Teachers' Self-efficacy Matters: Exploring the Integration of Mobile Computing Device in Middle Schools

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Abstract:

How can teachers be inspired to integrate technology properly into their teaching? As technology has been playing a more crucial role in classrooms, it is highly necessary to investigate how teachers perceive the benefit of technology and feel confident to use it. The present study focused on teachers' self-efficacy and belief regarding mobile computing devices. To investigate the relationship among self-efficacy, belief and technology integration, we administrated a survey to teachers (N = 57) in middle schools adopting one-to-one technology initiatives. Results showed that teachers' self-efficacy toward mobile technology predicted the integration of the technology. Teachers' belief had a positive relationship with, but did not predict, technology integration. Factors related to teachers' self-efficacy and belief were discussed.

Keywords: Self-efficacy | Teacher belief | Technology integration | Mobile learning

Article:

Introduction

Studies have shown that one-to-one initiatives continue to be implemented in many school districts across states (National Research Council 2012). With these initiatives, stakeholders expect students and teachers to use technology more purposefully for learning (Islam and Grönlund 2016; Penuel 2006). One common expectation for the one-to-one technology use has been to enhance students' learning outcomes through more student-centered learning. Studies have shown that technology can help students solve problems by utilizing technology as cognitive tools (Jonassen 1995) to understand complex learning materials with a reduced cognitive load (Hwang et al. 2013). In particular, mobile computing devices (MCDs), such as smartphones and tablets, can provide new learning opportunities (Gikas and Grant 2013). MCDs have the unique capacity to allow students mobility and Internet access. With these two features, teachers can facilitate students' inquiry activities in many locations, even outside the classroom (Shih et al. 2010; So et al. 2009). Considering the fundamental changes in our

education due to technological advances, we agree with Ertmer and Ottenbreit-Leftwich (2010) that "technology is essential to successful performance outcomes" as opposed to "a supplemental teaching tool" (p. 256).

However, research has revealed inconsistent and even skeptical results regarding the effectiveness of technology integration in various contexts (Lowther et al. 2008; Sung et al. 2016). For example, Weston and Bain (2010) argued that "(e)vidence compiled over the last decade, shows a diminutive effect of 1:1 computing on teaching, learning, and student achievement across schools, districts, and states" (p. 6). They suggested that one of the main reasons for the unsatisfactory results might be the "uninspired" use of technology by teachers and students, such as using technologies only as presentation tools and being distracted by social media or games (Storz and Hoffman 2013). To effectively integrate technology into classrooms, the consideration of pedagogy for empowering teaching and enhancing the learning processes is necessary (Blau et al. 2016).

One can find another reason from teacher attributes, such as the lack of relevant knowledge regarding pedagogical and technical use of new technology, low self-efficacy toward integrating technology for educational goals, and teacher's traditional pedagogical beliefs and cultures that can negatively affect the process of incorporation of new technology (Ertmer and Ottenbreit-Leftwich 2010). Environmental attributes, supports from administrators, peers, and the community as well as technical support regarding access to resources and troubleshooting are also critical to the effectiveness of technology integration (Inan and Lowther 2010).

Among many factors affecting the integration of technology in the classroom, our proposed study focuses on in-service teachers' self-efficacy and beliefs towards MCDs because we assume the most influential agents to integrate technology in the classroom are the teachers who use it with students (Rosen and Weil 1995). We also view that the factors are not independent but interact with each other while teachers integrate the technology (Ertmer 2005; Zhao and Frank 2003). Thus, we also consider the environmental factors that affect teachers' self-efficacy and belief.

The purpose of this study is to explore middle school teachers' attitude toward mobile technology adoption for their teaching practice. Specifically, teachers' self-efficacy and belief regarding MCDs for teaching practice were examined to predict how teachers use the MCDs while teaching. In the following sections, we will examine teachers' self-efficacy and belief toward technology integration and review the main factors influencing them.

