



Preparing Teacher Education Students to Integrate Mobile Learning into Elementary Education

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Abstract

The wide adoption of mobile technology has greatly influenced K-12 education. In teacher education programs, it is necessary for educators to train teacher education students to use mobile technology for educational purpose. This paper reports an exploratory effort in preparing elementary education students for mobile learning. The participants' perceptions of mobile learning and intended use of mobile technology were examined through the analyses of their online discussion posts, responses to survey items and their projects. Their perceived benefits of mobile learning, limitations of mobile technology, their intended implementation of mobile learning and the challenges they anticipated were reported. Implications and recommendations were discussed regarding the knowledge of mobile apps, pedagogical practices and some non-instructional issues.

Keywords Mobile technology · Apps · Mobile learning · Teacher education · Pedagogical practices · Challenges

Introduction

With the advancement of mobile technology, mobile devices have been widely adopted in daily life. The advantages of mobile devices include portability, mobility, Internet access, communication, audio and video recording and downloading apps. These technological features promote the educational use of mobile devices. Some schools have provided the students with mobile devices to motivate them and facilitate their learning across subject areas in various learning contexts in K-12 education (Fritschi and Wolf 2012). The increase of mobile device ownership also promotes the Bring Your Own Device (BYOD) approach in schools. The students bring their own mobile devices to school for learning.

Mobile learning is defined as “learning across multiple contexts, through social and content interactions, using personal electronic devices” (Crompton 2013; p. 4), such as tablets, iPads and smartphones. Mobile learning enriches students' learning experience, makes learning occur outside of schools and supports spontaneous learning.

Background

Mobile Learning in K-12 Education

The wide adoption of mobile devices has greatly influenced education. In K-12 setting, positive results from mobile learning have been reported in different subject areas including science (Sánchez and Olivares 2011; Song et al. 2012; Land and Zimmerman 2015; Liu et al. 2014a; Looi et al. 2014), math (Kiger et al. 2012; White and Martin 2014; Zhang et al. 2015), social studies (Hwang and Chang 2011; Lin et al. 2012), literacy (Coe and Oakhill 2011; Wood et al. 2011; Jere-Folotiya et al. 2014) and English as a second language (Shadiev et al. 2015; Sandbert et al. 2014; Liu et al. 2014b).

The educational affordances of mobile technology support the pedagogical practices of learning theories (Naismith et al. 2004; Keskin and Metcalf 2011; Thomas and O'Bannon 2013; Crompton et al. 2017). According to Collins (1989), “Situated learning is the notion of learning knowledge and skills in contexts that reflect the way the knowledge will be useful in real life” (p. 2). The convenient hand-held mobile devices are well suited to situated learning (Liu et al. 2014c), as the technological attributions of mobile devices can facilitate students' working on learning tasks in an authentic learning environment and real-world context. In the current literature, some researchers reported the positive effects of mobile-supported situated learning in science (Land and Zimmerman

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2015), math (White and Martin 2014), and language learning (Shadiev et al. 2015).

Due to the features of mobility and ubiquity, mobile technology also supports informal learning and personalized learning. It was reported that using mobile technology, the students extended learning outside of school, which supplemented their formal learning and helped to improve academic achievement (Sandberg et al. 2011; Liu et al. 2014b). Personalization is a characteristic of mobile learning (Kearney et al. 2012). The students “have control over the place (physical or virtual), pace and time they learn, and can enjoy autonomy over their learning content”. Song et al. (2012) reported the effectiveness of using smartphones to support the students’ personalized learning in school and outside of school when they engaged in the scientific inquiry in science learning. In special education, mobile technology has been used to adapt and personalize the learning activities to meet the individual needs of students (López et al. 2013).

The ability to access information coupled with communication features are important affordances of mobile devices, which greatly supports communication and collaborative learning (Liu et al. 2014c; Hsu and Ching 2013; Lin et al. 2012; Thomas and Orthober 2011). When reviewing the research about mobile collaborative learning, Fu and Hwang (2018) found that there were significantly more studies in the period of 2012–2016 than that in 2007–2011. This implied that more educators had adopted collaborative learning strategies in a mobile learning environment.

