Predicting Teachers' ICT Integration in the Classroom

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Abstract
This study was conducted to explore the teacher factors associated with the frequency of the use of ICT for instructional purposes in the K-12 classroom. Survey data was collected from 810 teachers in Thailand in order to examine how teachers use ICT as a tool for teaching and supporting students' learning in the classroom. Additionally, the antecedents of ICT use for support students' learning such as teachers' beliefs (personal teaching efficacy beliefs and self-efficacy toward ICT integration), ICT training experience, ICT infrastructure and demographical variables (gender, teaching experience) were taken into account. Correlation and hierarchical regression analysis were applied in the study. The results indicated that teachers are more likely to use ICT for teaching materials preparation and less likely to assign students to use ICT for their learning. The frequency of ICT use to support students's learning has a positive relationship with ICT training experience and self-efficacy toward ICT integration but has a negative relationship with female and teaching experience. Regression analysis results showed that self-efficacy toward ICT integration is the strongest predictor for ICT use to support students' learning. The findings are of particular importance to sustaining teacher development program and shed light on how to support teachers on ICT integration in the classroom.

Keywords: Self-efficacy beliefs; ICT integration; Technology integration

Introduction

Many studies during the past decades about promotion of ICT as a learning and teaching tool in educational systems have focused on enhancing students' learning outcomes, for example, Hakkarainen et al., 2000; Hopson, Simms& Knezek, 2002; Keengwa, 2007; Cox & Marshall, 2007 and Dominguez et al., 2013. Many researchers provided a variety of ways on how to integrate ICT into teaching practices (Kozma & Anderson, 2002; Jimoyiannis, 2010). In addition, the previous studies also described the conceptualization of ICT integration which can fostered development of 21st-century skills of students (Pedersen & Yerrick, 2000; Law 2009; Wang, Hsu, Reeves, & Coster, 2014). Thus, teachers have a critical role to promote learning with ICT in the classroom context by developing new curricula and new pedagogies (UNESCO, 2011).

Commonly, ICT in schools refers to hardware, software and other tools (e.g. personal computers, laptops, smartphones, printers, LCD projectors, digital cameras, Internet, multimedia resources, databases, Web sites, and word-processing programs). Additionally, there is an expectation for educators to proficiently use these technologies in their teaching and learning process (Martinovic & Zhang, 2012). A review in this domain identified similar terms being used in the same context i.e. ICT integration and Technology integration. Hew & Brush (2007) viewed technology integration as "typically include the use of computing devices for instruction" (p.225). Ertmer & Ottenbreit-Leftwich (2010) highlighted technologies as the tools "to facilitate meaningful learning which enables students to construct deep and connected knowledge, which can be applied to real situations" (p.257). UNESCO (2011) emphasized the outcomes and persistence to learning with ICT in Education and believed that ICT can change the nature of teaching and learning.

Recently, Thailand's government by Ministry of Information and Communication Technology (MICT) has launched the ICT Policy for 2011-2020 or "ICT 2020" as "SMART THAILAND 2020" to drive the country forward by using ICT to increase the "Quality of life" in the aspect of Education (MICT, 2011). In addition, The Ministry of Education in Thailand (2015) responded to the government's policy by releasing the MOE ICT Masterplan (MOE, 2011). In the area of professional development for preservice and in-service teachers, ICT has been promoted as the essential tool and encouraged teachers to integrate ICT in the instructional practices (MOE, 2011). The target of MOE's ICT Education Masterplan 2011 was utilization of ICT in all levels of education and 80% of teachers and educational personnel to have sound ICT knowledge (MOE, 2011). However, success at an implementation level is still questionable. UNESCO (2014) reported that teachers' actual use of ICT in the classroom was increasing but the teachers were using traditional teacher-centred approaches such as using slides and drill-and-practice exercises and omission to use ICT to innovative teaching. The teachers realized the importance of ICT integration for productive classroom activities. However, teachers were incapable of integrating ICT in their teaching while professional development was not sufficient to develop the skill of implementation (Laohajaratsang, 2010).

