EXPLORING THE REASONS FOR USING ELECTRIC BOOKS AND TECHNOLOGIC PEDAGOGICAL AND CONTENT KNOWLEDGE OF TAIWANESE ELEMENTARY MATHEMATICS AND SCIENCE TEACHERS

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ABSTRACT
This study highlights trends and features of E-books and their versatility of this tool in elementary educational settings. There has been little quantitative research employed to examine teachers' reasons for using or not using E-books. The purpose of this study was to examine elementary school mathematics and science teachers' reasons for using or not using E-books and to assess how the use of E-books relates to TPACK among Taiwanese teachers. The survey was developed based on an overview of discussions from prior research related to the benefits and drawbacks of using E-books. The results show the percentages for four reasons for using E-books were high, and low for four reasons for not using E-books. The teachers' perceptions of E-books' usefulness and ability to increase motivation and interaction were significantly different according to gender and the perceptions of E-books' ability to increase interaction were significantly different according to teaching experience. Elementary science teachers demonstrated significantly higher TPACK than elementary mathematics teachers. There was no significant difference found in TPACK according to gender, except for in teachers' technological knowledge. Teachers who had more years of teaching experience demonstrated significantly higher TPACK than the teachers who had fewer years of teaching experience. The results of this study can provide researchers, policy makers, and school administrators with a better understanding of elementary school teachers' perspectives.
Keywords: Electronic Books; TPACK; Elementary Mathematics and Science Teachers

INTRODUCTION

Changes in instructional technology have influenced many educational activities, especially in the fields of game-based learning and e-learning. In fact, instructors face a complex task in designing, developing, and evaluating e-learning courses, which include many different factors (Pearson & Trinidad, 2005; Thurmond et al., 2002; Trinidad, Aldridge, & Fraser, 2005). For this reason, program planners and instructors must consider several factors as they provide their learners with effective learning activities by using technology. Moreover, technology-assisted teaching has received increasing attention in the e-learning field and many related studies have investigated a variety of topics, including web-based learning, mobile-assisted learning, and ubiquitous learning (Bierman & Rupp-Serrano, 2010; Derting & Cox, 2008; Grant, 2004; Jang, 2009; Prey & Weaver, 2007).

The government in Taiwan has developed various learning opportunities for citizens to access new knowledge via e-learning platforms. It has established many online recourses and educational institutions, such as the National Science and Technology Program for e-Learning, and the Digital Opportunity Center (DOC). Taiwanese policy makers have identified distance education as an important way to encourage people to engage many different kinds of learning activities. The Taiwan E-book Association Web was officially established in 2011. Fortunately, as the demands of educational settings have expanded, various technology tools have become available to teachers and institutions. Therefore, education programs frequently re-evaluate teaching strategies and content delivery methods and test new ones in an effort to ensure that they are still valid in current educational environments. It is now possible to explore the multitude of technological tools emerging almost daily and the effective uses of E-book tools in the classroom (Buckley & Tritt, 2011 Mol, Bus, & de Jong, 2009).

Moreover, researchers have pointed out that E-books are one type of critical learning platform with considerable potential for students to learn new knowledge in web-based context (Lam & McNaught, 2009; Mock, 2004). Electronic books are one way to enhance the digital library with global 24-hours-a-day and 7-days-a-week access to authoritative information, and they enable users to quickly retrieve and access specific research material easily, quickly, and effectively (Anuradha & Usha, 2006; Buckley & Tritt, 2011). We are exploring an interactive E-book learning system and environment which can be designed to assist students to learn new knowledge and skills. Some famous interactive web-based applications include E-book software and devices,

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e.g., tablet PCs or web pads. The interactive applications allow users to interact with peers and teachers in online learning environments. Some studies have described how to integrate E-books into teaching and learning environments (Bierman& Rupp-Serrano, 2010 ; Crespo et al., 2011 ; Lam, et al., 2009; Shamir & Shlafer, 2011), and many researchers have suggested that E-books could be used to increase students' motivation and capture learners' responses quickly (Anuradha & Usha, 2006; Buckley & Tritt, 2011; Huang et al., 2012). However, several studies have pointed that both instructors and learners are not ready to use E-books to replace traditional textbooks (Huang et al., 2012).