In addition, the current literature suggests the effectiveness of the integration of mobile technology into other theory-based learning activities, such as game-based learning (Sánchez and Olivares 2011; Sandbert et al. 2014), inquiry-based learning (Looi et al. 2014; Ahmed and Parsons 2013; Liu et al. 2017; Hwang et al. 2018), and behaviorist learning activities (Reeves et al. 2017; Zhang et al. 2015).

Teacher Education Students’ Perceptions

Despite the adoption of mobile technology in education, mobile learning has not been systematically integrated into the curriculum at various education levels. This needs to be changed through preservice teacher education and in-service teacher training (Traxler and Vosloo 2014). Nowadays, in teacher preparation programs, most of the students are digital natives (Prensky 2001). They have grown up with new technology and use various forms of digital technology including mobile devices. However, Burke and Foulger (2014) pointed out that, “though students may have extensive technology skills, students do not necessarily know about or understand how to use mobile technologies to support teaching and learning” (p. 115).

In a study that investigated 117 preservice teachers’ beliefs and attitudes about mobile learning in a one-year preparation

program, Burden and Hopkins (2016) found that the preservice teachers’ ratings of self-efficacy beliefs and confidence in using iPad fluctuated during the program. However, using the iPad did not significantly change their pedagogical beliefs about mobile learning. Most of them intended to employ teacher-centered strategies when using the iPad to support teaching and learning.

Thomas and O’Bannon (2013) examined preservice teachers’ perceptions of the use of cell phones in the classroom. The participants were in initial teacher certification programs at a liberal arts university. None of them had taken the required technology course. It was found that more than half of the participants were not sure about using cell phones in the classroom. The percentage of those who supported the use of cell phones was equal to that of those who did not support. The findings implied that digital natives may not be technology savvy as expected and they needed instructions to better understand the capabilities and pedagogical meanings of cell phones. Şad and Göktaş (2014) reported that the preservice teachers found mobile phones were more limited in some technical capabilities than laptops. They had more favorable attitudes towards using laptops than mobile phones. The preservice teachers’ perceptions were formed on their experiences in using regular mobile phones with limited features. Şad and Göktaş argued that the preservice teachers needed to be better informed about the capabilities and educational value of smartphones and to develop an awareness of mobile learning.

Baydas and Yilmaz (2018) conducted a motivational analysis to determine preservice teachers’ intentions to adopt mobile learning. They collected data from 276 preservice teachers from a university in Turkey. The results revealed that the preservice teachers’ attitudes and cognitive needs would influence their intention to adopt mobile learning. It was recommended that preservice teachers receive training on mobile learning and have knowledge about effective mobile applications.

Teacher Preparation for Mobile Learning

After conducting a literature review, Baran (2014) concluded that the integration of mobile learning into teacher preparation programs generally fell into two categories. One was to teach candidates about mobile learning so they can implement mobile learning in their classrooms. The other was to have the candidates learn with mobile technology to enhance their learning. To get information about preparing teacher candidates to use mobile technology in PK-12 settings, Foulger et al. (2013) distributed a questionnaire to all teacher preparation institutions in the United States. A total of seventy-nine institutions responded. Twenty-one institutions reported that the mobile technology was used in dedicated technology course

and the use was isolated to one to two faculty members. In thirty-two institutions, mobile learning was taught in technology and methods classes, and the students were expected to use mobile technology in field experiences. Six institutions fully incorporated mobile learning into the curriculum. In these institutions, the students and faculty members used mobile technology in multiple ways. The students were expected to design lessons that incorporated mobile learning technology. Burke and Foulger (2014) interviewed representatives from four of the six institutions. It was found that institutional beliefs, commitment and expectations from local schools were important motivators for change. In the adoption of mobile learning, faculty knowledge about mobile technology, financial issues, developmental and instructional approaches were challenges. Some other researchers (Pegrum et al. 2013; Hashim 2014) also reported the integration of mobile learning experience into teacher education programs.

Srisawasdi et al. (2018) examined the effects of a mobile integrated pedagogy module in improving preservice teachers' TPACK knowledge in science education. A total of 119 preservice teachers who enrolled in a science education course participated in the study and used smartphones. The results showed that preservice teachers' TPACK knowledge was fostered after the implementation of this module. They also developed knowledge of mobile learning in science education. In literacy education courses, Husbye and Elsener (2014) reported that the educators used mobile technology, including audio recording tool, QR codes, presentation app and backchannel apps to engage students in learning literacy education. In two science methods classes for education majors, Wash (2014) had students access Socrative daily using their own mobile devices to conduct assessments or take surveys. They received positive feedback from the students regarding the learning experience. They believed that the mobile-assisted response technology increased participation and engagement in class.