When considering ICT use in education, teachers should design how to integrate technology with their pecific subject. There are many different ways of ICT integration in the classroom. Russell, Bebell, O'Dwyer, & O'Connor (2003) examined 2,894 teachers to use technology for different instructional purposes such as using e-mail,

creating quizzes and tests, preparing lessons and ask students to do the task with ICT for example: writing a paper and using spreadsheets or creating Web pages. Interestingly, the result showed that teachers frequently use ICT more for preparation and communication than for delivering instruction or assigning learning activities that require the use of technology. The Second International Technology in Education Study 2006 (SITES, 2006) conducted the study to identify the ways in which teachers use ICT in the classroom supported by their general pedagogical orientation and capability. There were 22 education systems from around the world (including Thailand) participated in SITES 2006. The data were collected by a survey design for teachers of mathematics and science in Grade 8. The result showed that the percentage of teachers reporting ICT use was significantly higher among science teachers than among mathematics teachers. In addition, more than half of science teachers reported having used ICT in extended projects, short-task projects, product creation, teacher lectures, and looking up ideas and information (Law, 2009). However, the previous study found that teachers' ICT usage for teaching and learning practices were still traditionally orientation. On the other hands, teachers' ICT adoption does not necessarily change the view of teachers to use innovative model of 21st century pedagogical orientation (Law, 2009).

Peeraer & Petegem (2012) developed the instruments for measurement of the frequency of teacher use of ICT for teaching and learning. This set of instruments incorporated the 21st-century skills based on UNESCO (2003) ICT competencies framework. The constructs of ICT integration in education listed in this study were divided into two groups: ICT use for teaching and ICT use for supporting of student learning. The items represented the teachers' perception of using ICT in teaching were for preparation, for presentation of lesson material and for pedagogical use. The other indicators focused on student innovative use of ICT represented by teachers' perceived use of ICT for support of student learning. The set of items referred to ICT as tools for the development of ICT-related skills and the enhancement of learning outcomes. The students were suggested to use ICT to improve their skills with ICT as the learning tools. The result concluded that the majority of teachers occasionally used ICT to replace their existing teaching practice or to enhance student learning. However, the innovative use of ICT in support of student learning was still very scarce.

The International Computer and Information Literacy Study 2013 (ICILS 2013) reported similar findings. ICILS 2013 focused on the assessment of computer and information literacy of students in the digital age as well as the ICT learning environment, such as teachers' ICT usage from over 3,300 schools of 21 participating countries. The result showed that teachers most frequently used ICT in their classes for simple tasks such as word-processing, presentations, and information resources (e.g. websites, wikis, and encyclopedias). Teachers also reported that, within their classrooms, ICT was most generally being utilized by their students to search for information, work on short tasks, and study on learning materials by individual work. Moreover, teachers tended to use ICT in teaching when they were confident in their ICT skills. Less than 50% of teachers expressed that they were able to use ICT for more complex tasks, such as managing software and hardware and working with others by sharing tools or resources. Older teachers lacked self-confident in ICT use than their younger colleagues. In addition, the ICT integration in schools remains limited (Fraillon, Ainley, Schulz, Friedman & Gebhardt, 2014).

Several researchers studied barriers that held teachers back from integrating ICT in teaching practices. Ertmer (1999) reviewed the barriers of both preservice and in-service teachers with the findings that can support teachers in ICT use. First-order barriers (e.g., lack of technical skills needed to operate a computer, lack of support ICT infrastructure) can seriously limit ICT use in the classroom. Teachers also felt frustrated and were resistant to using ICT (Vanderlinde & Braak, 2010). From a study by Chen (2010), teachers' use of technology was influenced by extrinsic factors such as technological equipment. The availability of material resources in the classroom (i.e., computers, software, and connectivity), also an extrinsic factor, positively influenced teachers' beliefs and teachers' readiness for ICT integration (Inan & Lowther, 2010).

