This is the post-print (i.e. final draft post-refereeing)

Citation:

Li, K., Li, Y., & Frankin, T. (2016). Preservice teachers' intention to adopt technology in their future classrooms. *Journal of Educational Computing Research, 54*(7), 946-966.

Abstract
This study examined four factors that influence preservice teachers' intentions to adopt technology in classrooms based on the Theory of Planned Behavior and Technology Acceptance Model. These four factors—technology self-efficacy, attitudes toward technology, perceived ease of use of technology, and perceived barriers of technology adoption—were explored through a multiple regression analysis. The results indicated that technology self-efficacy, attitudes toward technology, and perceived ease of use of technology were significantly predictive of technology adoption intentions when the other predictors were statistically controlled. Perceived barriers of technology adoption was not a significant predictor. Gender analyses were con- ducted showing no significant difference on all the factors between male and female. Practical and theoretical implications were addressed either to guide practitioners in designing teacher professional development program or assist researchers in their future study.
Keywords: pre-service teachers, technology adoption, technology self-efficacy, K-12 classrooms, TAM, TPB, barriers

Pre-service Teachers' Intention to Adopt Technology in Their Future Classrooms

As technology becomes more and more important in education today, it is critical that teachers obtain the skills to use different technologies in their classrooms. Ertmer and Ottenbreit-Leftwich (2010) argued that teachers did not already integrate technology into classrooms, at least not in a meaningful way. The U.S. Department of Education's (DOE) National Educational Technology Plan 2010 presented a model of learning powered by technology, which emphasized the importance of providing technology access to students and teachers and supporting the usage of open source educational resources. The plan addressed the potential of using technology to build a professional community of educators. The plan stated that all pre-service and in-service teachers should be provided with technology professional development opportunities to increase their capabilities of applying technology into teaching. Vannatta and Beyerbach (2000) stated that higher education had set the goal of preparing preservice teachers to adopt technology in the future by incorporating technology education into teacher preparation curriculums. However, several studies found out that teachers' technology usage in teaching was not sufficient (Gu˙lbahar & Guven, 2008; Hew & Brush, 2007; Hsu, 2010). Various researchers recommended investigating factors influencing teachers' technology adoption and developing different methods to assist them in integrating technology into teaching activities accordingly (Gu˙lbahar, 2007; Milman & Molebash, 2008).

It is important to understand the factors that influence pre-service teachers' technology adoption, including but not limited to teachers' attitudes toward using technology in education, pedagogical beliefs, self-efficacy in teaching and in technology, and barriers of incorporating technology into teaching. Celik and Yesilyurt (2013) stated that teachers' attitudes toward technology could be affected by the other factors such as computer self-efficacy and computer

anxiety. Strategies of helping teachers to adopt technology in their classrooms could be deployed if barriers that prevented teachers adopting technology were found and dealt with (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012). Anderson, Groulx, and Maninger (2011) argued that understanding factors influencing pre-service teachers' intentions of using technology could help build programs to enable them use technology effectively.

The primary purpose of this study was to investigate the factors that influence pre-service teachers' intentions to adopt technology in classrooms based on the Theory of Planned Behavior (TPB) and Technology Adoption Model (TAM), discussed in the next section.

Theoretical Framework

Theory of Planned Behavior

The Theory of Planned Behavior (TPB) describes human beliefs of and attitudes toward behaviors, behavior intentions, and actual behaviors (Ajzen, 1985, 1991). Ajzen (1985) argued that human behavior intentions influence actual behaviors, but not all intentions will be executed eventually due to changing circumstances. Behavior intentions are determined by people's attitudes toward the specific behavior, subjective norm, and perceived behavior control (Ajzen, 1991). An attitude refers to whether this behavior is perceived as positive or negative. Subjective norm is the belief that "specific individuals or groups think he should or should not perform the behavior" (Ajzen, 1985, p. 14). Perceived behavior control is similar to Bandura's concept of self-efficacy (Ajzen, 1991, p. 184), which suggests how confident people perceived their ability in performing the specific behavior. TPB has been used in various fields concerning human behaviors like weight loss or students' academic behaviors (Ajzen & Madden, 1986; Schifter & Ajzen, 1985). However, a few studies using TPB studying behaviors were related to technology

especially in recent years, like acceptance of instant messaging (Lu, Zhou, & Wang, 2009) and social media usage (Pelling & White, 2009).