In addition to integrating mobile learning into dedicated teacher education courses or implementing mobile learning at the program level, offering preservice teachers professional development opportunities can also be helpful. Kearney and Maher (2013) examined preservice math teachers' uses of iPads in professional development activities in math education. It was found that the mediation of iPads enabled the teachers to think about providing authentic math learning experiences in real-life context for K-6 students and assessment techniques in children's math learning.

Purpose of Research

The experience of teaching with technology, technology-related professional development in schools and a teacher's use of technology can affect classroom

technology integration (Ritzhaupt et al. 2012). In this digital age, if teachers are expected to adopt mobile learning strategy in K-12 education, teacher candidates need to be prepared in teacher education programs to effectively use mobile technology to engage student learning (Ally et al. 2014). The purpose of this research was to examine teacher education students' perceptions of mobile learning and their intentions after they learned about mobile learning in an instructional technology course.

Methods

Participants and Context

This research was conducted in a graduate level course that intended to prepare elementary education students to use instructional technology in the classroom. Twenty-three students who enrolled in the elementary education program participated in this research. Fifteen of them used iPhones. The other participants used Android phones. Ten participants owned iPads.

In this semester-long course, mobile learning was one learning unit which went across three weeks. The participants were asked to use their mobile phones or tablets in course-related work. To support their learning using mobile technology, it is important to provide "pedagogical input" on the use of the mobile device and "encourage a higher level of student reflection" (Pegrum et al. 2013, p. 475). In the first week, the participants were engaged in a series of activities including lectures, reading and online discussions. The lectures and reading focused on the pedagogical practices of mobile learning in elementary education. In online discussions, the participants reflected on their learning and communicated with each other. Hands-on explorations are necessary when training teachers about mobile learning (Baran 2014). The participants reviewed and selected some apps they would use in teaching practice. Each participant downloaded two apps on their mobile devices. In the second week, the participants shared their findings with the class using their mobile devices, explored the apps that the peers had selected, and made comments on peers' selections in online discussions. In the third week, besides participating in online discussions, the participants collaboratively created a website dedicated to the educational use of the apps that they had selected. Each participant developed two web pages. In each page, the participant provided a summary of the features of an app, posted a demonstration video that was screen recorded on their mobile devices, and created a learning activity to introduce the application of the app in teaching and learning.

When training teachers to use new technology, it is important to consider their “inexperience or immaturity with the new technology” (Ekanayake and Wishart 2015, p. 176). Although all the participants used personal mobile devices such as smartphones, most of them did not have a mobile learning experience as students. To help them develop the awareness of mobile learning, at the very beginning of the semester, the participants were strongly encouraged to use their smartphones to access course materials in the learning management system throughout the semester. Also, in the first class meeting, the participants used their phones to take an online quiz.

Developing mobile lesson plans was a method for training teachers about mobile learning (Baran 2014). At the end of the semester, the participants created a lesson plan. In this lesson, in addition to integrating different technology programs to support teaching and learning, it was required that mobile learning strategy should be adopted.

Data Collection and Analysis

The participants’ data included their posts in online discussions, responses to survey items and their lesson plans. In the mobile learning unit, the participants discussed their thoughts about mobile learning, their intentions to implement it and their perceived challenges in teaching practice. After the unit was finished, the participants took a survey that assessed their perceptions of the use of mobile technology in the elementary classroom. The survey contained twenty-three 5-point Likert scale items ranging from 1 (Strongly disagree) to 5 (Strongly agree). Twenty items were modified from Şad and Göktaş’ instrument (Şad and Göktaş 2014). Three items were created and included at the end to solicit the participants’ intentions to adopt mobile learning and BYOD (Bring Your Own Device) strategies, as well as their confidence level of integrating mobile technology as a result of taking this class. Then, the participants worked in groups of two to create a technology-integrated lesson plan in which mobile learning needed to be implemented.

