



Mobile learning: Pre-service teachers' perceptions of integrating iPads into future teaching

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Abstract

This study investigated pre-service teachers' perceptions of using iPads in teaching, with a focus on motivation to adopt iPads, iPad-integration self-efficacy, and intention to adopt iPads for future teaching. Changes of pre-service teachers' perceptions of using iPads over time as well as the relationships of motivation, self-efficacy, and intention for iPad adoption were examined. Participants were pre-service teachers from a university in the northeastern United States. Data were collected using online pre- and post-surveys. Quantitative and qualitative approaches were performed to analyze the data. Results indicated that there were significant changes in pre-service teachers' motivation and intention to adopt iPads before and after their participation in a mobile learning project. Motivation and iPad-integration self-efficacy were significant predictors of pre-service teachers' intention for future adoption. iPad ownership and prior experience with iPad-integrated lesson plans were potential factors that had a significant impact on pre-service teachers' perceptions of using iPads in future teaching. Pre-service teachers' perceived advantages and disadvantages of using iPads were reported and discussed. The findings of this study not only contribute to the understanding of iPad integration among pre-service teachers, but also provide an evidence on the positive influence of iPad-integrated activities on pre-service teachers' perceptions of using iPads for future teaching.

Keywords Mobile learning · iPad integration · Motivation · Self-efficacy · Intention · Pre-service teachers · Change of perceptions

1 Introduction

The rapid spread of mobile technologies has enhanced the development of mobile learning (M-learning) in both K-12 and higher education (Ata & Cevik, 2019; Christensen & Knezek, 2018; Parsons & MacCallum, 2020). M-learning refers to ubiquitous learning opportunities that take place through the use of mobile devices such as smart phones, tablets, or tablet computers. Through M-learning, learners with wireless devices are able to learn anytime and anywhere by connecting to and interacting with content on mobile devices (Almaiah & Abdul Jalil, 2014; Almaiah, Almomani, et al., 2021; Kukulska-Hulme et al., 2021). Due to the features of mobile devices such as affordability, availability, flexibility, and portability, as well as the relevant infrastructure and resources that have been invested in support of the use of mobile devices (Almaiah et al., 2022; Johnson et al., 2011), integrating mobile technologies into teaching and learning has become a trend and gained educators' attention.

With the increasing interest of mobile learning in education, it is necessary for teachers to be aware of the value of applying mobile technologies in teaching as well as strategies that can help teachers integrate such technologies into their classes in an effective way (Baran, 2014; Schuck et al., 2013). The research on mobile learning in teacher education is at the growing stage (Menon et al., 2020), with the majority of relevant work under-theorized (Kearney & Maher, 2013) and a limited number of mobile learning research on teacher support and teacher training (Ekanayake & Wishart, 2014; Kearney & Maher, 2019). Owning mobile devices does not indicate the proficiency or effectiveness of use of mobile devices for teachers and students (Christensen & Knezek, 2018). It is imperative to equip teachers with the knowledge and skills to incorporate and implement mobile learning opportunities in ways that enhance student learning, shape students' understanding of a concept or a subject, or facilitate classroom activities (Bano et al., 2018). To inspire pre-service teachers' use of mobile devices in future teaching and to further their knowledge about the potential of mobile learning, this study focused on exploring pre-service teachers' experiences during a mobile learning project implemented with iPads.

iPads, one type of the mobile technologies for teaching and learning, have the potential to promote student-centered learning and to improve teaching effectiveness (Hashim, 2014; Steeg et al., 2014; Vaughan et al., 2015). Galway et al. (2020) pointed out the critical role of iPads serving as an effective tool to facilitate collaborative learning among students and resource persons or mentors. Yusup (2014) found teachers' preferences of using iPads in teaching and that teachers indicated the use of iPads as an important approach for them to share or exchange information with their colleagues. Pegrum et al. (2013) indicated that iPads support pre-service teachers' learning in developing their understanding of content and pedagogy, and help them stay organized or connected. Although there is an increase of iPad adoption at different educational sectors, limited empirical research on pre-service teachers has investigated how or whether the use of iPads enhances pre-service teachers' learning and their views of using iPads to improve their teaching and their students' learning (Kearney & Maher, 2019; Menon et al., 2020).

Motivation and self-efficacy are two of the most important factors that influence teachers' intention to adopt or integrate a new technology into classrooms (Kuo,

2015; Ertmer et al., 2012; Menon et al., 2017; Sad & Goktas, 2014; Tonbuloglu & Kiyici, 2018). Teachers who see the value of mobile learning are more likely to show an interest in integrating these devices into their classes. The confidence level of teachers' knowledge and skills in using mobile devices to develop activities for various instructional purposes and engage their students in the learning process is critical to successful integration of mobile technologies. Teachers who feel more confident in their abilities to perform teaching-related tasks (e.g., teaching content, managing class, providing feedback, etc.) using mobile devices are more likely to apply such devices in their instruction. Other issues or problems related to the use of iPads for teachers include technical/network challenges, lack of support or training, equity of access, and shift of pedagogical strategy for iPad use (Galway et al., 2020; Marron & Coulter, 2021). For example, the unstable connectivity between the iPad and classroom project devices would prohibit instructors from incorporating iPads in teaching, and technical problems would decrease pre-service teachers' interests of using iPads or relevant applications in the learning process (Galway et al., 2020). The access to iPads is also a problem (Galway et al., 2020; Marron & Coulter, 2021). Many pre-service teachers did not own an iPad, which might lead to the issues including pre-service teachers not fully engaged in the learning activities where iPads are required, the pressure for instructors to modify lessons to use other or similar applications to achieve the same learning performance, etc.