Technology Acceptance Model

The Technology Acceptance Model (TAM) was developed by Davis (1989). He found that perceived usefulness and perceived ease of use were two significant factors affecting users' attitudes toward technology; then attitudes toward technology and perceived usefulness together affect users' technology usage intentions. Perceived usefulness refers to "the degree to which a person believed that using a particular system would enhance his or her job performance", while perceived ease of use refers to "the degree to which a person believes that using a particular system would be free of effort" (p. 320). TAM has been widely used to investigate human behaviors in different areas concerning technology uses, such as consumer behavior in online shopping (Pavlou, 2003), students' behaviors in online education (Roca, Chiu, & Martínez, 2006), and teachers' technology adoption in teaching (Yuen & Ma, 2008).

TAM has been challenged by various researchers in the field of information system. Although several researchers in the information system field acknowledged the importance and wide applications of TAM, they all pointed out the shortcomings of it. Bagozzi (2007) criticized TAM being oversimplified in that it neglects any social influences, as well as individual's self-regulation and emotions on this person's technology acceptance. Goodhue (2007) argued that TAM led researchers to focus only on a small scope of technology usage and ignore some other significant points, such as whether using technology was always better than not using it. Benbasat and Barki (2007) claimed that TAM focused too much on perceived usefulness and neglected the more important factor: actual usefulness of the technology.

The Framework of the Current Study

In this study, a new model was developed based on the Technology Acceptance Model (TAM) and the Theory of Planned Behavior (TPB), aiming to explore the factors that influenced pre-service teachers' intentions to adopt technology in their future teaching. TAM had been applied in the field of technology integration in education (Holden & Rada, 2011; Ma, Andersson, & Streith, 2005; Teo, 2011). TPB was not developed specifically for the technology integration field. It is a theory that may be used in wider ranges of fields to explain the relationships among variables related to human behaviors. So fewer studies in technology adoption behaviors for teachers were conducted based on TPB. To avoid the limitations of TAM as discussed in the Technology Acceptance Model section, in this study, the authors adopted three variables used by TPB to investigate how the factors impact the technology adoption in classes: 1) attitudes toward technology usage, 2) perceived barriers of technology adoption, and 3) technology self-efficacy. One variable was used from TAM: the perceived ease of use of technology in education. Since perceived usefulness in TAM was similar to attitudes toward behavior in TPB, solely attitudes toward technology were used in this research. Subject norms weakly predicted teachers' technology adoption (Shiue, 2007), so it was not included in the study.

Gender difference is an important component in the study of teacher technology adoption. It was found that the decisions to adoption a new software between men and women were influenced by different factors – men were influenced more by their "attitudes toward using that software" (Venkatesh, Morris, & Ackerman, 2000, p. 33). Similarly, Venkatesh and Morris (2000) reported that women's technology adoption decisions were influenced more by their perceived ease of use than men. Gefen and Straub (1997) even recommended incorporating gender as a variable when conducting technology adoption research. A number of studies

reported no significant gender differences in technology. However, when examining the adoption pattern of a mobile commerce technology, Li, Glass, and Records (2008) found that male and female participants had similar attitudes toward technology adoption and similar adoption rates.

According to the proposed model, two specific research questions (RQ) were addressed in this study as follows:

RQ1. Are pre-service teachers' attitudes toward technology usage in education, technology self-efficacy, perceived ease of use of technology, and perceived barriers of technology adoption statistically significantly predictive of their intentions of using technology in future classrooms?

RQ2. Are there statistically significant differences on the four factors between male and female pre-service teachers?