In data analysis, the mean value of the participants’ responses to each survey item was calculated. The participants’ posts in online discussions were analyzed to find out more information about their perceptions. The emerging patterns were identified to help to examine their thoughts in greater detail. Also, the participants’ lesson plans provided extra data that helped to understand their intended use of mobile technology.

Results and Discussions

Benefits of Mobile Learning

When examining preservice teachers’ perceptions of the use of mobile phones, Şad and Göktaş (2014) found the participants

only agreed that using mobile phones offered comfort and ease to students. Interestingly, the data in this study showed a different pattern. The participants’ survey responses revealed that they thought the use of mobile technology could promote individualized learning ($M=4.5$), offer comfort and ease to students ($M=4.1$), motivate students ($M=4.4$), make learning interesting and enjoyable ($M=4.5$), make students more active in learning process ($M=4.0$), and enable students to have access to information fast and easily ($M=4.4$), to learn anytime anywhere ($M=4.1$) and to learn new things in their spare time ($M=4.3$). They tended to agree that the use of mobile technology in elementary education could encourage students to become more inquisitive ($M=3.8$), improve student achievement ($M=3.8$), provide equal opportunities for students to learn ($M=3.7$), and enable students to learn more efficiently ($M=3.6$). However, the participants had neutral perceptions that using mobile technology could help students to concentrate on lessons ($M=3.3$), support learning by enhancing teacher-student interaction ($M=3.2$) and student-student interaction ($M=3.4$). Overall, the participants’ perceptions were more positive than what was reported by Şad and Göktaş (2014). It needs to be noted that in both studies, the participants’ ratings on the use of mobile technology to help students to concentrate on lessons were almost the lowest.

When the participants discussed their perceptions of mobile learning in the first week, the participants pointed out many benefits of mobile learning. Motivation and differentiation were the most commented benefits. The participants thought mobile learning could motivate students in learning and helped to differentiate instruction, learning and assessment. They also commented that using mobile technology could support personalized learning and informal learning, promote student engagement and collaboration. This is broadly consistent with what has been identified in the current literature (O’Bannon and Thomas 2015; Thomas and O’Bannon 2013; Thomas et al. 2014).

The participants considered mobile technology helpful to facilitate communication with students’ parents. Only one participant mentioned of communication with students and the teacher. Other benefits of mobile learning that the participants perceived included providing immediate feedback to students, tracking students’ progress, helping with problem-solving and the development of literacy skills.

Limitations of Mobile Technology

In the survey, five items were negatively stated. These items measured the participants’ perceptions of the limitations of the use of mobile technology. The mean value of the items “Using it in lesson distracts students”, “Security of data causes problems” and “It causes anxiety among students with poor information and communication technology literacy” was 2.7, 3.0 and 3.2, respectively. This indicated that they had neutral perceptions on some potential issues related to the use of mobile

technology, such as distraction, data security and students' anxiety in using technology. The mean value of the items "Using it in schools causes disciplinary problems" and "Using it in lesson causes classroom management problems" was 2.5 and 2.4, respectively. This implied that the participants had less positive perceptions of the effects of using mobile technology on students' behaviors and classroom management. The survey results echoed the participants' comments in discussions about mobile learning in elementary education. Some participants expressed their concerns about the students' behaviors when using mobile technology, as the students would easily access unintended resources and apps and be distracted by irrelevant information. Cyberbullying and cheating were also anticipated as issues related to the use of mobile technology. The concerns about ethical issues and the students' disruptive behaviors echoed the findings reported by some researchers (Thomas et al. 2014; O'Bannon and Thomas 2015; Thomas and O'Bannon 2013; Baran 2014) who examined the perceptions and attitudes of preservice teachers and in-service teachers.

The technological limitations of mobile devices were pointed out by the participants, such as difficulty in typing and small screen size. This is in line with the findings of the earlier research that reported the hardware limitations of iPad perceived by preservice teachers (Pegrum et al. 2013). The limitations include the lack of a keyboard and the small screen size. In this class, mobile devices mainly referred to phones and tablets with touchscreen features. One participant stated, "I do not think that m-learning is solid enough to stand as a lesson alone without the support of a major lesson beforehand. Either it be taught traditionally or taught on a larger screen for more depth and detailed learning". This supported Thomas and O'Bannon's (2013) claim that not all mobile devices were perceived by the teachers as equally instructional.