Literature review

Teachers' Self-Efficacy toward Technology Integration

Self-efficacy refers to individuals' beliefs about their capabilities (Bandura 1977). It is not an objective evaluation regarding one's skills but the subjective judgment of what one can do with the skills (Bandura 1977). Teachers tend to develop their own self-efficacy from four potential areas: (1) their previous successes or failures, (2) other teachers' successful or failed experiences, (3) suggestions from others, and (4) anxiety or stress toward a task (Klassen and Chiu 2010; Pendergast et al. 2011). As Bandura et al. (1996) pointed out, self-efficacy is not domain-general but domain-specific. In other words, a high self-efficacy in one area (such as teaching math) does not necessarily mean high self-efficacy in another area (such as teaching reading). Inan and Lowther (2010) surveyed 1382 teachers participating in a 1:1 laptop initiative,

and found that teachers who self-reported a high self-efficacy in the traditional pedagogy did not necessarily have an equivalent self-efficacy for innovative teaching strategies.

It is essential to consider teachers' self-efficacy because teachers will avoid activities that they feel less confident and instead focus on activities that they believe they will be successful (Pajares 1992). Researchers have found that in-service teachers' technology self-efficacy can impact their technology use (Inan and Lowther 2010; Pan and Franklin 2011).

As discussed, direct and indirect personal experiences, as well as environmental conditions, affect the development of self-efficacy. Teachers' self- efficacy toward technology is also influenced by many factors such as professional development (Brinkerhoff 2006; Watson 2006), time to prepare for technology use (Curts et al. 2008), support from colleagues (Tilton and Hartnett 2016), and knowledge of using technology (Abbitt 2011).

Teacher Beliefs

Pajares (1992) suggests that teachers develop their educational belief based on their "critical episodes and images" (p. 310), which influence their perceptions, judgments, and critically their teaching practices in turn. Teachers' beliefs regarding the educational usefulness of technology for the achievement of their educational goals play an essential role for their technology integration (Ertmer and Ottenbreit-Leftwich 2010; Kim et al. 2013). Ottenbreit-Leftwich et al. (2010) revealed that teachers actively incorporated technology in their teaching practice when they held a belief that technology could address their needs by motivating students, promoting higher order thinking, and equipping students with technology skills for future use.

While admitting the importance of a teacher's value system, one needs to note that the value system each teacher holds varies based on an individual's experience, competency, teaching philosophy, cognitive/affective structures, and culture (Goodman 1988; Pajares 1992). For example, if a teacher had difficulty preventing students from using MCDs for playing games or surfing websites during class, he would have a contrary belief regarding the MCDs. The belief system is also related to a teacher's self-efficacy. Teachers who are competent to use technology tend to have a positive belief regarding the integration of technology (Buabeng-Andoh 2012). It is also possible that although teachers hold a positive belief regarding a particular technology, they may be reluctant to use the technology if they are not competent enough to utilize it for their teaching practice (Koehler et al. 2007; Ottenbreit-Leftwich et al. 2010). In the following section, we will review some factors affecting a teacher's self-efficacy and beliefs in more detail.

Technical Skills

Teachers feeling less competent in using technology will have a lower self-efficacy toward the integration of technology because they will judge the consequence of their performance in consideration of their skills (Bandura 1982). Thus, it is reasonable that teachers will have a low self-efficacy if they do not have the proper skills of using technology to teach, but not vice versa - i.e., even skillful teachers may have low self-efficacy for different reasons. Teachers' lack of technological experience is highly related to technology anxiety, "technophobia" (Rosen and Weil 1995). Until teachers feel "skilled and comfortable with computers," they will have a negative attitude toward technology integration and feel they are not prepared (Rosen and Weil 1995, p. 25). Thus, it seems to be a prerequisite for self-efficacy to

have the proper knowledge to utilize technology.

Mishra and Koehler (2006) differentiate technical knowledge (that is discussed above) from technological pedagogical content knowledge (TPCK, renamed TPACK later). They emphasize that teachers need to develop "a nuanced understanding of the complex relationships between technology, content, and pedagogy, and using this understanding to develop appropriate, context-specific strategies and representations" for quality teaching (p. 1029). In the subsequent study, Schmidt et al. (2009) revealed that the TPACK was significantly associated with other sub-knowledge (technological, pedagogical, and content knowledge) which suggests that technical knowledge, including other knowledge, is necessary for appropriate self-efficacy of teachers.