Method

Data Collection

A survey was developed by Qualtrics to collect data regarding the variables discussed above: 1) perceived technology adoption control from pre-service teachers, 2) attitudes toward technology usage in education, 3) technology self-efficacy, 4) perceived ease of use of technology, and 5) perceived barriers of technology adoption.

Instrument

A total of thirty-four items, including four demographic questions and two open-ended questions, were developed into an online survey as the instrument for the study. Likert-type items and open-end questions were applied in this survey. Many items of the instrument used in this study were derived from previously-validated instruments published in Schwarzer and Jerusalem (1995) and Brush, Glazewski, and Hew (2008). All of them were shown in Table 1.

Technology Adoption Intention. Pre-service teachers' intention to adopt technology in their future classrooms was measured by three items (item 2 through item 4 in Table 1), which were designed by the researchers with the guidance of Ajzen (2002).

Technology Self-efficacy. Technology self-efficacy was adopted and modified based on the *General Self-Efficacy Scale* developed by Schwarzer and Jerusalem (1995) such that the items measured participants' self-efficacy in technology in particular instead of self-efficacy in general. Six out of ten items were chosen and modified from the *General Self-Efficacy Scale*. An example was that an item was modified to *"I can always manage to solve difficult technology problems if I try hard enough"* from the original statement *"I can always manage to solve difficult problems if I try hard enough"*. Item 5 through item 10 were used to measure the effect of technology self-efficacy.

Attitudes toward Technology. In this study, attitudes toward technology usage in education was adopted from part of the attitude scale developed by Brush, Glazewski, and Hew (2008) with permission. Eight out of the twelve items were chosen to measure participants' attitudes toward technology usage in education. See item 11 through item 18 in Table 1.

Perceived Ease of Use of Technology. Perceived ease of use of technology employed four self-designed items, item19 through item 22 in Table 1.

Table 1

Survey Questions

No.	Items
1	What is the single most important advantage do you perceive using technology in education?
2	How likely are you to integrate technology in your future classrooms?
3	I will encourage my future students to use technology for learning.
4	I will seek opportunities to adopt technologies in my teaching.
5	I can always manage to solve difficult technology problems if I try hard enough.
6	It is easy for me to stick to my aims and accomplish my goals when dealing with technology.
7	I am confident that I could deal efficiently with unexpected technical problems.
8	I can remain calm when facing technology difficulties because I can rely on my coping abilities.
9	I can usually handle whatever comes my way when working with technology.
10	Thanks to my resourcefulness, I know how to handle unforeseen technical problems.
11	I support the use of technology in the classroom.
12	A variety of technologies are important for student learning.
13	Incorporating technology into instruction helps students learn.
14	Knowledge about technology will improve my teaching.
15	Technology facilitates the use of a wide variety of instructional strategies designed to maximize learning.
16	Student motivation increases when technology is integrated into the curriculum.
17	Technology helps teachers do things with their classes that they would not be able to do without it.
18	Technology might interfere with “human” interactions between teachers and students.
19	I find it easy to learn technology.
20	I always learn technology faster than my peers.
21	I find technology easy to use in everyday life.
22	I don’t spend a lot of time trying to figure out how to get started with technology.
23	Lack of or limited access to computers in schools.
24	Not enough software available in schools.
25	Lack of knowledge about technology.
26	Lack of knowledge about ways to integrate technology into the curriculum.
27	Lack of mentoring to help me increase my knowledge about technology.
28	There isn’t enough time in class to implement technology-based lessons.
29	Technology-integrated curriculum projects require too much preparation time.
30	Please write down any of your thoughts concerning adopting technology in classrooms.
31	What is your gender?
32	What is your ethnicity?
33	What is your age range?
34	What year are you in college?

Sources: Some items are from Schwarzer & Jerusalem (1995) and Brush, Glazewski, & Hew (2008). Used with permission.

