study had above-average level of technology acceptance. Within a possible range of a score of 16–112 for the TAMPST, the mean score for the participants in this study was 86.12, and this was regarded as positive.

It is possible that the high level of technology acceptance may be attributed to the emphasis on the use of technology at the basic education and the university levels in Thailand. Through the two ICT Master Plans, ICT Master Plan I (2002–2008) and ICT Master Plan II (2009–2011), in Thailand, a strong emphasis was made to build ICT infrastructure and strengthen ICT literacy among students and teachers from K to 12 levels at the national

level (Ministry of Education 2010; Ministry of Information and Communication Technology 2009). Coupled with other related national-level projects such as the "Thai Kem Kang" (National Strong Thai), ICT in education was given a boost in terms of an increased budget to acquire hardware, develop software and digital content, and provide professional development for teachers. From these Master Plans, pre- and in-service teachers were given training in the use of guidelines and standards using technology for instructional purposes. These guidelines and standards in technology competence were designed for evaluating the achievement of an overarching goal of the Master Plans to produce teachers who are capable to help the nation produce "Smart Thais with information literacy."

To this end, technology is featured very strongly in the pre-service teacher training in Thailand. Some evidence included the use of non-traditional methods for lesson delivery such as blended learning (Laohajaratsang 2010). Furthermore, all pre-service teachers have to complete mandatory technology-related courses during their training in order to satisfy their program requirements (Monsakul 2007). Against this background, it is reasonable to expect most pre-service teachers in Thailand, including those who have participated in this study, to have practiced teaching in technology-rich environments at their universities, in addition to being exposed to various technological tools for professional and personal uses.

A recent boost to increase the presence of technology in pre-service teacher education in Thailand was the launch of the *One Tablet Per Child* (OTPC) project in which all first-graders would be given a tablet PC in the first semester of the 2012 academic year (Kunakornpaiboonsiri 2013). The main goal of this initiative was to equip and expose the students to learning in the digital age. It was very possible that the OTPC project had provided a further catalyst for universities and colleges to optimize the use of technology in training their pre-service teachers in order that their graduates would be adequately prepared to teach next generation of learners. Together with the official sanctions and endorsements by the Thai government for the integration of technology into teacher training and the concerted effort on the part of the Thai universities to create a technologically rich learning environment, this has resulted in the high level of technology acceptance reported by the pre-service teachers in this study.

This study also found that pre-service teachers with less experience with technology had a higher level of technology acceptance than those with more experience. Using the median score to categorize the sample into pre-service teachers with more or less technology experience, there were 63 % that were classified as pre-service with less technology experience. Further analysis of the data revealed that those with lesser technology experience were significantly younger in age than those with more experience with technology in the sample. It was possible that, between age and technology experience, the former may have a greater influence on the acceptance of ICT among the pre-service teachers in this study. This is consistent with current research that suggests younger users tend to react to technology more positively than their older counterparts. Describing them as "digital natives," Bennett and Maton (2010) attributed this age differentiation to the continuous, pervasive exposure to modern technology among the young, although this suggestion has received mixed reactions and the debates are currently ongoing within the research community (e.g., Prensky 2001; Teo 2013; Toledo 2007; Waycott et al. 2010).

Implications for practice

Although much have been done in areas of strategic planning and infrastructure building for technology integration in schools at the national level (described above), educators and policy makers should seriously consider the issues relating to users' acceptance in order to ensure that the efforts made to ensuring that pre-service teachers are adequately trained to engage ICT in their future employment as teachers are not in vain. These include ensuring effective ensuring and monitoring of resources allocation, basic and advanced skills training for teacher, and continuous professional development for educators across all levels of schooling.

Limitations of the study

Despite the care given to ensuring that the methodology is sound, this study has several limitations. Firstly, as data were collected through self-reports, there is a possibility of the common method variance (CMV) occurring. The CMV is a situation where the true associations between variables are inflated. Secondly, although the sample was taken from five universities in different regions of Thailand, this only represents one-third of the public universities in Thailand. Thirdly, the variance of technology acceptance was explained by only a mere 15.3 % with the TAMPST, leaving more than 80 % unexplained. It was possible that, in the pursuit of parsimony, Teo (2010a) may have excluded other variables in the TAMPST that may have increased its explanatory powers on technology acceptance. This raises the need to consider additional validation of the TAMPST to achieve a greater level of precision of measurement. A strategy may include modifying the model underpinning the TAMPST with a view to consider other latent variables in order to achieve greater validity in the TAMPST scores to explain technology acceptance. Finally, there might have been an inflation of the measurement error inherent in the

translation process of the TAMPST that was performed for this study. To test the validity of this conjecture, a measurement invariance study on the TAMPST across cultures and contexts should be conducted in future research.

Conclusion

It is hoped that this study has contributed to the ensuing debates on technology acceptance in education and offered additional insights into the advancement of technology integration in Asia. Future research could include an investigation into the impact of the government initiatives on users' acceptance of ICT for teaching and learning. In addition, studies on users' acceptance of technologies for leisure and entertainment could be conducted so that teachers could use the findings of such studies to inform them on how to capitalize on technologies for leisure and entertainment for teaching and learning. Finally, it is useful to continue the investigation of age and its influence on technology acceptance within the context of research on digital natives. While it is far from reaching a consensus, debates on digital natives provide valuable insights on various aspects of users' responses to technology that are relevant for teaching and learning. Some of these include type of technology use and their frequency, purpose of technology use, and usage preferences.

Thailand is one of the largest developing Asian countries, and there is a high likelihood that the educational issues and challenges she faces are shared by other developing countries in the region. The integration of technology in teaching and learning in the modern education milieu is confronted with problems and challenges, many of which require much time, money, and political will to resolve.

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