Professional Development

Research has indicated that professional development enhances teachers' self-efficacy regarding the integration of technology into classroom instruction (Curts et al. 2008; Niederhauser and Perkmen 2008). Professional development consists of a set of activities that are planned for mentoring teachers' classroom practices conducted by either school personnel, experts from a university, or a software development company's personnel (Levin and Wadmany 2008). This activity can be in the forms of training courses, workshops, support sessions, or mentoring sessions. These opportunities positively affect teachers' confidence in using technology for their teaching practice (Drenoyianni and Selwood 1998; Ertmer and Ottenbreit-Leftwich 2010). Robertson and Al-Zahrani (2012) also suggest that increasing access to additional educational resources, training, and exposure to technology would enhance teachers' self-efficacy and their motivation to use technology. Instructional decision and practices, like technology adoption in teaching, might come as the result of teachers' continuous inquiry and exposure to professional development experiences (Teo 2009; Zhao and Cziko 2001).

Teaching Experience

In general, teachers' teaching experiences are referred to by the number of years that the teachers have been teaching, and not necessarily attributed to the quality of teachers' experiences. Hence, many studies have used teaching experiences as a representation of the length of teachers' teaching (Baek et al. 2008; Chen 2008; Sugar et al. 2004).

Regarding teaching experience and technology integration, Ertmer et al. (2006) found that the years of teaching have restrained teachers' confidence in using technology. However, they suggested considering several other factors that affected teachers' technology use. For instance, a novice teacher might have self-confidence with technology but have difficulty integrating it into their classroom due to the lack appreciation of technology as a teaching tool, lack of classroom organization and management skills, or the influence of experienced teachers.

Sugar et al. (2004) suggested that the more teaching experiences teachers have, the more they have a negative perspective on technology, (e.g., technology is mere entertainment instead of a teaching tool, technology has made the students too dependent). If experienced teachers have a negative perspective, they will be reluctant to integrate technology into their teaching (Inan and Lowther 2010). Experienced teachers may not have proficient technical skills compared to younger teachers who have experienced technology more often during their

pre-service education and daily life (Lam 2000). Additionally, Baek et al. (2008) found that experienced teachers tend to adopt technology being enforced by external forces, while young teachers choose technology based on their personal decision.

Gender

Research on cultural and social fields revealed that there are differences between men and women, for instance, in terms of the use and interpretation of language, thinking and behavior, perceptions about power and interpersonal relation, socialization, perceptions about intimacy and independence, discourse patterns, problem-solving approaches, etc. (Gefen and Straub 1997). These findings suggest that gender can be a factor affecting the belief and integration of information technology in the workplace (Gefen and Straub 1997; Sang et al. 2010; van Braak et al. 2004).

Specifically related to technology integration in teaching, perceived ease of use and usefulness can be more influential to female teachers than male teachers (Yuen and Ma 2002). Female teachers seem to have more difficulty adopting technology due to lack of technology access, skills, and interest (Markauskaite 2006; Shapka and Ferrari 2003; Shashaani 1994; Volman and van Eck 2001; Zhou and Xu 2007) as well as higher computer anxiety (Rosen and Weil 1995; Shashaani 1994) and low self-efficacy (Kay 2006). Shapka and Ferrari (2003) suggested that female's attitudes and use of technology might result from "early exposure to technophobic teachers and more intense exposure to stereotypical beliefs in later grades" (p. 321).

Some other studies, however, found that females were more dominant regarding self-perception and use of technology (Adams 2002; Beisser 2005). Other researchers also found that there were no gender differences regarding belief and integration of technology among teachers (Buabeng-Andoh 2012; Shapka and Ferrari 2003). This is probably because gender is not the primary factor affecting teachers' adoption of technology in teaching, but other factors like computer experience, general computer attitude, or constructivist orientation in teaching may interact with gender (Hermans et al. 2008).

Challenges

Teachers face various challenges including pedagogical, technological, and support issues while integrating technologies into their teaching practices. Fleischer (2012) listed pedagogical challenges of integrating laptops in classrooms, such as changing teachers' previous teaching beliefs and methods in response to learners' greater flexibility and autonomy; balancing learners' desire for studying independently and the amount of teachers' guidance; and facilitating teachers' competence by designing an appropriate curriculum and teaching practice.

Technological challenges are related to hardware and software issues, such as Internet connectivity, battery life, screen size, network, content security or copyright issue, multiple operating systems, appropriate apps, and limited memory (Mehdipour and Zerehkafi 2013). For example, as teachers and students depend more on the network when they use MCDs, the network capacity and reliability is crucial (Grant et al. 2015).

Another challenge for technology integration is professional development for teachers. During the integration of new technology, teachers need more technological and instructional support. Ertmer and Ottenbreit-Leftwich (2010) highlighted the importance of providing support

for teachers through various forms according to their needs. There can be a lack of policy and governmental support, such as insufficient funding or professional development support (Herro et al. 2013).