Perceived Barriers of Technology Adoption. Perceived barriers of technology adoption was used as one factor that could influence pre-service teachers' intentions to adopt technology. Seven out of the ten items of Brush, Glazewski, and Hew's (2008) Barrier scale were adopted with permission to measure participants' Perceived barriers of technology adoption to integrate technology in classrooms. Based on Ertmer's (1999) definitions of first and second-order barriers, three items deal with first-order barriers, which referred to pre-service teachers' lack of technological knowledge; while four items measure second-order barriers, which were the lack of technology access, lack of administration support, or lack of time. The items 23 through item 29 measured perceived barriers of technology adoption.

Participants and Procedures

Participants of the study were undergraduate pre-service teachers enrolled in a technological application class at a midwestern university. To obtain enough responses, two rounds of data collection were conducted in fall and spring semester 2012-13 respectively. The instructors of the course were asked to assist the researchers by distributing an online survey hosted by Qualtrics, to which the university had a subscription for its faculty and students, to all their students through emails. The first page of the online survey was the research consent form with an item asking participants to select "Yes" to indicate that they agreed to participate in the study. Week ten was chosen as the time to first send out the survey because most students would be familiar with some technologies and their applications in the classroom at that time. Three reminder emails were sent to remind the students to participate in the study in the following three weeks. In spring semester, research conditions were the same with fall: (a) the four instructors; (b) the number(s) of session they taught; (c) the week during one semester that the online surveys were sent out; and (d) the online surveys and host sites. In the fall 2012 semester, 42 out of the

76 students from three different classes responded to the survey. The response rate was 55.3%. While in the spring 2013 semester, 45 out of the 75 students from three different classes responded to the survey. The response rate was 60.0%.

Results

Demographic Description

Total 87 participants responded the survey; however, after screening data, 79 valid responses were used to conduct analyses. Among them, 20 were male and 59 were female. Seventy reported being Caucasian/White, one as African American, one as Hispanic, one Bi-racial, one as American Samoan/Caucasian, and 4 did not responded ethnicity question. Ninety-four percent of the participants (n=74) were between 18 and 22 and no one was above 30 years old; three were between 23-25 and two are between 26-30. One participant did not respond the college year question; the majority of examinees were sophomores (n=34, 43% of the overall participants) and juniors (n=30, 38% of the overall participants); one was a freshman, 12 were seniors, and 1 noted other.

Reliability Statistics and Power Estimation

The research design made use of a multiple regression analysis with the dependent variable being technology adoption intention. The four predictors were 1) technology self-efficacy, 2) attitudes toward technology, 3) perceived ease of use of technology and 4) perceived barriers of technology adoption. A total of 79 responses were used in the survey. The reliability of the survey, as indexed by Cronbach's α was .90, indicating a relatively high reliability. For the predictors technology self-efficacy and attitudes toward technology, Cronbach's α was .92 and .87, respectively, showing a relatively strong reliability as well. For perceived ease of use of technology and perceived barriers of technology adoption, Cronbach's α was .76 and .79,

respectively, which were acceptable. The power for this research was estimated through the software G*power with an estimated power of .77 under medium effect size, which was acceptable and .99 under large effect size.

Multiple Regression Analysis

The multiple regression assumptions were tested. Firstly, the scatter plots showed linear relationships between the dependent variable and predictors. Secondly, all the VIFs for the predictors ranged from 1.05 to 2.15, which were lower than 10, indicating no multicollinearity occurred (Neter, Wasserman & Kutner, 1989). Thirdly, residual scatterplot demonstrated the assumption of independence of the errors and homoscedasticity were held. Finally, the histogram and normal P-P plot showed the errors were approximately normal distributed.

Shapiro-Wilk test of normality indicated that the distribution of technology self-efficacy was approximately normal (p=.065) while attitudes toward technology, perceived ease of use of technology and perceived barriers of technology adoption were not normal distribution. (p=.004, p=.003 and p=.021, respectively). Due to the violation of normality, Kendall's Tau for pairs of variables were examined to show the relationships among all variables of this study (see Table 2). The Statistical significant correlations occurred among all pairs of variables except perceived barriers of technology adoption, that is, perceived barriers of technology adoption was not significantly related to the other variables. The dependent variable technology adoption intention had a moderate correlation with technology self-efficacy (τ_b =.32, p<.001), attitudes toward technology (τ_b=.50, p<.001) and perceived ease of use of technology (τ_b =.28, p=.001). Technology adoption intention was weakly correlated with perceived barriers of technology adoption (τ_b = -.057, p=.515).