Second-order barriers also influence teacher beliefs about teaching, and beliefs about ICT integration in classroom practices. Teachers' belief influences the decision whether to and how to integrate technology in educational practice (Ertmer, 2005; Hew & Brush, 2007; Paraskeve, Bouta & Papagianni, 2008). Teachers with high perceived self-efficacy toward ICT integration will have tendency to integrate ICT into the learning environment to motivate and promote student outcomes (Bandura, 1982; Gassert, Shroyer, & Staver 1996; Hoy & Spero, 2005). On the other hand, teachers who perceived themselves as lacking the capabilities in technology and persistence to obstacles or challenges of new circumstances tend to avoid managing and setting ICT environment for their students (Bandura, 1982; Compeau & Higgins, 1995; Paraskeve, Bouta & Papagianni, 2008).

Recognizing the importance of preparing in-service teachers to effectively integrate ICT in the classroom, the purpose of this study is to identify the ways in which teachers integrate ICT in their teaching or supporting students' learning in the classroom. Moreover, examination of relationship between factors that influence teachers use ICT integration in teaching practices is an important key to understanding how to motivate them to use ICT and to overcome barriers to teaching with ICT. The demographic characteristics of teachers (gender, teaching experience and prior experience in ICT training) and self-efficacy toward ICT integration have been studied in relation to efficacy in ICT use. This study also aims to understand more clearly the construct influencing ICT integration in Science, Mathematics and Technology teachers in the K-12 classroom.

Methodology

Participants and procedure

The survey was carried out at the end of the second semester, the school year 2014–2015. The participants for this study were 810 school teachers from Thailand, 261 (32.2 %) were primary teachers and 549 (67.8%) secondary teachers. Among these 325 (40.1%) taught science, 257 (31.7%) mathematics and 228 (28.1%) technology. The majority of participants were female, 529 female and 281 male. The average age of the sample was 41.8 years (SD = 8.43) with the mean teaching experience of 15.3 years (SD = 10.95). These teachers had prior experience in ICT training in the past three years ranging from never to five times or more, with a mean of 2.4 times (SD =1.67). The selection method started with stratified random sampling in order to select the schools. The questionnaires were sent by post. The questionnaire examined how teachers use ICT as a tool for teaching and supporting students' learning in the classroom. The data

were analyze for the relationship between ICT use for support students' learning, personal teaching efficacy, self-efficacy in ICT integration, ICT infrastructure and demographics data.

Instrument

The research instruments for the data collection were:
(i) The demographic questionnaire regarding gender, teachers' subject areas, teaching experience, previous ICT training.
(ii) The Personal Teaching Efficacy Scale was first developed by Gibson and Dembo (1984). The scale is a four item, Likert-type scale ranging from ''1'' (Strongly Disagree) to ''5'' (Strongly Agree) that measures a teachers' beliefs in their teaching abilities to bring about the positive students' behavioral change (Gibson & Dembo, 1984; Ross, Cousins & Gadalla, 1996).
(iii) The Self-Efficacy Belief toward ICT Integration Scale was modified from the Personal Internet Teaching Efficacy Beliefs Scale (PITEBS) by Koul (1999). This scale was developed to measure teacher confidence in teaching with ICT. It includes 9 items that are scored using a five-point response.
(iv) The ICT Infrastructure Scale by (Vanderlinde & Braak, 2010) was developed to measure teachers' perceptions about the instructional resources. It includes 4 Likert-scale items.
(v) ICT use for teaching and ICT use for support students' learning were first developed by Peeraer & Petegem (2012). The self-report measurement assesses the perceived frequency of teachers in ICT use for teaching and for support of student learning. It includes 7 items measuring teachers' use of ICT for teaching purposes and 7 items for measuring teachers' use of ICT for support of student learning. This study adapted the response level to ''never'', ''rarely'', "sometimes", "often, and "daily".

Results

Frequency counts, correlation, and regression were used to analyze the data. A summary of the descriptive statistics of ICT use for teaching and support student learning follows in Table 1 and 2 respectively. In Table 1, word processing and Internet were the most frequently reported method of ICT use. As can be seen, about 98.5% of the teachers used word processing for the production of documents and the Internet as a source of information. Only 1.5% of the teachers reported never using word processing and the Internet for teaching purpose.