A few participants explicitly noted their concerns about the amount of screen time that the students would have if a mobile learning strategy was adopted. They felt too much screen time would result in stunting social skills and be physically harmful as it may cause eye strains, radiation poisoning and the decrease of physical movement. These concerns were reported by some researchers in earlier studies (Şad and Göktaş 2014; Thomas et al. 2014).

Intended Implementation

In the third week, the participants discussed how they would implement mobile learning in teaching practice. Many participants specified that they would integrate mobile technology into activities to assess the students' learning. At the beginning of the semester, the participants used their mobile devices to take a quiz that checked their understanding of the course policies. It was the first time that most of the participants used their smartphones as clickers to respond to the questions in the

quiz. Prior to the mobile learning unit, the participants learned to use two programs for assessment and knowledge check. With each program, they had hands-on experience as students using their mobile devices. Therefore, it was not surprising that they intended to use mobile technology in assessment. Also, some participants pointed out that they would use the assessment apps to create activities to have students review what they have learned.

The participants were interested in the features of some apps that support individualized learning. They expressed intentions to implement mobile learning for differentiation and personalized learning in practice and homework, as one participant noted, "I would definitely want to use some of the great math apps periodically in class, or assign them as homework, because they offer that instant feedback and allow students to work at their own pace". Using mobile technology for communication was also discussed by some participants. Unlike the participants' perceptions in the first week that communication with parents was mainly noted, communication with students was addressed by four more participants in discussions in the third week. It needs to be noted that by the third week, the participants had explored various apps, shared their findings with the class and started to create learning activities for the educational use of each app. In their selections, there were two apps for communication and social interaction between the teacher and the students.

Some participants intended to have students use mobile technology for content learning. They noted that some apps could be used by the students to study course materials. One participant wrote, "I love the idea of integrating mobile applications in lessons, specifically teaching students specific content and materials and allowing them to use certain apps to supplement their learning". Some participants pointed out that the learning needs, the students' characteristics, the features of assignments and the technology resources should be considered. One participant posted,

Some ideas lend themselves to the use of technology better than others. I want to make sure that I don't want to get in the way of hands-on learning, just because there is a new app that creates something very realistic, especially if that is something that could be done in real life.

At the end of the semester, the participants worked in groups to create a technology-integrated lesson plan in which mobile learning strategy was adopted. A total of fourteen lesson plans were created. In eight lesson plans, the students would use mobile devices to take quizzes to formally assess their learning. This reflected the participants' intended implementation of mobile learning discussed in their posts in which using mobile technology for assessment was the most frequently commented activity. The participants' preference for mobile-based

assessment activities is in line with the findings reported by some researchers (Thomas et al. 2014; O'Bannon and Thomas 2015) that using a mobile phone as a clicker device was considered one of the most useful features. In three lesson plans, the students would use the assessment apps to informally check what they have learned. In addition to the assessment apps, the other apps that the participants planned to use included those for math learning, reading, multidisciplinary learning and practicing skills. All of these apps supported personalization and differentiation in learning. This also echoed the participants comments in discussions on their intended adoption of mobile learning strategy. Such intentions are different from what Kearney et al. (2012) reported that teachers barely engaged students in personalized mobile learning. They further noted the significant relationship between the experience using mobile technology in teaching and the extent to which the students were given control over the learning pace and the learning content.

Having the students use mobile devices to access resources online or course materials was also a major mobile learning activity created by the participants, which was specified in six lesson plans. In one lesson plan, the students would use a video discussion platform app in homework to communicate with each other and build a learning community. This was the only communication and collaboration activity that was intended to be implemented through the use of mobile technology in all the lesson plans.

Challenges

In the participants' discussions, the biggest challenge in the implementation of mobile learning was technological issues including the accessibility of mobile technology, Wifi availability and firewall. This is consistent with the issues identified in current literature (Burden and Hopkins 2016; Baran 2014; Thomas et al. 2014). Many participants expressed concerns about the students' equal access to mobile technology. One participant stated,

Some of the challenges I foresee with mobile learning is whether the school/district are able or have available resources so that every student has access to a mobile device that they are able to use in class/at home. Also, on this point, whether the school/district has the WiFi available to bear the number of devices on one network and still process at a normal speed for Internet speed.