Table 2

Correlations among Variables

Scale	Self-efficacy	Attitudes	Ease of use	Barrier
Intention	.32***	.50***	.28**	-.057
Self-efficacy		.33***	.56***	.14
Attitudes			.38***	-.068
Ease of use				.058

Note. ** p<.01, *** p<.001two-tailed.

The results for the multiple regression analysis were presented in Table 3. For the prediction on technology adoption intention from the overall model, R^2 = .33, suggested that around 33% of the variance in technology adoption intention could be explained by all four predictors. The overall multiple regression model was statistically significant, $F(4, 74) = 9.01$, $p < .001$, f^2=0.49.

Table 3

Multiple Regression Analysis

Variable	R^2	Adj R^2	F	f^2	β	t	Sr^2	p
Model	.33	.29	9.01	0.49				.000
Self-efficacy					.39	2.90	.076	.005
Attitudes					.48	4.19	.16	.000
Ease of use					-.33	-2.33	.049	.022
Barrier					-.065	-.67	.004	.506

Technology self-efficacy significantly predicted technology adoption intention when the other three predictor variables were statistically controlled: $t(74) = 2.90$, $p = .005$. The square semipartial that estimated how much variance in technology adoption intention was uniquely

predictable from technology self-efficacy $sr^2 = .076$, showed that about 8% of the variance in technology adoption intention was uniquely explained from technology self-efficacy after statistically controlling the other three predictors.

Attitudes toward technology was statistically significant predictive of technology adoption intention when the other predictor variables were statistically controlled: $t(74) = 4.19$, $p < .001$. The square semipartial was $sr^2 = .16$. About 16% of the variance in technology adoption intention was uniquely predictable from attitudes toward technology when the other three predictors were statistically controlled.

Perceived ease of use of technology was statistically significant predictive of technology adoption intention as well when controlling other predictors: $t(74) = -2.33$, $p = .022$. The square semipartial $sr^2 = .049$, that is, it uniquely explained around 5% of the variance in technology adoption intention. Nevertheless, perceived barriers of technology adoption was not a significant predictor: $t(74) = -.67$, $p = .506$.

Gender Analysis

Statistical analyses were employed to determine whether there were statistically significant differences on the four predictors between male and female pre-service teachers. As mentioned above, technology self-efficacy was normally distributed. Accordingly, the authors conducted independent t test for technology self-efficacy since the normality assumption was held. The Levene's test was not statistically significant (F=0.305, p=.582), indicating the equal variance assumed was upheld. The Bonferroni correction was applied to reduce the Type I errors (α=.0125) because of multiple comparisons. Technology self-efficacy did not significantly differ between gender, t (77) =1.06, p=.291, d=0.28.

Nonparametric tests should be considered for the other three predictors because of the violation of normality assumption. Consequently, a series of Mann-Whitney U Tests were conducted. There was no significant difference on attitudes toward technology (U=554, p=.688, r=.045). Similarly, perceived ease of use of technology did not perform significant difference between male and female (U=486, p=.237, r=.13). There was no significant difference on perceived barriers of technology adoption as well (U=545, p=.613, r=.057).

Qualitative Analysis

Two open-ended questions were examined. Firstly, the second author on this paper developed the themes and made definitions on the themes. Then the first author reviewed the themes and provided feedback. After discussing and refining the themes several times, the final data analyses were reported. Forty-three participants answered the open-ended question: What is the single most important advantage do you perceive using technology in education? Nineteen responses were positively related to "students", that is, around 44% of the 43 responses indicated that students were able to benefit from the use of technology in education. For instance, one participant reported, "Allows students to have another outlet rather than traditional means." Another examinee stated, "Helping students keep up to date with technology and showing good examples of how to use it." Likewise, a participant mentioned, "Being able to provide more opportunities for my students." Seven responses were related to "easy access". For instance, one participant answered this question as "Exposure and access to more material". Another respondent stated as "Being able to access classroom information online." Five answers for this question were associated with "connections". For example, the respondents indicated that using technology "Connecting with the world and other students/classrooms." or "CONNECTING OTHERS". In addition, three responses were related to "research", three responses were

associated with “communication” and three responses were about “efficiency”. It is worth mentioning that there were some other states like “Fun for the students”, “smart board” and “keeping up with the pace of our society.”