Current Study

In this study, teachers' self-efficacy and beliefs regarding MCDs for teaching practices were examined to predict how teachers used the MCDs in their teaching. Other factors such as challenges that teacher might perceive as barriers to integrate MCDs, teachers' technical skills and perceived ease of using the MCDs were also investigated to see how they were associated with teachers' self-efficacy and belief. The study would have a significant contribution to our knowledge of the relationships between teachers' self-efficacy, beliefs, and other factors that are related to the integration of mobile learning technologies. For this reason, it is important to examine what factors were associated with teachers' self-efficacy and belief and to test how the self-efficacy and belief influence the integration of MCDs. The following research questions have been addressed in the study.

1. Is there any difference in teachers' self-efficacy, belief and integration of MCDs according to gender?

2. Is there any significant relation between teaching experience and teachers' self-efficacy, belief and integration of MCDs?

3. How are teachers' technical skills as well as perceived ease of use and challenges related to their self-efficacy and belief?

4. How are teachers' self-efficacy and belief related to the integration of MCDs?

Method

Participants

A purposive sampling technique was used to identify and select participants who utilized MCDs in their classrooms (Creswell and Poth 2018). Considering the similar educational policies and location, we chose five states from the Midwestern United States (Indiana, Kansas, Missouri, Nebraska, and Ohio). We conducted a Google search utilizing the terms "1:1," "tablets," "iPads," "Chromebooks," and "middle school," along with each of the five states. We then examined each website and selected schools that adopted one-to-one technology initiatives. In total, we identified 60 schools where students used iPad as a learning tool. In each of these schools, we collected the teachers' email addresses from their schools' websites, for a total of 1066 teachers. A total of 57 teachers (5%) from 26 schools responded to the survey. We understand that this response rate is quite low. However, this may be due, in part, to the fact that although the teachers had access to MCDs, they may not have used them for their teaching, and thus decided not to fill out the survey. The participants were 36 females and 19 males; two did not identify their gender.

Measures

A survey was developed by the authors to measure the following constructs: integration of MCDs for teaching practice, belief regarding the usefulness of MCDs, self-efficacy toward MCDs, ease of use for teaching and learning, technical skills to use MCDs, and challenges to utilize MCDs (see Table 1). Participants responded on a 7-point Likert scale ranging from strongly disagree (1) to strongly agree (7) to each item. Because the target schools of this study only used iPads rather than other MCDs, we specified iPads as the mobile computing devices in our survey. Thus, the MCDs indicate iPads in this study.

Table 1. Survey constructs and their internal consistency

Construct	Number of items	Cronbach Alpha	Samples
Integration of MCSs for teaching practices	6	$\alpha = .92$	• I often integrate iPads into my instruction. • My students often use iPads to access information related to the class activities.
Belief regarding the usefulness of MCDs	5	$\alpha = .88$	• I believe iPads could enhance students' learning. • I believe iPads increase my students' motivation to learn.
Self-efficacy toward MCDs	6	$\alpha = .84$	• I feel confident using iPads for my classroom activities. • I have enough experience integrating iPads into my lesson.
Ease of use for teaching and learning	6	$\alpha = .79$	• I believe using iPads to access information is easy. • My students are comfortable using a variety of iPad-apps to complete assignments.
Technical skills to use MCDs	3	$\alpha = .62$	• I am skillful in solving technical issues related to iPads in my classroom. • I am able to record video on an iPad.
Challenges to utilize MCDs	7	$\alpha = .63$	• Using iPads often cause a distraction in my classroom. • I do not have adequate training for using iPads

Data Analysis

At first, the internal consistency reliability of the survey items was tested according to the constructs, and items that were not consistent with their construct were excluded. The analysis of the correlation between the constructs was carried out to find overall relationships. To reveal a predictive model of integration of technology in teaching, we conducted a multiple regression analysis. Teachers' self-efficacy and belief were entered in the regression analysis to see whether they predicted the integration of MCDs in their teaching practice.

Results

The results of this study are described with three areas: (a) gender differences in self-efficacy, belief, and technical skills, (b) relations between teaching experience and self-efficacy, belief, and technical skills, and (c) a predictive model regarding MCDs integration.