As for having the students bring in their own devices, the participants concerned that not all the students would own mobile devices and some schools had strict rules on the use of smartphones inside the school.

Lack of knowledge about mobile learning was a challenge to the effective integration of mobile technology into education (Baran 2014). Some participants noted the importance of the teachers' knowledge and skills in using mobile technology. The teachers needed to master the use of the apps before introducing them to the students. Also, the teachers needed to have good knowledge about the evaluation and the selection of apps. One participant wrote, "probably my biggest challenge is making sure the app actually is beneficial to my students and me. Just because the app may seem fun and exciting, does not always mean it is helpful to my students learning". How to appropriately use mobile apps to support teaching and learning was important, as one participant wrote, "It is so easy to just download something and use it to teach. The challenge would be incorporating the apps with the lessons and not focusing just on the apps themselves".

When examining preservice teachers' use of iPads, Pegrum et al. (2013) found that time was considered an important factor in the exploration and the use of iPads by the preservice teachers. Similar findings are presented in this study. A few participants concerned about the time committed to the adoption of mobile learning strategy. This did not only include the time that the teachers needed to engage with mobile technology, but the time that the students needed to learn to use apps and the class time needed for the accomplishment of learning objectives.

The students' behaviors and responsible use of mobile technology were also considered challenges in mobile learning. In the literature, classroom management was reported to be one of the teachers' perceived barriers to mobile phone usage (Thomas et al. 2014), which was supported by the current study. The participants thought that the student distraction, cheating and cyberbullying behaviors would negatively affect learning outcome in the mobile learning environment. This helped to explain their responses to the survey items which indicated that they had less positive and neutral perceptions of the effects of using mobile technology on the students' behaviors and classroom management.

Some participants expressed concerns about the parents' attitudes towards the use of mobile technology for communication. One major concern was about getting parents on board with online connectivity, as one participant noted, "I would imagine that some parents may get sick of the updates or feel entitled to real-time responses". The other concern was the consistency in the use of apps for communication. One participant commented that "One of the biggest issues as a parent I had was that different teachers in one grade were using different programs to let me know what was going on in their classrooms. There needs to be continuity throughout for getting information to parents and students".

Influence of this Class

In discussions, when being asked whether they thought about integrating mobile technology into elementary education before taking this class, nine participants responded “yes” and six participants responded “no”. Four participants commented that they thought about mobile learning, but they had very limited knowledge about it prior to taking this class. Three participants did not give much thought about it either because of lack of knowledge or due to some concerns. One participant somewhat considered about integrating mobile technology into elementary education.

In the survey that the participants took after the mobile learning unit was finished, there were three items at the end to solicit their intentions to adopt mobile learning and BYOD strategies, as well as their confidence level of integrating mobile technology as a result of taking this class. The mean value of the survey item “The class helps me to develop my confidence in integrating mobile technology into teaching and learning” was 4.5. On this item, all the participants rated either 4 (Agree) or 5 (Strongly Agree). This meant that all the participants felt their confidence increased through taking this class.

The mean value of their responses to the item “I intend to adopt mobile learning strategy in my teaching practice” was 4.4. The examination of individual participants’ responses revealed that of the twenty-three participants, two participants rated 3 (Neutral) on this item and the other participants rated either 4 (Agree) or 5 (Strongly Agree) on this item. This indicated that the majority of the participants planned on integrating mobile technology into teaching and learning after they learned about mobile learning in this class. One participant had experience in using mobile technology in the classroom before taking this class, but took a very strict approach due to the personal belief that mobile technology should only be used when physical learning was not effective. In online discussions at the end of the mobile learning unit, this participant commented,

Throughout these last few weeks, I have learned that mobile learning is a unique way to increase student engagement and provide differentiation options. Seeing so many different apps expanded my schema of what mobile learning could be, and I now realize that having students use the technology they are intimate with-phones-increases their ownership in the learning experience.

One of the two participants who rated 3 (Neutral) on this item had conservative attitudes toward mobile learning. This participant noted,

I have little to no desire to implement mobile learning into my teaching practice. While I recognize the benefits of

this type of learning exist, I don’t know that they outweigh the risks at this point. I honestly don’t feel comfortable handing hundreds of dollars worth of electronics to children, one) because I feel as though they don’t need further exposure to screen time and two) because these electronics are generally expensive and fragile.