Teachers change their perception of adopting new technologies during or after they gain an opportunity to use them through teaching, training, professional development, or other associated learning opportunities (Chiu & Churchill, 2016; Ertmer & Ottenbreit-Leftwich, 2010). Limited research on mobile learning has investigated changes of teachers' perceptions of using mobile devices in their classes (Chiu & Churchill, 2016; Menon et al., 2020). Moreover, the studies on the use of mobile devices (e.g., iPads) in teacher education contexts are limited (Brown & Englehardt, 2019; Menon et al., 2020). Parsons and MacCallum (2020) indicated the importance of providing pre-service teachers with opportunities to engage with mobile technologies to be well prepared for teaching in the classroom. The majority of existing research examined pre-service teachers' perceptions of using iPads through qualitative analyses, and none of the studies have investigated motivation, self-efficacy, and intention together. Therefore, it is imperative to conduct more studies to investigate pre-service teachers' perceptions of integrating iPads, and how their perceptions change after an intervention (e.g., mobile learning related opportunities). To increase the understanding of iPad integration in teaching and to better prepare pre-service teachers for the integration of mobile technologies in their future teaching, this study investigated pre-service teachers' perceptions of incorporating iPads into future teaching through an iPad-integrated project, with a focus on factors including motivation, self-efficacy, and intention to adopt iPads.

2 Literature review

2.1 Mobile learning in teacher education

Recently, researchers and educators have started linking the importance of mobile learning to teacher education by exploring the potential and value of mobile learning and devices in teacher education contexts (Ata & Cevik, 2019; Kuo & Kuo, 2020; Baran, 2014). Mobile learning provides extended interactions among students or between teachers and students within or beyond classrooms or meeting locations through communication networks. The feature of mobility not only enhances engagement across physical, conceptual, and social spaces (Sharples et al., 2009), but also provides teachers and students with seamless access to information and resources, as well as opportunities for personalized, situated, or collaborative learning in independent, authentic, or informal contexts (Cheon et al., 2012; Kearney & Maher, 2013; Martin & Ertzberger, 2013).

Among the mobile learning studies conducted in teacher education contexts, the majority focus on the application and implementation of a mobile learning system, programs, or projects related to presentations of cases or course activities. Within the various options of mobile devices that can be used, mobile phones appeared to be used most frequently in teacher education contexts, followed by tablets (such as iPads) and other types of devices (Baran, 2014). Most of the relevant research in teacher education has generally indicated mobile learning as a beneficial approach that has a positive impact on students' learning experiences as well as teachers' learning experiences and professional development (Baran, 2014; Bas & Sarigoz, 2018; Burke & Foulger, 2014; Pegrum et al., 2013). Pre-service teachers value mobile learning because mobile devices provide opportunities for knowledge transmission, learning facilitation, active learning, technology support, and increased student engagement and collaboration (Menon et al., 2020; Tsai & Tsai, 2019). On the other hand, several barriers, concerns, or disadvantages related to mobile learning were reported, including accessibility limitations, lack of technical support, continuous training opportunities, threats to human health (e.g., eye strain), student distraction, classroom management problems, poor technology literacy, and so on (Burden & Hopkins, 2016; Sad & Goktas, 2014; Vasinda et al., 2017; Walsh & Farren, 2018).

In terms of the use of iPads in teacher education, few studies were conducted to investigate pre-service teachers' perceptions and use of iPads in the classroom, and most of these studies are situated in early childhood or elementary education (Brown & Englehardt, 2019; Franklin & Smith, 2015; Menon et al., 2020). The existing research indicated that pre-service teachers use iPads as learners and future teachers for content learning, skill development, teaching practice placements, and professional development (Menon et al., 2020; Mourlam & Montgomery, 2015; Reese et al., 2016). The benefits of using iPads include knowledge sharing, increased student engagement and collaboration, resource sharing, and development of technology and problem-solving skills (Galway et al., 2020; Menon et al., 2020). The challenges for iPad use include technical infrastructure issues, misalignment of iPad use with lesson content and pedagogies, lack of educational value of iPads, lack of technological sup-

port, and device and time limitations (Galway et al., 2020; Marron & Coulter, 2021; Pegrum et al., 2013).

2.2 Pre-service teachers' perceptions of mobile technology integration

2.2.1 Motivation, self-efficacy, and intention to adopt mobile technology

Mobile learning approach is beneficial to enhance teachers' learning experiences with mobile technology (Cakir, 2015) and their perceptions and skills of integrating mobile technologies (Al-Takhayneh, 2018; Baran, 2014; Baydas & Yilmaz, 2018). In pre-service teacher education contexts, motivational factors are important in determining pre-service teachers' intention to adopt mobile technologies (Baydas & Yilmaz, 2018; Tonbuloglu & Kiyici, 2018). These factors include motivation, self-efficacy, attitudes, or feelings (Kuo, 2018; Baydas & Yilmaz, 2018; Cakiroglu et al., 2017; Menon et al., 2017; Sad & Goktas, 2014; Tonbuloglu & Kiyici, 2018). In research on motivational factors for mobile learning in teacher education contexts, the focus appeared to be mainly placed upon in-service teachers' attitudes toward the use of mobile devices for teaching in different subject areas (Tilton & Hartnett, 2016). Motivation and self-efficacy about adopting mobile learning or devices for instruction were much less addressed for both pre- and in-service teachers (Hur et al., 2015; Menon et al., 2017; Sad & Goktas, 2014), although sometimes the attitude or self-efficacy construct in some research appeared to encompass the concept of motivation (Baek et al., 2017; Gunter & Reeves, 2017; Sad & Goktas, 2014).