Table 2 displays Pearson's correlation coefficients and descriptive statistics of the constructs. Overall, the challenges teachers perceived were negatively correlated with other constructs, such as the integration of MCDs ($r = -.41$), ease of use ($r = -.48$) and self-efficacy ($r = -.65$). The years of teaching revealed a statistically significant negative relationship with the technical skills ($r = -.42$). Other constructs show positive relations among them.

Table 2 Summary statistics and pearson correlation coefficients for constructs

	1	2	3	4	5	6	7
1: Integration of MCD	–						
2: Self-efficacy	.610**	–					
3: Teacher Belief	.338*	.524**	–				
4: Ease of Use	.614**	.589**	.744**	–			
5: Technical Skills	.336*	.627**	.268*	.335*	–		
6: Challenges	-.407**	-.651**	-.437**	-.475**	-.515**	–	
7: Years of teaching[a]	.021	-.195	-.164	.013	-.423**	.118	–
M	5.16	5.40	5.58	5.48	6.01	3.48	14.7
SD	1.459	.950	1.104	.968	.793	.989	9.87

$N = 57$, [a] $N = 56$
* $p < .05$, ** $p < .01$

Gender Differences

In order to test whether teachers' self-efficacy, belief and integration of MCDs were

different between male and female teachers, independent samples t-tests were carried out. The result confirmed that male teachers had higher self-efficacy ($M = 5.77$, $SD = .774$) than female teachers ($M = 5.19$, $SD = .991$), $t(53) = 2.21$, $p = .03$. Regarding teacher belief, no statistically significant difference was found between male ($M = 5.63$, $SD = 1.09$) and female teachers ($M = 5.56$, $SD = 1.15$), $t(53) = .22$, $p = .83$. About the integration of MCDs, no statistically significant difference was found between male ($M = 4.93$, $SD = 1.72$) and female teachers ($M = 5.26$, $SD = 1.33$), $t(53) = .80$, $p = .43$.

Another t-test was run to test the difference in technical skills and revealed that male teachers had better technical skills ($M = 6.33$, $SD = .430$) than female teachers ($M = 5.86$, $SD = .896$), $t(52.71) = 2.64$, $p = .01$ (Because the equal group variances were not assumed, an adjustment to the degrees of freedom using the Welch-Satterthwaite method was used). A stepwise regression analysis was carried out for the self-efficacy using the technical skill and gender as predictors. The result revealed that only the technical skill ($\beta = .76$) was a significant predictor of self-efficacy while the gender was removed from the model, $F(1, 53) = 34.88$, $p < .001$. The result suggests that although the gender was correlated with the self-efficacy toward MCDs, only the technical skill being associated with the gender predicted the self-efficacy.

Teaching Experience

Correlation analysis revealed that the longer teachers had taught, the less likely they had technical skills, $r(54) = -.42$, $p = .001$ (see Table 2). The results implied that younger teachers had higher technical skills than more experienced teachers. Although the year of teaching was associated negatively with self-efficacy ($r(54) = -.20$) and belief ($r(54) = -.16$), they were not statistically significant. For the insignificant results of the correlation analysis, the teaching experience was excluded from the following analysis.

Self-efficacy

How would teachers' technical skills, perceived ease of use, and challenges predict self-efficacy toward MCD? As Table 2 describes, higher self-efficacy was correlated with higher technical skills ($r = .63$) and ease of use ($r = .59$) but less challenges ($r = -.65$). A stepwise multiple regression analysis on self-efficacy revealed that the significant predictors were challenges ($\beta = -.32$), technical skill ($\beta = .36$) and ease of use ($\beta = .32$), $F(3, 53) = 28.49$, $p < .001$ (see Table 3). They explained 62% of the variance in self-efficacy in this model.

Table 3 Regression analysis of predictors of integration of mobile computing devices

Dependent Variables	Variables Entered	R^2	*df*	*F*	β
Self-efficacy		.62	3, 53	28.49***	
	Challenges				-.32**
	Technical				.36***

	skill				
	Ease of use				.32**
Belief		.55	1, 55	68.27***	
	Ease of use				.74***
	Challenges[a]				
	Technical skill[a]				
Integration of MCD		.37	1, 55	32.57***	
	Self-efficacy				.61***
	Belief[a]				

All betas are standardized
[a] Excluded variables, * $p < .05$, ** $p < .01$, *** $p < .001$

Belief

We also examined how the predictors of self-efficacy were related to teachers' belief regarding the usefulness of MCDs. As Table 2 describes, the teachers' belief was correlated positively with the ease of use ($r = .74$) and technical skills ($r = .27$), but negatively with challenges ($r = -.44$). A stepwise multiple regression analysis on the belief revealed that the only significant predictor was the ease of use ($\beta = .74$), $F(1, 55) = 68.27$, $p < .001$ (see Table 3). The perceived ease of use explained 55% of the variance in belief in this model. Other constructors were excluded from the model.