Although most of the participants intended to adopt mobile learning in teaching practice, overall, they had neutral intention to implement BOYD in the classroom. The mean value of their responses to the item “If the school policy permitted, I would allow my students to bring their own mobile devices to my class for educational use” was 3.3. Twelve participants rated 4 (Agree) or 5 (Strongly Agree) on this item. The other eleven students’ ratings ranged from 1 (Strongly Disagree) to 3 (Neutral). The different responses are broadly consistent with the findings reported by Thomas et al. (2014) that a slight majority of teachers supported students’ use of mobile phones in the classroom, while the other teachers agreed with the ban on mobile phones in schools.

Implications and Recommendations

Preparing teacher education students to integrate technology into teaching practice is “a complex job given the fast-changing nature of digital technology, such as mobile devices, and the multiple sources of knowledge which need to be synthesized” (Srisawasdi et al. 2018, p. 4). This research was an exploratory effort in preparing future teachers to implement the use of mobile technology. In general, through studying mobile learning in this class, the participants recognized the educational benefits of mobile technology and intended to adopt the mobile learning strategy in teaching practice although they had some concerns and foresaw some challenges. They all agreed that this class helped to increase their confidence in the implementation of mobile learning. Due to the small sample size in this research, no definite conclusion can be made. Nevertheless, the participants’ responses to the discussion prompt and the survey questions, as well as their projects held implications for the teacher education students’ training in mobile learning.

Knowledge of Educational Apps

In addition to mobile devices, the other important component of mobile learning is the app used to support learning activities and facilitate the achievement of learning objectives (Liu et al. 2014c). There are tens of thousands of educational apps covering various subjects and serving different learning purposes. Some of them are free and easy to use. To successfully implement mobile learning, it is important for teachers to know how to use the apps. Then, they can

help the students to learn to use and reduce the students' anxiety in using technology.

Given the fact that some schools face the budget issue, the participants in this research were encouraged to explore and select free apps. Despite the fact that there are lots of free apps available in the market for educational purpose, most of them do not contain the information about the specific application methods for which they are appropriate and suitable (Noorhidawati et al. 2015). In this research, evaluating and selecting apps so they can truly benefit the students' learning was one of the challenges that the participants anticipated in their practice. In this class, two evaluation rubrics reported in the current literature were introduced to the participants. One was for the evaluation of iPod apps (Walker 2011), the other was the Mobile App Selection for Science rubric (Green et al. 2014). Meanwhile, the participants were suggested that they make decisions using their own professional judgment and other useful resources. However, the lack of a standard evaluation rubric may have posed uncertainty to their decisions.

To meaningfully integrate mobile apps into teaching and learning practices, teachers need to consider the characteristics of the apps and most importantly, the pedagogical application in alignment with the learning objectives (Green et al. 2014). When preparing teacher education students to use free apps with their future students, it would help if teacher educators could provide a general guideline and engage teacher education students in some practices to select appropriate apps in different lesson scenarios, as Srisawasdi et al. (2018) suggested, "teacher education events need to identify the many applications (Apps) that can meet specific subject and topic needs" (p.7). In the current literature, few studies have been conducted to examine the use of free apps. Future research is needed to explore the teaching and learning implications of existing apps including free apps in k12 settings (Liu et al. 2014c) to better inform the teachers of the effective use of such apps.

Pedagogical Practices

When reviewing the current literature about mobile learning in PK-12 education, Crompton et al. (2017) found that the students were most frequently engaged in behavioral learning activities "such as classroom response systems and drill and feedback" (p. 60). This was reflected in the participants' discussion posts and their lesson plans. In this research, using mobile technology to assess the students' learning was commented most frequently when they discussed the intended implementation. In eight out of fourteen lesson plans, the participants would engage the students in assessment using mobile technology. In these assessment activities, the mobile devices would be used as clickers to respond to questions. Feedback would be provided after the answers were submitted. According to Şad and Gökaş (2014), "to fully engage

with mobile technologies, faculty needs to acknowledge that they are professional role models to their students" (p. 616). In this research, the participants had hands-on experience in using their mobile devices for assessment in class. The modeling of such practice and the participants' experience as students in this class might have contributed to their positive perceptions of such use of mobile technology and greatly influenced their intended implementation.