Intention to use or adopt technology refers to the degree to which an individual is willing to use a particular technology tool (Almaiah, 2018; Davis, 1989). This variable is critical to the research of computer information systems, and in recent decades, it has been gradually applied to the field of education for research on teachers' or students' use of emerging technology tools in teaching and learning (Alghazi et al., 2021; Almaiah, 2018; Almaiah, Al-Khasawneh, et al., 2021; Althunibat et al., 2021; Baydas & Yilmaz, 2018; Hughes et al., 2017; Lestari & Indrasari, 2019). Almaiah (2018) conducted a study to investigate students' use and acceptance of a mobile information system at University of Jordan, and found that factors including trust, perceived security, perceived ease of use, and context of applications had a significant impact on students' intention to use the mobile system. Almaiah et al. (2021) explored the influence of individual, technological, and psychological factors on students' use of mobile learning applications during the covid-19 pandemic. They found that technological factors (e.g., Internet speed, easy access, etc.) were significant factors, and that individual factors (e.g., knowledge, training, etc.) had a positive impact on students' motivation for mobile learning. Psychological issues (e.g., stress, phobia of working, etc.) would impede students' continuous use of mobile applications.

Based on the model of mobile learning adoption developed by Hashim et al. (2015) that included major variables from the technology acceptance model (Davis, 1989; Baydas & Yilmaz, 2018) proposed the same mobile learning adoption model for pre-service teachers from motivational perspectives. They found that pre-service teachers' intention to adopt mobile learning was directly influenced by three motivational needs (i.e., affective, cognitive, and social needs) and attitudes. Similarly, Ismail et al.

(2013) found that Malaysian teachers' motivation to accept the use of mobile phones was positively related to their readiness for mobile learning. Lestari and Indrasari (2019) investigated the factors that influenced teachers' adoption of iPads in the upper-middle-class schools in Indonesia, and found that teachers' ability to perform iPad related activities (e.g., notetaking, online assessment, online collaboration, etc.) had a significant impact on their adoption of iPad for teaching. In the study exploring factors associated with high schools teachers' iPad adoption, Hughes et al. (2017) found that iPad-supported practices, including replacement, amplification, and transformation activities, are important for iPad adoption or integration in teaching STEM courses. Most of the existing research indicates that pre-service teachers tend to have positive attitudes toward the adoption of mobile technologies in their teaching (Bas & Sarigoz, 2018; Burke & Foulger, 2014).

On the contrary, there are several studies indicating pre-service teachers' low levels of perceptions about mobile learning and their preferences for using or adopting laptops over mobile phones (Sad & Goktas, 2014; Serin, 2012; Thomas & O'Bannon, 2013). For example, Sad and Goktas (2014) investigated pre-service teachers' perceptions of mobile learning tools (i.e., mobile phones, mobile laptops) and found that pre-service teachers had less positive attitudes toward using mobile phones than mobile laptops. It is necessary to conduct more research to verify pre-service teachers' viewpoints about using mobile tools, especially on their perceptions of using iPads.

Self-efficacy for technology integration is an important factor that influences teachers' actual use, acceptance, or adoption of technology in teaching (Anderson et al., 2011; Ertmer et al., 2012; Lestari & Indrasari, 2019; Mac Callum et al., 2014; Sang et al., 2010). It refers to teachers' confidence in their capabilities to successfully incorporate technology into teaching to facilitate student learning (Hur et al., 2015; Menon et al., 2017). Teachers with higher levels of technology integration self-efficacy are more open to new ideas, strategies, or experiments for incorporating technology to create learning opportunities, and are more willing to put forth continuous efforts to tasks that involve the use of technology (Anderson & Maninger, 2007). Pre-service teachers' self-efficacy regarding mobile technology integration is highly related to their intention to adopt mobile devices in teaching (Burden & Hopkins, 2016; Hur et al., 2015; Menon et al., 2017). Hur et al. (2015) explored factors that affect pre-service teachers' intention to utilize mobile devices for teaching through structural equation modeling (SEM). Self-efficacy for technology integration was found to have a significant influence on intention to use mobile devices, in both direct and indirect ways. Burden and Hopkins (2016) indicated the importance of self-efficacy for mobile technology adoption from their study examining pre-service teachers' beliefs regarding using mobile technologies as a teaching or learning tool. Low self-efficacy for using iPads effectively in teaching was considered as the second order barrier that is internal to pre-service teachers' mobile technology adoption (Burden & Hopkins, 2016).

2.2.2 Changes in pre-service teachers' perceptions of mobile technology integration

Providing teachers with personal and successful experiences with new technology and innovations leads to teacher change in knowledge, self-efficacy, and pedagogical belief about technology integration (Chiu & Churchill, 2016; Ertmer & Ottenbreit-Leftwich, 2010; Kim et al., 2016). Teachers' adoption of mobile devices enhances not only teachers' understanding of the use and value of mobile learning, but also student learning outcomes (Chiu & Churchill, 2016) examined secondary school teachers' changes in beliefs, attitudes, and anxiety for the adoption of mobile devices after these teachers used these mobile devices to teach various subjects. No changes in attitudes and anxiety were found after the use of mobile devices. Teachers who taught mathematics and science had a significantly positive change in their beliefs about the use of mobile devices.