Table 1: *Frequency and percentage of teacher use ICT in teaching (n=810)*

Teaching Practices		***Never***	***Rarely***	***Sometimes***	***Often***	***Daily***	***Total***	***Mean (SD.)***
1. Production of documents by word processing	n (%)	12 (1.5)	24 (3.0)	162 (20)	340 (42)	272 (33.5)	810 (100)	4.03 (0.89)
2. Presentation	n (%)	20 (2.5)	58 (7.2)	202 (24.9)	325 (40.1)	205 (25.3)	810 (100)	3.77 (0.98)
3. Use specific software	n (%)	56 (6.9)	86 (10.6)	250 (30.9)	284 (35.1)	134 (16.5)	810 (100)	3.44 (1.00)
4. CD-ROM/DVD as resource materials	n (%)	14 (1.7)	83 (10.2)	271 (33.5)	336 (41.5)	106 (13.1)	810 (100)	3.54 (0.91)
5. Electronic Communication with students	n (%)	45 (5.6)	61 (7.5)	176 (21.7)	331 (40.9)	197 (24.3)	810 (100)	3.71 (1.09)
6. Internet/WWW as a source of information	n (%)	12 (1.5)	41 (5.1)	119 (14.7)	351 (43.3)	287 (35.4)	810 (100)	4.06 (0.91)
7. Use classroom management software	n (%)	189 (23.3)	90 (11.1)	209 (25.8)	222 (27.4)	100 (12.3)	80 (100)	2.94 (1.35)

Teachers' use of ICT for presentation and electronic communication with students were less frequent, as compared to the use of word processing and the Internet. Only about half of the teachers reported "often" or "daily" for use of subject specific software and CD-ROM/DVD as resource materials (51.60% and 54.60%, respectively). Finally, about 23.30% of teachers stated that they had never used classroom management software in a computer classroom setting.

Table 2 shows that data collecting and information gathering from digital resources were the ICT activities that the teachers most frequently assigned to students. As can be seen, the number of teachers who often or daily assigned these ICT activities were 69.5% and 64.3%, respectively. The second most commonly assigned ICT activity was the computer use by students to synthesizing knowledge (62.4%). About 60.7% of the teachers often or frequently assigned students to ICT to communicate with others. More than half of the teachers (59.8%) assigned students to work with a computer to solve a problem and students integrated different media to create products. Finally, about 6.9 % of teachers had never assigned students to give a presentation supported by a computer.

Table 2: *Frequency and percentage of teacher use ICT for supporting students' learning (n=810)*

Ways to Support Student Learning		***Never***	***Rarely***	***Sometimes***	***Often***	***Daily***	***Total***	***Mean (SD.)***
1. Work with the computer to orientate themselves to a new subject	n (%)	34 (4.2)	71 (8.8)	277 (34.2)	303 (37.4)	125 (15.4)	810 (100)	3.51 (1.00)
2. Gather information from digital resource	n (%)	15 (1.9)	61 (7.5)	213 (26.3)	364 (44.9)	157 (19.4)	810 (100)	3.72 (0.92)
3. Use technology to collected data	n (%)	19 (2.3)	62 (7.7)	166 (20.5)	371 (45.8)	192 (23.7)	810 (100)	3.81 (0.96)
4. Work with a computer program to solve problems	n (%)	32 (4.0)	70 (8.6)	224 (27.7)	353 (43.6)	131 (16.2)	810 (100)	3.59 (0.99)
5. Give a presentation with a computer	n (%)	56 (6.9)	76 (9.4)	219 (27)	314 (38.8)	145 (18.9)	810 (100)	3.51 (1.10)
6. Integrate different media to create products	n (%)	32 (4.0)	84 (10.4)	210 (25.9)	348 (43)	136 (16.8)	810 (100)	3.58 (1.01)
7. Synthesize their knowledge	n (%)	27 (3.3)	75 (9.3)	203 (25.1)	379 (46.8)	126 (15.6)	80 (100)	3.62 (0.97)
8. Communicate with others (locally and/or globally)	n (%)	39 (4.8)	72 (8.9)	208 (25.7)	352 (43.5)	139 (17.2)	80 (100)	3.59 (1.03)

In terms of using ICT for teaching activities, as compare to the using ICT for supporting students' learning activities, with means of 3.77 and 3.62 respectively. It should be further noted that teachers are more likely to use ICT for preparing teaching materials and less likely to assign students to use ICT for their learning.