The participants also intended to use mobile technology to support individualized learning, differentiation, review of knowledge, content learning and communication. This could be owed to their explorations of various apps. These apps supported the participants' intended practices in using mobile technology. This implied that to train teacher education students to adopt the mobile learning strategy, it would help if they could be guided to explore different types of apps and create learning activities to plan on the integration of these apps. To address the concerns about the class time spent on mobile learning activities and the effects of mobile learning, the teacher educators need to pedagogically inform the students and expose them to different pedagogically sound practices of mobile learning. In this process, the teacher educators could also guide them to reflect on instructional decisions regarding the adoption of mobile learning.

To fill the gap in mobile learning research, Baran (2014) called to create "pedagogical and theoretical models that can guide teacher educators in designing mobile learning experiences for preservice and in-service teachers" (p. 23). Such models will help teacher educators to develop effective strategies to implement mobile learning and prepare teacher candidates to integrate mobile learning into the classroom.

Non-instructional Issues

The participants considered that the biggest challenge for them to implement mobile learning was the availability of resources, such as the students' equal access to mobile devices. The lack of such resources was defined as first-order barriers in technology integration (Ertmer 1999). The participants in this study enrolled in a teacher preparation program at an urban university. Despite the increased ownership of mobile devices, the lack of equity is still an issue unless all the students had access (Thomas et al. 2014; Burden and Hopkins 2016). "Lack of easy access did not translate into a significant barrier" (Ertmer 1999, p. 50) if creative strategies could be employed to obtain technology for students. When preparing teacher education students for mobile learning, it would help if the educators could provide them with donations and funding resources, and help them to seek grant opportunities.

The participants had neutral perceptions of implementing BYOD for the educational purpose, even if the school policy would permit. In the situation that the schools cannot afford a digital device for each student and most of the students use

their own mobile devices to connect to the Internet (Norris and Soloway 2011), BYOD is making its way into education. In addition, it could mitigate the problem that the students use their own devices in classrooms for non-educational purposes (Ng 2015). Nevertheless, the participants expressed concerns about potential issues related to the use of mobile technology, including distraction, access to inappropriate information, cheating and cyberbullying. The participants' concerns helped to explain their neutral perceptions of BYOD initiatives. When training teacher education students to use mobile technology, in addition to exposing them to different pedagogical practices of mobile learning, the educators could discuss with them about strategies for managing instructional uses of mobile technology and boosting positive student behaviors.

In this study, the participants expressed interest in using mobile technology to update parents on school activities and the students' performance. However, they were not sure about the parents' attitudes towards such communication due to the concerns about the parents' preferences and their knowledge of the apps in use. To address this issue, the teacher educators could help future teachers to learn to solicit the parents' opinions before making a decision on the format of communication. The parents should be informed of the use of the apps and receive training on the use when necessary. It is important that the teachers, the parents and the students are in an agreement on the intended use of mobile technology.

Future Research

This study potentially contributes to the understanding of teacher preparation for mobile learning. Due to the small sample size, the results might be limited. Future research can be conducted with a large number of teacher education students to better examine the variations of data. In this study, the participants learned about mobile learning in a three-week unit. Their perceptions of mobile learning prior to this learning unit were not measured. In the future investigation, pre-post design or experimental design can be employed to examine the effects of instructional interventions on their attitudes and perceptions of mobile learning.

In this study, the participants' intended implementation of mobile learning was derived from their online discussion posts and the lesson plans they created. To understand the effects of teacher education students' learning about using mobile technology in the classroom, longitudinal studies can be conducted to examine their perceptions over time and their actual teaching practice in the classroom.

Conclusion

This paper reported the practice of preparing elementary education students for mobile learning in an instructional

technology class. The participants' perceptions of the use of mobile technology, their intentions to adopt the mobile learning strategy and the challenges they anticipated were examined. It is in the hope that the findings would cast light on teacher preparation in mobile learning and provide a reference for future research and instructional practice. To effectively prepare teacher education students to integrate mobile technology into the classroom, mobile learning needs to be integrated into the entire teacher education program, not only the instructional technology courses (Baran 2014). Teacher educators should model the use of mobile technology and provide pedagogical contexts for teacher education students to understand the value and practice of mobile learning.

Compliance with Ethical Standards

Conflict of Interest The author declares that there is no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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