Pre-service teachers' current use of mobile technology forms their perceptions of adopting mobile technology for instructional or future use (Cakiroglu et al., 2017). They continuously develop their belief system about mobile technology integration through their experiences of teaching and learning with mobile technology as well as models or support provided in teacher education programs that help them to shape their ideas of leveraging technological resources as pedagogical tools (Cakiroglu et al., 2017; Ertmer & Ottenbreit-Leftwich, 2010). Menon et al. (2017) explored pre-service teachers' self-efficacy about the use of iPads in a physics content course. Through a pre- and post-implementation, significant gains were found in pre-service teachers' self-efficacy regarding using mobile technologies in science teaching. Several factors contributed to this change, including experiences with iPads, understandings of science content, interactivity and engagement, and instructor modeling the use of technology.

2.3 Research questions

Among the research on the use of iPads in teacher education, limited studies were conducted to examine pre-service teachers' motivation and self-efficacy for using or integrating iPads (Mourlam & Montgomery, 2015; Menon et al., 2020). To add more evidence to the existing literature, this study investigated pre-service teachers' perceptions of adopting mobile technologies, with a focus on factors including motivation, self-efficacy, and intention to adopt iPads. We examined the changes of proposed factors and the relationships of these factors. In addition, technology ownership was found to be related to technology adoption (Potter & Thompson, 2019). An individual's prior experiences of using a technology tool may have an influence on his or her future adoption for that tool (Almaiah et al., 2016; Almaiah, Al-Khasawne, et al., 2021; Talukder, 2012). Therefore, we explored factors, including iPad ownership and prior experience with iPad-integrated lesson plans, in our study.

1. Are there changes in pre-service teachers' motivation, iPad integration self-efficacy, and intention to adopt iPads for future teaching after their participation in an iPad-integrated project?

Table 1 *Background Information of Pre-service Teachers*

Characteristic	<i>n</i>	%
Gender		
Male	10	14.3
Female	60	85.7
Age		
18–19	19	27.1
20–21	32	45.7
22 and above	19	27.2
Grade level		
Freshman	5	7.1
Sophomore	24	34.3
Junior	35	50.0
Senior	6	8.6
iPad owner		
Yes	22	31.4
No	48	68.6
Prior experience with iPad-integrated lesson plans		
Yes	5	7.1
No	65	92.9

Table 2 *Instruments*

Scales	Number of items	Range	Cronbach's alpha
Motivation	4	1–7	0.97
iPad integration self-efficacy	16	1–5	0.97
Intention to adopt iPads	3	1–7	0.96

2. Do pre-service teachers' motivation, iPad integration self-efficacy, and intention to adopt iPads differ in terms of iPad ownership and prior experience with iPad-integrated lesson plans?
3. What are the relationships between pre-service teachers' motivation, iPad integration self-efficacy, and intention to adopt iPads?
4. Do pre-service teachers' motivation and self-efficacy to integrate iPads predict their intention to adopt iPads in future teaching?
5. What are pre-service teachers' perceptions of using iPads for future teaching?

3 Method

3.1 Participants

Participants were 70 students enrolled in the Educational Technology courses from a northeastern university in the United States (see Table 1). The undergraduate-level courses, offered through the College of Education, were face-to-face and taught by the same instructor in the Spring semester. The undergraduate students were pre-service teachers, with the majority of them in their sophomore or junior year. There

were much more female students (85.7%, $n=60$) than male students (14.3%, $n=10$). Most of them aged between 18 and 21 years (72%, $n=51$). About one third reported owning an iPad, and only 7.1% of these students had the experience of developing an iPad-integrated lesson plan before attending the Educational Technology class.

3.2 Procedure

Students in the class were asked to participate in the mobile learning project (known as the iPad project) that involves the development of an iPad-integrated lesson plan. The project required students to explore and analyze apps through iPads that show potentials to enhance student learning in the subject areas that they will teach in the future, and to develop a lesson plan that includes selected apps from their exploration. This project took about seven weeks to complete. Before the project started, the instructor provided an overview of this project, indicated the components required for the lesson plan, and offered assistance to students who encountered difficulties or problems throughout the development process.

3.3 Data collection

The study was conducted using an online survey. The approval from the university's Institutional Review Board (IRB) was obtained before the online survey was distributed to the students. The online pre- and post-surveys were provided to students at the beginning of the mobile learning project and at the end of the semester. The survey questionnaire consisted of four sections: student background information, motivation, iPad integration self-efficacy, and intention to adopt iPads. Student background information included gender, age, grade level, iPad ownership, and prior experience of developing an iPad-integrated lesson plan. One open-ended question that asked about pre-service teachers' perceptions of using iPads for future teaching was only included in the post-survey.