Thirty-one examinees responded the open-ended question: Please write down any of your thoughts concerning adopting technology in classrooms. Thirteen responses (42%) from this question further confirmed the advantages of using technology in classrooms. One participant stated, “Technology simply makes the classroom work more efficiently.” Another participant mentioned, “I think it is beneficial to the students and the teachers. I will be using different types of technology in my future classroom to ensure my students are getting the most out of my lessons.” A response indicated, “I think adopting technology into the classroom is a great idea.” Eight participants (26%) proposed their concerns on the technology adoption in classrooms. For example, an examinee wrote, “The more popular technology becomes within classrooms, a concern I have is the degree of distraction the students could have if they spend some time on the Internet. Games, Facebook, Twitter.” Another participant reported, “I worry that technology will distract my students from their academics. Additionally, I am do not feel that I am technologically competent, so I fear that I will not be able to use technology as well as some of my students.” Likewise, a response stated, “Adopting technology can really hurt the classroom when the school doesn't have high quality technology to use. If you order the mobile lab for the day and none of the computers can connect to the Internet in time to start the project, then the class period is wasted.” In addition, two participants both confirmed the advantage of adopting technology and presented the concerns: “Technology is good but sometimes the resources aren't available.” and “I think that adopting technology in classrooms is a wonderful idea. My only concern is that sometime students and teachers get too dependent on the technology and then

when it stops working they don't have a back up and/or have trouble teaching without the technology." Five participants provided comments and suggestions like "The lack of funding in a school making it unable to give students enough computers to use for the classroom discussions." and "Teachers who are already in the field need proper instruction on how to use certain technological pieces and how to troubleshoot." and "don't tell me what to do." etc. Moreover, two examinees preferred the traditional teaching method, stated as "I PREFER CLASSIC INSTRUCTION." and "I like the idea of using technology in the classroom, but it should always be in addition to true face-to-face, hands on teaching." Finally, one respondent had a neutral attitude, "Some is relevant, some is unnecessary."

Conclusions and Discussion

Most previous research (Holden & Rada, 2011; Sadaf, Newby, & Ertmer, 2012; Teo, Lee, & Chai, 2008) only focused on either Theory of Planned Behavior Model or Technology Acceptance Model. However, in the current study, the authors proposed a model based on both of theories, aiming to explore the significant factors, which have effects on the technology adoption intention of pre-service teachers.

Some of the results from this research were in agreement with those of prior studies (Anderson, Groulx, & Maninger, 2011; Buckenmeyer, 2010; Igbaria & Iivari, 1995; Miranda & Russell, 2012). First of all, according to the correlation results (Table 2), technology self-efficacy drawn from the TPB model and perceived ease of use of technology drawn from the TAM model had the highest correlation coefficients compared to the other variables, which was consistent with the study conducted by Igbaria and Iivari (1995). Fanni, Rega, and Cantoni (2013) argued that technology self-efficacy was a valid factor to evaluate teachers' technology adoption in class. Researchers have found that when evaluating teachers' technology acceptance, their