Table 3: Correlations, Means, and Standard Deviations among ICT use for supporting students' learning, ICT infrastructure, demographics and self-efficacy variables. (N = 810)

	1	**2**	**3**	**4**	**5**	**6**	**7**	***M***	***SD***
1. ICT use for Support Student Learning	-	-.18**	-.13**	.24**	.29**	.33**	.49**	3.62	0.85
2. Gender		-	-.01	-.09*	-.09*	-.15**	-.19**	1.65	0.48
3. Teaching experience			-	-.02	.08*	-.03	-.12**	15.34	10.95
4. Personal Teaching Efficacy				-	.32**	.11**	.55**	4.03	0.52
5. ICT Infrastructure					-	.11**	.33**	3.62	0.80
6. ICT Training experience						-	.23**	2.44	1.67
7. Self-efficacy toward ICT Integration							-	3.94	0.55

*$p < 0.05$; **$p < 0.01$

As can be seen in Table3, the associations of the variables in this study, zero-order correlations were calculated. In terms of the outcomes of interest, ICT use for support student learning was positively related to personal teaching efficacy ($r = .24$, $p < .001$), ICT infrastructure ($r = .29$, $p < .001$), ICT training experience ($r=.33$, $p < .001$) and self-efficacy toward ICT integration ($r = .49$, $p < .001$).

Finally, gender and teaching experience were negatively to endorse ICT use for supporting students' learning ($r = -.18$ and $r =-.13$, respectively, both $p < .001$).

To examine the extent to which teachers' perceptions of ICT infrastructure, personal teaching efficacy, ICT training experience, and self-efficacy toward ICT integration predicted changes in teacher use ICT for supporting students' learning. A series of hierarchical regression analyzes were conducted.

Table 4: *Summary of Hierarchical Regression Analysis for Gender, Personal Teaching Efficacy, ICT Infrastructure, ICT Training Experience and Self-Efficacy ICT Integration Predicting ICT use for Support student learning (N= 810)*

Variable	B	$SE(B)$	β	R^2	ΔR^2
Step1				.03	.03***
Gender	-.31	.06	-.18***		
Step 2				.05	.02***
Gender	-.31	.06	-.18***		
Teaching Experience	-.01	.00	-.13***		
Step 3				.09	.05***
Gender	-.28	.06	-.16***		
Teaching Experience	-.01	.00	-.13***		
Personal Teaching Efficacy	.36	.05	.22***		
Step 4				.15	.05***
Gender	-.25	.06	-.14***		
Teaching Experience	-.01	.00	-.15***		
Personal Teaching Efficacy	.23	.06	.14***		
ICT Infrastructure	.26	.04	.25***		
Step 5				.22	.07***
Gender	-.19	.06	-.10***		
Teaching Experience	-.01	.00	-.14***		
Personal Teaching Efficacy	.20	.05	.12***		
ICT Infrastructure	.24	.04	.23***		
ICT Training Experience	.14	.02	.28***		
Step 6				.32	
Gender	-.11	.05	-.06*		.10***
Teaching Experience	-.01	.00	-.09***		
Personal Teaching Efficacy	-.10	.06	-.06		
ICT Infrastructure	.17	.03	.16***		
ICT Training Experience	.11	.02	.22***		
Self-efficacy ICT Integration	.61	.06	.40***		

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.
Note. ΔR^2= Change in R^2. Adjust R^2= .32.

The results of analysis were shown in Tables 4. These results respond to the research questions about the important factors for predicting of ICT integration. Self-efficacy toward ICT integration is the strongest predictor for ICT use to support students' learning. Furthermore, ICT training experience, ICT infrastructure, Teaching experience and gender explained additional variance in ICT use to support students' learning.