The motivation scale, developed by Shroff and Keyes (2017), was adapted to measure pre-service teachers' perceived interest in using iPads for future teaching. The wording about the name of technology tools and the course in the item was changed to iPads and teaching, respectively. The iPad-integration self-efficacy scale was adapted from the instrument developed by Wang et al. (2004) that measured pre-service teachers' technology integration self-efficacy. The wording of computers in the item was changed to iPads. The scale measuring pre-service teachers' intention to adopt iPads for teaching was adapted from the instrument developed by Hashim et al. (2015). Both motivation and intention for iPad adoption scales are a 7-point Likert scale. The iPad-integration self-efficacy scale is a 5-point Likert scale. These three scales were validated (e.g., the measurement of content or construct validity), and the reliability information of these scales was reported with Cronbach's alpha values larger than 0.8 in the original studies. The Cronbach's coefficient alpha values calculated based on the sample of this study were high: motivation (0.97), iPad integration self-efficacy (0.97), and intention to adopt iPads (0.96) (see Table 2).

Table 3 *T-test Analysis for Pre- and Post-scores in Motivation, iPad Integration Self-efficacy, and Intention to Adopt iPads*

	Pre		Post		<i>t</i> (69)	<i>p</i>	Cohen's <i>d</i>
	M	SD	M	SD			
Motivation	5.95	0.99	6.18	0.92	2.461	0.016*	0.24
iPad integration self-efficacy	4.28	0.69	4.54	0.49	4.540	0.000***	0.43
Intention to adopt iPads	5.79	1.25	5.99	1.04	1.765	0.082	0.17

Note. * $p < .05$; *** $p < .001$

3.4 Data analysis

Data were analyzed using quantitative and qualitative approaches. Quantitative approaches included descriptive analyses, T-tests, and correlation and regression analyses. SPSS 20 was used for data analyses. Content analysis was applied to analyze the open-ended question.

4 Results

This section includes information about the results of data analysis for research questions proposed in this study.

4.1 RQ1: Are there changes in pre-service teachers' motivation, iPad integration self-efficacy, and intention to adopt iPads for future teaching over time?

Paired-sample *t*-tests were performed to answer research question one (RQ1). Normality of data distribution was acceptable with the absolute value of skewness and kurtosis smaller than 1.96. Table 3 shows the changes of scores in pre-service teachers' perceptions of adopting iPads for future teaching before and after they participated in the iPad-integrated project. There was an increase of the average scores from pre- to post-surveys about pre-service teachers' perceptions of adopting iPads. Pre-service teachers' motivation ($t = 2.461$, $p < .05$) and iPad integration self-efficacy ($t = 4.540$, $p < .001$) significantly increased after their participation in the project. For intention to adopt iPads, although an increase of averages was detected, the change was not significant ($t = 1.765$, $p > .05$).

4.2 RQ2: Do pre-service teachers' motivation, iPad integration self-efficacy, and intention to adopt iPads differ in terms of iPad ownership and prior experience with iPad-integrated lesson plans?

Independent *t*-tests along with Levene's test for equality of variances were performed to answer research question two (RQ2). iPad ownership appeared to be an important factor for pre-service teachers' perceptions of integrating iPads into future teaching (see Table 4). Pre-service teachers who owned an iPad had higher motivation and intention to adopt iPads in their future teaching, compared to those without an iPad ($t = 6.21$, $p < .05$). Prior experience of developing iPad integrated lesson plans had a

Table 4 *T-test Analysis for Motivation, iPad Integration Self-efficacy, and Intention to Adopt iPads in Terms of iPad Ownership*

	Having an iPad		No iPads		<i>t</i> (65)	<i>p</i>	Cohen's <i>d</i>
	M	SD	M	SD			
Motivation	6.54	0.50	6.00	1.03	2.848	0.006**	0.60
iPad integration self-efficacy	4.70	0.42	4.47	0.52	1.890	0.064	0.47
Intention to adopt iPads	6.33	0.57	5.83	1.17	2.358	0.021*	0.49

Note. * $p < .05$; ** $p < .01$

Table 5 *T-test Analysis for Motivation, iPad Integration Self-efficacy, and Intention to Adopt iPads in Terms of Prior Experiences with iPad-integrated lesson plans*

	Have experience with iPad-integrated lesson plans		No prior experience with iPad-integrated lesson plans		<i>t</i> (65)	<i>p</i>	Cohen's <i>d</i>
	M	SD	M	SD			
Motivation	6.68	0.93	6.14	0.95	1.27	0.209	0.57
iPad integration self-efficacy	5.00	0.00	4.51	0.50	7.77	0.000***	1.01
Intention to adopt iPads	6.60	0.56	5.94	1.05	1.36	0.178	0.64

Note. ** $p < .01$

Table 6 *Correlations among Variables*

	Motivation	iPad integration self-efficacy	Intention to adopt iPads
Motivation	-	0.713**	0.750**
iPad integration self-efficacy		-	0.696**
Intention to adopt iPads			-

Note. ** $p < .01$

significant influence on motivation and iPad integration self-efficacy (see Table 5). Pre-service teachers who had experience of developing iPad integrated lesson plans ($M=5.0$) showed significantly higher levels of iPad integration self-efficacy than those who had never developed an iPad integrated lesson plan ($M=4.51$), $t=6.21$, $p < .05$.

4.3 RQ3: What are the relationships between pre-service teachers' motivation, iPad integration self-efficacy, and intention to adopt iPads?

Pearson's correlation was performed to examine the relationships of proposed factors. Table 6 indicates the correlations between motivation, iPad integration self-efficacy, and intention to adopt iPads. Motivation was positively related to iPad integration self-efficacy ($r=.713$, $p < .01$) and intention to adopt iPads ($r=.780$, $p < .01$). Similarly, iPad integration self-efficacy had a positive relationship with intention to adopt iPads ($r=.696$, $p < .01$). The correlation between Motivation and Intention to adopt iPads is the strongest among the three correlations.