Integration of Mobile Computing Devices

Through the following prediction model, we examined how teachers' self-efficacy and belief regarding MCDs were related to the actual use of technology for their teaching practice. As Table 2 describes, the use of MCDs was correlated with self-efficacy ($r = .61$) and belief ($r = .34$). A stepwise multiple regression analysis revealed that only the self-efficacy ($\beta = .61$) was a significant predictor of the actual use, and the belief was excluded from the model, $F(1, 55) = 32.57$, $p < .001$ (see Table 3). Self-efficacy explained 37% of the variance in the integration of MCDs in this model.

Discussion

The results revealed how teachers' self-efficacy toward mobile technology for their teaching practice was related to technology integration in the classroom. Although teachers' belief regarding the usefulness of mobile technology was closely associated with the use of technology, the regression analysis suggests that teachers can be reluctant to integrate technology into their classroom if they feel less confident to utilize technology. The study also revealed how other factors such as gender, years of teaching, technical skills, and challenges that teachers perceived were related to teachers' self-efficacy and belief. In the following, we discuss each factor in turn.

Gender and Technical Skill

As many studies have revealed, the present study suggests that male teachers have a higher self-efficacy than female teachers do (Kay 2006; Rosen and Weil 1995). This finding will add knowledge to the field in that gender differences in technology integration can be explained from the self-efficacy aspect. Male teachers who have higher self-efficacy than female teachers show a higher tendency to integrate mobile technology into their teaching practice. However, differences have not been found in their belief, which triggers another investigation regarding the gender differences.

As commonly revealed, men are better than women at technical skills, and that has been observed in this study too (Markauskaite 2006; Shashaani 1994; Volman and van Eck 2001; Zhou and Xu 2007). When considering the gender and technical skills together, we found that technical skills were the significant predictors of teachers' self-efficacy, while gender was not. Therefore, the study suggests that gender is not the sole attribute to teachers' self-efficacy toward technology integration. Actually, technical skill was the more important factor of self-efficacy, which we need to pay more attention to. The finding is consistent with previous studies, suggesting that technical skills influenced teachers' adoption of technology into their teaching practice (Kay 2006). Inan and Lowther (2010) also suggested that technology skills had the greatest influence on teachers' readiness to adopt technology. Knezek and Christensen (2002) revealed that teachers' expertise in technology was the main factor in effective usage of technology in teaching.

Teaching Experience and Technical Skills

The years of teaching were not significantly related to teachers' self-efficacy or belief, but they were negatively related to technical skills in this study. Overall, these findings are consistent with previous studies that have revealed negative relations between years of teaching and technical skills (Inan and Lowther 2010) or positive relations between years of teaching and technical anxiety (Rosen and Weil 1995). Inan and Lowther (2010) revealed, "when teachers' years of [teaching] experience increase, their feeling of readiness to integrate technology decreases" (p. 145). They also found that teachers' computer proficiency had been negatively

influenced by their age and years of teaching, which negatively affected technology integration into their classroom as a result. It is plausible to assume that the newer teachers will have more opportunities to be exposed to new technologies than the older generations while they were in teacher education (Kleiner et al. 2007; Polly et al. 2010).

The results also suggest the necessity of professional development for in-service teachers to compensate the gap. As technology plays a vital role in education, technology integration is becoming valued in professional development for in-service teachers (Lawless and Pellegrino 2007). Since technology updates each year, what teachers learned from their previous education program might be outdated after a few years. Studies have shown that professional development is not sufficient to enable teachers to get adequate knowledge and skills, and to integrate technologies effectively into their classes (Duran et al. 2011; Ertmer 2005; Lawless and Pellegrino 2007). If professional development is a "one-size-fits-all" workshop, rather than tailored toward teachers' specific technology integration needs, we may not expect it to be sufficient enough (Gamrat et al. 2014).