technology self-efficacy was a better predictor than computer self-efficacy (Holden & Rada, 2011) In fact, it was not surprising that pre-service teachers who hold higher beliefs of their technology ability also considered technology easier to use in classrooms. Second, the results from the multiple regression analysis showed that about 16% of the variance in technology adoption intention was uniquely predicted by attitudes toward technology, while approximately 8%, 5%, and 0.4% variance were uniquely explained by technology self-efficacy, perceived ease of use of technology and perceived barriers of technology adoption, respectively. Attitudes toward technology were reported as the most important factor to influence on pre-service teachers' technology adoption intention in this study. Buckenmeyer (2010) proposed that attitudes toward technology were the most influential factor that predicted teachers' technology adoption. Anderson, Groulx, and Maninger (2011) stated that value belief, which was the perceived value of using technology in education, was the best predictor of pre-service teachers' technology adoption intention. Miranda and Russell (2012) reported one important factor affecting teachers' technology usage was whether they believed technology would help teaching and learning. Inan and Lowther (2010) reported that attitudes toward technology being the most influential factor that explained teachers' technology uses. Obviously, this finding in the present research was consistent with that of some prior studies.

This study demonstrated that technology self-efficacy, attitudes toward technology and perceived ease of use of technology were statistically significantly predictive of technology adoption intention, parallel to the observation of Teo's (2009) study indicating computer self-efficacy, attitudes toward computer usage, and perceived usefulness significantly predicted pre-service teachers' intentions in using computers.

Venkatesh (2000) suggested that several determinants affected perceived ease of use of certain technical systems, including "computer self-efficacy, facilitating conditions, computer playfulness, and computer anxiety" (p. 342). Teo, Ursavaş, and Bahçekapili (2012) found that perceived usefulness and perceived ease of use were two most significant factors on pre-service teachers' attitudes toward technology. They stated that perceived ease of use was one of the factors that had indirect effects on pre-service teachers' technology adoption intentions. Some researchers mentioned that pre-service teachers' technology perceived ease of use was significantly correlated with perceived usefulness (e.g. Teo & Noyes, 2011). Ma, Andersson and Streith (2005) reported that perceived ease of use was not a significant predictor on people's intention of adopting technology; however, they stated that technology adoption intention was correlated with perceived usefulness, that is, perceived ease of use indirectly affected technology adoption intention indirectly.

In the present research, the authors reached a conclusion that perceived ease of use of technology was significantly predictive of the technology adoption intention. Obviously, it was not totally consistent with the findings of all the previous studies (e.g. Goktas, Yildirim, & Yildirim, 2009), which might be explored more in the future study to confirm its impaction on pre-service teachers. This study suggested that perceived technology barriers from the TPB model did not significantly predict technology adoption. It might be explained that the potential technology integration barriers presented in the original instrument by Brush, Glazewski, and Hew (2008) were not considered as strong barriers that could prevent pre-service teachers from planning to use technology in their classrooms by the sample of this study. For instance, "lack of or limited access to computers in schools" (p. 121) might no longer be a serious problem for many schools in the U.S. recently. Students know how to use digital devices after bringing their

own devices to school under the Bring Your Own Device (BYOD) model (Ballagas, Rohs, Sheridan, & Borchers, 2004; Song, 2014). As more digital natives growing up using different technology in life became teachers, they would not consider themselves as lack of technical knowledge or skills. This might no longer be perceived as a barrier to use technology in classroom. Early studies have shown that although digital natives lack the skills of more advanced technology, they were very familiar with basic technology like social networking (Lei, 2009). Ng (2012) noted that digital natives were able to learn unfamiliar technologies easily in their own learning.

Previous studies only explored gender differences on part of the variables examined. Zhou and Xu (2007) proposed that males were more confident with their technology skills than females and females considered technology adoption barriers more greatly than males. Sang, Valcke, Braak, and Tondeur (2010) failed to find any gender as an important factor to affect teachers' technology adoption. Few studies have mentioned how the gender difference impact on all the predictors: technology self-efficacy, attitude toward technology, perceived ease of use of technology and perceived barriers of technology adoption, however, the present study indicated that no statistically significant difference occurred on all influence factors between male and female.

The qualitative data provided more detail information about the participants' attitudes toward technology adoption in education or in classrooms. The participants' comments and suggestions can assist the future survey design on exploring similar topic of technology adoption. Some participants discouraged the technology adoption in classrooms since they concerned the use of technology would have negative impact on students. Several participants were aware of the issue that technology integration was dependent upon the school policy related to technology.