Table 7 Multiple Regression Model: Intention to Adopt iPads Explained by Two Predictor Variables

Variables	<i>B</i>	<i>SE B</i>	β	<i>t</i>	<i>p</i>
Motivation	0.789	0.105	0.703	7.542	0.000***
iPad integration self-efficacy	0.405	0.195	0.194	2.083	0.041*

Note. * $p < .05$; *** $p < .001$

Table 8 Advantages and Disadvantages

Advantages	Disadvantages
<ul style="list-style-type: none"> • creating enjoyable and fun ways of learning for students (15) • increasing students' learning engagement, and enhancing interactions among students, teachers, and parents (14) • enhancing the development of knowledge and skills (11) • contributing to teachers' instruction (16) • increasing the access to useful resources (7) 	<ul style="list-style-type: none"> • too much screen time (5) • distractions for students' learning (22) • addiction to electronics (5) • technology difficulties or issues (14) • unequal access to devices or WiFi (9) • teachers or students lacking adequate technology skills (4) • issues for instruction (3)

Note. The number in the parentheses shows the frequency of advantages/disadvantages indicated by pre-service teachers

4.4 RQ4: Do pre-service teachers' motivation and self-efficacy to integrate iPads predict their intention to adopt iPads in future teaching?

The multiple regression model (see Table 7) was significant, $F(2, 64) = 85.12$, $p < .001$. The model explained 72% of the variance in intention to adopt iPads. Both Motivation ($t = 7.54$, $p < .001$) and iPad integration self-efficacy ($t = 2.08$, $p < .05$) significantly predicted intention to adopt iPads. Among the two variables, motivation was the strongest predictor of intention to adopt iPads for future teaching.

4.5 RQ5: what are pre-service teachers' perceptions of using iPads for future teaching?

Most of the pre-service teachers (65 out of 70) showed their interests in using iPads and apps in their future teaching. Only a few pre-service teachers (5 out of 70) indicated that they did not prefer to use iPads for future teaching, or they were unsure about using iPads for teaching. Major reasons include the age of children and subject areas that are not suitable for the use of iPads, the preference for the traditional way of teaching, and the limited knowledge about the use of iPads for teaching.

Pre-service teachers also indicated their perceived advantages and disadvantages toward the use of iPads for future teaching. Table 8 shows the information of frequency of advantages and disadvantages mentioned by pre-service teachers. The advantages of using iPads for teaching include (a) creating enjoyable and fun ways of learning for students, (b) increasing students' learning engagement, and enhancing interactions among students, teachers, and parents, (c) enhancing the development of knowledge and skills, (d) contributing to teachers' instruction, and (e) increasing the

access to useful resources. Pre-service teachers stated that the use of iPads would create a fun and interesting learning environment to promote learning and keep students motivated and actively engaged. The use of iPads provided opportunities for students to interact with their peers through collaborative activities and keep connected with their teacher and parents. iPads have apps that are easy to use and provide useful resources to help students develop their knowledge on different subjects and their skills for collaboration, advanced technology, etc.

In terms of instruction, pre-service teachers pointed out that the use of iPads and apps would benefit their teaching in several ways, for example, creating interactive lessons or group work, organizing lessons or work, making content easier for students, grading, making rubrics or worksheets, recording student learning progress through apps, etc. Some pre-service teachers thought that the design of apps (e.g., colors, sounds, etc.) was appealing to students, and provided a better visual understanding of concepts. Apps also provided more information than the textbook could offer, and presented the content in a variety of ways (e.g., games, interactive activities, etc.) that helped students relate more to the content. In addition, some pre-service teachers thought that using iPads could reduce the use of books and paper because most of the activities and assignments could be done digitally.

The disadvantages of using iPads for teaching include (a) too much screen time, (b) distractions for students' learning, (c) addiction to electronics, (d) technology difficulties or issues, (e) unequal access to devices or WiFi, (f) teachers or students lacking adequate technology skills, and (g) issues for instruction. Pre-service teachers indicated that using iPads in the class might lead to too much screen time and students could get distracted easily and use iPads or apps for unintended purposes. Some students might even get addicted to iPads and could not physically get off iPads when they were done using them. Technical malfunctions with iPads or apps and poor Internet connection might impede both teachers and students from using iPads. In terms of equal access to devices, iPads could be expensive and not every family or school was able to afford to provide students with their own iPads.

As for the issues associated with instruction, pre-service teachers pointed out that the use of iPads might lead to a more independent classroom in which less social or face-to-face interactions took place among students. Students might lose the opportunities of practicing writing because they could become reliant on technology. It would be necessary for teachers to monitor students or their screens when using iPads and apps; however, monitoring could be time consuming for teachers. In addition, some pre-service teachers thought their students might not have enough knowledge or skills in using iPads.