Unexpectedly, the correlation analysis of this study revealed that the years of teaching were not significantly associated with self-efficacy, belief, or even the integration of technology. One possible explanation regarding the result is that the participants of this study were self-selected as those who use mobile technology in their classroom. The descriptive statistics ($M = 5.16$, $SD = 1.46$) showed that the participants utilized mobile technology quite often. The results imply that the participants, especially those who had many years of teaching experience, overcame the technical barrier that they might face. However, the current study could not investigate the argument for the limit of the research design.

Teachers' Self-efficacy and Belief

As expected, teachers' self-efficacy predicted the integration of MCD into their teaching practice. However, the teachers' belief was not a significant predictor of the integration of MCD like self-efficacy, even though both showed significant positive correlation with the integration of MCD. The results suggest that teachers may not integrate MCD when they do not feel confident in utilizing mobile technology for their teaching, even when they perceive that the integration of MCD will be beneficial.

It is noteworthy that researchers "use the same term but define and measure efficacy in varying ways" while mentioning teacher efficacy (Woolfolk and Hoy 1990, p. 81). The current study identifies teachers' self-efficacy in terms of Bandura's (1977, 1982) theory of self-efficacy, which differentiates teachers' belief system regarding the perceived usefulness of technology (teachers' belief) and their personalized efficacy toward integrating technology (teachers' self-efficacy) into classes. Bandura explains that people decide their behavior based on both expected outcomes of the behavior and perceived efficacy of the behavior. This suggests that teachers anticipate the consequences of their specific teaching behaviors in a particular classroom situation (expected outcomes) and judge their competence to achieve the desired level

of performance in the situation (perceived efficacy) for the integration of technology in their teaching practice.

The current study suggests that teachers are more likely to believe that using mobile technology will be beneficial to their teaching when they perceive it is easy to utilize. Regarding the teachers' belief, technical skills are not a significant factor, which suggests teachers' belief system is affected by the perceived easiness rather than their current ability to use it. Considering teachers' efficacy, however, technical skills in addition to the ease of use and environmental challenges are significant factors to judge the success in utilizing mobile technologies. It is also important to note that the challenges teachers perceived are a significant predictor of self-efficacy but not of belief. As Bandura suggests, efficacy is affected by people's competence toward a particular task (technical skill) in a specific situation (challenges and ease of use). Especially when teachers have a low technical expertise, they tend to pay more attention to the technical issues at the early phase of technology integration (Koehler et al. 2007). Teachers will develop a low self-efficacy when teachers do not have the opportunity or time to learn to integrate mobile technology (Lam 2000; Tilton and Hartnett 2016). In this study, teachers identify several challenges such as the lack of professional development, limited resources with high expectations, unexpected results of utilizing technology in class, and insufficient technical infrastructures.

It is possible that teachers who believe that utilizing technology is beneficial to their teaching and student learning may think either that they have sufficient or lack of technical skills and environmental support, which will influence the integration of technology into their classes. The current study suggests the importance of enhancing technical skills of teachers and resolving challenges for teachers to be willing to integrate mobile technologies into their teaching practice.

Limitations

There are several limitations to be considered when interpreting the findings of this study. First, this work included a small number of participants (57 teachers) from 26 middle schools. Statistical analyses were limited due to the small sample size, and caution is needed in generalizing the findings of the study. Participation to the study was voluntary and self-selected. Thus, the participants of this study might not represent the entire target population well.

Second, the findings heavily relied on the self-reported survey responses. Critics of survey research argue that survey findings may be biased toward "socially desirable" responses (Koziol and Burns 1986). The exploratory nature of this study suggests further research that includes multiple data sources, such as student learning activities, classroom observations, and teacher interviews.

Conclusion

Bandura (1986) mentioned, “among the different aspects of self-knowledge, perhaps none is more influential in people’s everyday lives than conceptions of their personal efficacy” (p. 390). As he suggested, the study reveals that teachers’ self-efficacy toward mobile technology influences the integration of the technology in their classes. Teachers’ self-efficacy is predicted by challenges that they have experienced in their professions, technical skills to use technology, and perceived ease of use. The current study suggests the need for further studies exploring ways to enhance teachers’ self-efficacy toward technology integration in consideration of these factors. Moreover, these studies need to expand their focus to educational problems that mobile technologies can solve from new approaches by identifying essential features of mobile learning environments and instructional design characteristics that affect learning experiences and performances (Grant 2019).

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have 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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