Previous studies have demonstrated that school policy on technology had a major influence in teacher's technology incorporation in class (Park, Lee, & Cheong, 2007; Tondeur, van Keer, van Braak, & Valcke, 2008; Warschauer, Knobel, & Stone, 2004). Qualitative data analysis revealed that pre-service teachers were aware of the potential harmful consequences of integrating technology into teaching, including using technology might hinder students' thinking because they became too dependent on them, technology could harm student-teacher relationship, technology might distract students' attention in class, and technology could be unreliable and might not be appropriate for everyone, etc. The concerns summarized in this study can guide researchers to investigate how to avoid the disadvantage of using technology in education or classrooms.

Behavior intentions are by no means equal to actual behaviors. In TPB, behavior intentions and perceived behavior control might predict the actual behaviors (Ajzen, 1991). Because of the limited prediction power of consumers' behavioral intention and their actual behaviors, Chandon, Morwitz, and Reinartz (2005) developed models to better predict actual purchasing behavior from consumers' intentions. Baumeister, Vohs, and Funder (2007) encouraged phycologists to use more observation of actual behaviors instead of asking participants to self-report their behavioral intentions. This study measured pre-service teachers' technology adoption intentions because most participants were college students without the opportunities to actually incorporate technology in real classrooms. It is acknowledged that these participants' actual technology adoption behaviors might be different by the time they find a teaching job. Future studies can test the relationships between pre-service teachers' technology adoption and their actual behaviors in a longitudinal study or focus on in-service teachers' technology adoption behaviors.

Admittedly, there are some limitations in this study. One is the use of convenience sampling. The participants in the study are not exactly representatives of the population. Using convenience sampling will limit the generalization of this study to some extent. A related issue is the potential biased attitude toward technology held by students enrolled in a technology course. Another limitation is regarding to the self-designed survey items for variables technology adoption intention and perceived ease of use, which may need a further confirmation on its generalizability although the reliability of those items are fairly high. Sample size in this study is relatively small. Future studies should try to recruit larger sample sizes to reduce uncertainty in statistical testing.

Implications

The current study has several practical implications to guide school administrators in designing teacher professional development program and those working on teacher technology education curriculum at universities. The study confirms that attitudes toward technology is the most influential factor to impact technology adoption intentions, so it reminds scholars that offering professional development to improve teachers' attitudes toward technology can be an effective way to encourage their technology adoption. Similar suggestions were provided by other researchers (Hew & Brush, 2006; Kopcha, 2012; Swan, & Dixon, 2006). In addition to attitudes toward technology, it is important to develop curriculum or professional development that can increase both pre-service and in-service teachers' technology self-efficacy. Prior research indicated that pre-service and in-service teachers' technology self-efficacy increased after receiving computer literacy courses or teacher professional development (Brinkerhoff, 2006; Papastergiou, 2010; Watson, 2006). Ertmer and Ottenbreit-Leftwich (2010) pointed out that there were other methods to increase teachers' technology self-efficacy in addition to

exposing them with personal successful technology adoption experience. How to design technology professional development for supporting teachers to gain perceived technology self-efficacy can be investigated in the future research.

Some theoretical implications may benefit future researchers. Further investigation can be conducted to determine the perceived ease of use of technology's impact on the technology adoption intention since discriminated results obtained from a variety of studies. This study concluded that perceived barriers of adoption technology was not a significant predictor on pre-service teachers' intention of using technology. It might be that today's pre-service teachers won't consider the perceived barrier items from the earlier study as current barriers. Further examination is needed to investigate whether there are emerging barriers that may discourage the contemporary pre-service teacher from using technology in his/her future classrooms. Hew and Brush (2006) describe teachers' lack of pedagogical knowledge of adopting technology in classrooms as a major barrier instead of the barriers on a resource level such as lack of computer access. It is worth investigating the existing barriers and how to eliminate the barriers, which will make the contemporary pre-service teachers use technology more effective in their courses.

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