5 Discussion

5.1 Pre-service teachers' motivation and iPad Integration self-efficacy increased after participating in the iPad-integrated project

Through pre- and post-questionnaires, the results revealed that pre-service teachers' perceptions of adopting and integrating iPads showed positive changes in motiva-

tion, self-efficacy, and intention. After the implementation of the iPad project in the class, pre-service teachers' motivation, self-efficacy, and intention to adopt or integrate iPads in future teaching increased, with the changes in motivation and iPad-integration self-efficacy being significant. The findings suggested that engaging pre-service teachers in activities or projects through the use of iPads helps to enhance their interests and confidence in adopting iPads in teaching, which further supported the viewpoints of Ertmer and Ottenbreit-Leftwich (2010) that hands-on experiences with technology in college classroom may facilitate the change in pre-service teachers' knowledge, skills, or attitudes regarding technology use or adoption. Teacher educators are encouraged to design activities or assignments that incorporate the use of iPads so that pre-service teachers can experience the affordances (e.g., portability, interactivity, data gathering, etc.) of iPads as learners (Menon et al., 2020; Parsons & MacCallum, 2020).

The results of this study are aligned with the study of Chiu and Churchill (2016) who found that through adopting mobile devices to teach different subjects, teachers changed their beliefs about using mobile devices in a positive way. However, their study did not find significant changes in in-service teachers' attitudes toward using mobile devices after adopting mobile devices in teaching, which is contrary to our findings that pre-service teachers experienced significantly positive changes in motivation to use iPads for future teaching. In the study of Chiu and Churchill (2016), they did not specify the types of mobile devices (e.g., iPads, iPhones, etc.) that were provided to teachers, and in our study, we focused on the use of iPads among pre-service teachers. Providing pre-service teachers with opportunities to experience different mobile learning examples modeled by their instructor appears to be an effective approach to motivate pre-service teachers to adopt mobile devices for teaching. In our study, pre-service teachers were able to learn the potential of using iPads to teach different content subjects through class discussions and the presentation of lesson plans.

Pre-service teachers' intention to adopt iPads did not show a significant change after participating in the iPad project, although an increasing average score was identified before and after the iPad-integrated project. This may be due to the timeline given for the iPad project implementation. This was too short of a time for pre-service teachers to change their intention to integrate iPads for future teaching. It takes time to develop teachers' desire and willingness for using technology (Ertmer & Ottenbreit-Leftwich, 2010).

5.2 iPad ownership and prior experience with iPad integrated lesson plans had an effect on pre-service teachers' perceptions of integrating iPads in future teaching

iPad ownership and prior experience with iPad-integrated lesson plans appeared to be important factors that impacted pre-service teachers' motivation, self-efficacy, and intention to adopt or integrate iPads in future teaching. Overall, there is a tendency that pre-service teachers who owned an iPad had higher levels of motivation, self-efficacy, and intention for iPad adoption, compared to those who did not own an iPad. Similarly, pre-service teachers who had experience with iPad-integrated lesson plans

tended to have higher average scores in motivation, self-efficacy, and intention for iPad adoption than those having no experience with iPad lesson plans. iPad ownership of pre-service teachers significantly influenced their motivation and intention to adopt iPads, but not their iPad-integration self-efficacy. It implies that owning an iPad increases the likelihood for pre-service teachers to see the value of mobile learning, develop interests of exploring potentials of iPads, and feel motivated to use them in teaching. Prior experience with iPad-integrated lesson plans had a significant influence on self-efficacy for iPad integration, but not on motivation and intention. This result suggests that providing pre-service teachers with opportunities to design lesson plans or other similar learning activities that incorporate the use of iPads contributes to the development of pre-service teachers' confidence level in their knowledge and skills of performing actions requiring the use of iPads for instructional purposes (Parsons & MacCallum, 2020).

5.3 Motivation and iPad integration self-efficacy significantly predicted intention to adopt iPads

Positive correlations were found between motivation, iPad integration self-efficacy, and intention to adopt iPads for future teaching. Both motivation and iPad integration self-efficacy were significant predictors of intention to adopt iPads, which implies that pre-service teachers who had higher levels of motivation to use iPads or confidence level in incorporating iPads into tasks relevant to teaching or learning were more likely to show the tendency to adopt iPads in their future teaching. These results were consistent with the findings of previous research where teachers' motivation and self-efficacy to adopt or integrate mobile devices were claimed or found to be closely related to their intention to adopt such devices for instruction (Baydas & Yilmaz, 2018; Burden & Hopkins, 2016; Hur et al., 2015; Ismail et al., 2013).

Existing research that investigated the cause and effect relationship between teachers' motivation and intention to adopt mobile learning was often situated in teachers from other countries such as Turkey, Malaysia, etc. (Baydas & Yilmaz, 2018; Ismail et al., 2013). The results of this study verified the effect of motivation on intention for mobile technology adoption among pre-service teachers in the United States. In addition, although self-efficacy about mobile technology integration was often claimed to be an important factor for intention to adopt mobile learning (Burden & Hopkins, 2016; Menon et al., 2017), limited research has conducted quantitative analyses to verify this assumption (Hur et al., 2015). Through regression analyses, our findings provided a supportive evidence on the role of motivation in predicting pre-service teachers' intention to adopt mobile devices.

5.4 Pre-service teachers' perceived advantages and disadvantages of using iPads for future teaching

Pre-service teachers indicated that the use of iPads would benefit their future teaching in several ways. The use of iPads would allow the creation of fun, interactive, and engaging learning environments that enhance knowledge acquisition and skill development. This finding is consistent with prior studies that indicated the use of iPads

contributed to instruction in a positive way, such as enhancing students' collaboration or learning experiences, access to available resources through apps, documenting student learning, etc. (Kuo & Kuo, 2020; Brown et al., 2016). An interesting finding, not present in prior research studies, was that pre-service teachers noted that the use of iPads would help in enhancing the communication among parents, teachers, and students when it came to student assignments and activities. For example, some apps may provide student outcome or participation reports that are accessible to teachers, parents, and students.