In the first and-and second step of this analysis, the gender and teaching experience were a significant predictor (β = -.18 and β = -.13, p < .001), accounted for 3% and 5% of the variance in the outcome of each step respectively. When a personal teaching efficacy was added to the equation (Step 3), the coefficient of gender dropped to -.16 (p < .001). In step4, when ICT infrastructure was taken into account, teachers were more likely to endorse ICT for support student learning (β = .25, p < .001), accounted

for 15% of the variance in the outcome. In step5, when ICT training experience was added to the equation, (β = .28, p < .001), the accounted for the variance in the outcome was added to 22%. In the last step, when self-efficacy toward ICT integration was taken into account, teachers were more likely to use ICT for supporting students' learning (β = .40, p < .001), and the coefficient for personal teaching efficacy dropped to -.06 and gender dropped to -.06 (p < .05). In addition, perceptions of gender, teaching experience, personal teaching efficacy, ICT infrastructure and ICT training experience accounted for an additional 7% of the variance (R^2 = .22, p < .001, ΔR^2 = .07, p < .001) whereas self-efficacy in ICT integration added a further 10% (R^2 = .32, p < .001, ΔR^2 = .10, p < .001).

Discussion

Our results clearly implicate that teachers more frequency use ICT for preparing material for teaching than use ICT for supporting students' learning or assigning them to do the activities by using ICT (Law, 2009; Hsu, 2011). This study found that the most frequently of ICT usage for teaching purpose were word processing for preparing the document and Internet as the source of information for lecturing. While teachers most frequently use ICT for supporting students' learning were assign students to collect data by using ICT and gather information from digital resources. Even so, for both result and discussion, it can be proposed that teachers' use ICT for teaching as a less innovative way by replacing and enhancing teaching practices from the traditional such as the use of electronic practices and drill exercises for revision (Peeraer & Petegem, 2012). In addition, teachers' perceived to use ICT for supporting students' learning focused on innovative ways for using ICT tools by students as acquisition and manipulation of the existing information for the development of ICT-related skills and enhancement of learning outcomes (Peeraer & Petegem, 2012). More than the half of frequently use ICT to support students' learning, teachers assigned students for constructing and synthesizing knowledge. It can be suggested that teachers prefer to use ICT to support student-centred learning approach. They need to design a flexible ways to use ICT for creating student-centred activities to engage students while they use ICT as a tool for processing deepening knowledge, supporting during problem-solving and promoting ability to think critically about information (Liu, 2011; Martinovic & Zhang, 2012).

Another key finding from this study is that self-efficacy towards ICT integration also positively influence ICT integration for support students' learning. The added value of this finding is that the moderating effect of teacher' perception of ICT use. This implies that if teachers perceive in confident to use ICT in education, they are more eager to integrate ICT into their teaching practices for support students' learning. This finding is in accordance with the findings of previous studies (Paraskeva, 2008; Chen, 2010; ICILS, 2013). Furthermore, Teachers' experience in ICT training, ICT infrastructure and self-efficacy toward ICT integration as the important variables that can predict the frequency of ICT integration in the classroom. It also concluded that teachers were more likely to use ICT if they were confident when using these tools with their teaching, if they had experienced in ICT-related professional development, and if there were relatively few ICT constraints for accessibility or availability of hardware and software (Law, 2009). However, the result of the current study also indicates that the two variables that represented teacher's demographic characteristics (gender and teaching experience) had a negative relationship with ICT integration. Female and teachers who

have more teaching experience tended to be less likely use ICT integration than male and their younger teachers (Inan & Lowther, 2010).

Conclusion

In conclusion, the current study supports previous research emphasizing for the important obstacles to use ICT and explaining the tendency of teachers' ICT usage to support students' learning through their instructional practices. Recent research has revealed important links between different aspects of teachers' perceived in sense of efficacy (Wolters, 2007) and the integration of ICT context into the learning environment. Future research is needed to explore the possible influence of goals effect on learning strategies such as deep or surface learning which teachers tend to use in their classroom. It would be valuable for developing teachers training course can change the confidence of teachers to integrate ICT as educational tools and also add the skills in teaching strategies for how to enhance students' learning ability in long-term persistence of academic's achievement.

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