In terms of the disadvantages of using iPads for teaching, pre-service teachers indicated their concerns about students being distracted from learning by using iPads, teachers' and/or students' lack of adequate knowledge or skill of using an iPad, availability of iPads, and issues related to the management of instruction with iPads. Consistent with the findings of other research, distraction and lack of familiarity with iPads or apps are two major challenges that pre-service teachers may have when integrating iPads into teaching practices (Englehardt & Brown, 2019; Hutchison & Colwell, 2016). Ensuring the availability of iPads for both teachers and students plays an important role in equal learning opportunities and teaching effectiveness. Not having equal access to iPads may decrease some students' learning experiences (Englehardt & Brown, 2019). Hutchison and Colwell (2016) also pointed out pre-service teachers' difficulties in managing the classroom with the use of iPads. For example, it is challenging to keep students engaged in the lesson without playing with the apps on iPads.

In addition, some pre-service teachers indicated their concern that the use of iPads might result in the creation of a more independent classroom in which social or face-to-face interaction might decrease largely among students. The use of iPads may lead to an increased amount of virtual communication (Galway et al., 2020). This disadvantage of using iPads among pre-service teachers was not reported in prior studies. According to Dobia et al. (2019), the development of social or social-emotional skills, which are especially important for younger students, requires interactions among students or between the teacher and students.

6 Conclusion, implications, and Limitations

This study contributes to the limited research on mobile learning (i.e., iPads) in pre-service teacher contexts by investigating pre-service teachers' perceptions of adopting iPads as well as the changes of their perceptions after participating an iPad-integrated project. The findings of this study provide evidence that verifies the positive impact of motivational factors (i.e., motivation, self-efficacy) on pre-service teachers' intention to adopt iPads. Additionally, the study examines how iPad ownership and prior experience of developing iPad-integrated lesson plans may possibly influence pre-service teachers' perceptions of adopting iPads in teaching. iPad ownership and prior experience with iPad-integrated lesson plans appear to play an important role in pre-service teachers' perceptions of iPad adoption. Motivation and self-efficacy for iPad integration were found to be critical factors in determining pre-service teachers' intention for iPad adoption. These results have confirmed the importance of offering

iPad-integrated hands-on or classroom experiences for pre-service teachers to shape their viewpoints of using iPads in facilitating teaching, and to increase their desire of and confidence level in leveraging iPads as an instructional tool for different types of learning activities. In addition, we explored the advantages and disadvantages that pre-service teachers perceived for using iPads for future teaching. This in-depth information may be beneficial for teacher educators to better design courses or activities that integrate the use of iPads for pre-service teachers.

This study suggests that offering opportunities to participate in learning activities or teaching practices through the use of iPads helps to enhance pre-service teachers' perceptions of mobile learning in a positive way. Teacher educators should (a) provide access to iPads to inspire pre-service teachers' interest or self-efficacy in using iPads for future teaching; (b) design iPad-integrated activities that provide pre-service teachers with learning or practical experiences with iPads to enhance their motivation, self-efficacy, and intention for mobile technology adoption; (c) provide pre-service teachers with opportunities to develop their own lessons or lesson plans using iPads in their subject areas; (d) provide additional assistance or support to pre-service teachers without any experiences of developing iPad-integrated lessons to enhance their confidence in incorporating iPads for future teaching; and (e) share best practices on cases or examples about iPad integration into teaching and learning and allow pre-service teachers to reflect on their experiences of using iPads.

There are some limitations for this study. The findings of this study may not be generalized to other groups of pre-service teachers from different cultures or countries (e.g., Asia, Europe, etc.). Pre-service teachers in this study were from different majors or subject areas (e.g., early childhood, science, math, etc.). We did not take into account the subject area that pre-service teachers majored in, and it might have a potential influence on pre-service teachers' intention to use iPads for future teaching. Researchers are encouraged to conduct similar studies with different pre-service teacher populations to validate the change of their perceptions toward the integration of mobile learning or devices over time, as well as the impact of proposed factors on pre-service teachers' perceptions of using iPads for teaching. In terms of the limitations for methodology, there are only three items in the intention scale and this small amount of the items may not provide enough data to detect the significant difference between pre- and post-survey results. The iPad integration self-efficacy has sixteen items, which may possible lead to sub-scales that measure different dimensions of self-efficacy that were not examined in this study. Therefore, future studies are encouraged to conduct confirmatory factor analysis (CFA) to validate the survey items used in this study. We did not take into account of the correlation between motivation and self-efficacy in the study, and future researchers are encouraged to adopt structural equation modeling approach to explore the relationships of these three variables and other variables that have the potential impact. As for the implementation of the iPad project, pre-service teachers were asked to present the lesson plan that they developed in the class, but they were not required to further implement the lesson plan with K-12 students. In addition, we suggest that future studies further investigate how different designs of mobile learning projects, including the assigned timeline, subject areas, required tasks, and pedagogies, may significantly enhance pre-service teachers' perceptions of using mobile devices in a significant way.

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Data Availability The datasets generated and/or analyzed during the current study are not publicly available due to the privacy policy.

Code Availability Not applicable.

Declarations

Conflict of interest The authors confirm that there is no conflict of interest in the research reported here.

Ethics approval The study was approved by the university's Institutional Review Board, and informed consent forms were obtained from the students who participated in the survey.

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