Mishra and Koehler (2006) proposed the Technological Pedagogical and Content Knowledge (TPACK) framework and stated that the central construct of TPACK represents an emerging form of transformative knowledge through an integrative process generated from the existing instructional forms into new forms that potentially maximize the effectiveness of integrating technology into teaching. Researchers have widely adopted the model to develop TPACK surveys for examining teacher development of this particular type of knowledge (Archambault & Barnett, 2010; Chai, Koh, & Tsai, 2010, 2011; Koehler & Mishra, 2005; Sahin, 2011; Schmidt et al., 2009). The choice of E-books and TPACK development indicates a reciprocal relationship with unique functions requiring different technological and application knowledge to be used according to content and pedagogy in their context. Teachers with more web-related experience show higher self-efficacy with TPACK and more positive attitudes toward the use of the Wed than do teachers with less experience using web-related tools (Lee & Tsai, 2010). Teachers who report use of interactive whiteboards (IWBs) in their teaching show higher TPACK than teachers who report no use of IWBs (Jang & Tsai, 2012).

In this paper, we highlight trends and features of E-books and their versatility as tools in elementary educational settings. Most of previous research has been done with students, while few studies have investigated the use of E-books by elementary school teachers. There has been little research conducted employing quantitative measures to examine teachers' reasons for using or not using E-books, as well as whether the reasons are related to teachers' teaching subjects, gender, or teaching experience. In this study, we first reviewed prior empirical research on the advantages and drawbacks of using E-books and categorized these findings into single reasons for elementary school teachers to rate. The results of this study can provide researchers, policy makers, and school administrators with a better understanding of elementary school teachers' perspectives on these reasons. Therefore, this study used a survey to examine elementary school mathematics and science teachers' reasons for using or not using E-books and how the use of E-books relates to TPACK among teachers in Taiwan.

RESEARCH QUESTIONS

The research questions for this study are:

1. Why do elementary school teachers use or not use E-books?
2. Are there any significant differences among the reasons according to teaching subjects, teacher gender, or teaching experience in the group using E-books?
3. Are there any significant differences in the TPACK of teachers using E-books according to teaching subjects, teacher gender, or teaching experience?

RELATED LITERATURE

THE TRENDS OF E-BOOKS

Over the past decades, web-based learning has become a critical issue in education due to the large amounts of information and recourses available in online environments (Pearson & Trinidad, 2005; Thurmond, et al., 2002). Nowadays, mobile learning technologies have influenced many aspects of education, including the computing applications for teaching, such as tablet PCs, which provide new method for instructors to deliver content and motivate students to engage in various learning activities inside and outside the classroom (Derting & Cox, 2008; Mitra, 2007; Siozos et al., 2009).

The use of E-books has increased in many different levels of institutions, and some researchers are also found potential applications for public school settings (Bierman& Rupp-Serrano, 2010; Buckley & Tritt, 2011; Shepperd, Grace, & Koch, 2008). Moreover, software technologies of E-book play a critical role in enabling various mobile devices such as tablet PCs for teaching in the instructional process (Liaw, Hatala, & Huang, 2010; Siozos et al., 2009). E-books have become more popular with publishers, librarians, and teachers within the past two years. This is evident by the number of E-book initiatives. E-book readers can be divided into the following categories: E-book hardware, Personal Digital Assistants (PDAs), tablet PCs and E-book software (Lam & McNaught, 2009; Mitra, 2007).

DEFINITION OF E-BOOKS

Electronic books (E-books) are gaining popularity for personal reading and teaching in the education field.

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Lemken (1999) defined interactive E-books as "mobile, physical devices to display electronic (i.e. digital) documents". On the other hand, E-book functionality is defined as the ability to support instructor in developing teaching strategies integrating teaching multimedia and assisting teachers in guiding students to engage in interactive learning and access learning contents using E-book devices. (Crespo et al., 2011 ; Derting & Cox, 2008; Korat & Shamir, 2007).

An E-book is based both on emulating the basic characteristics of traditional books in an electronic format, as well as leveraging internet technology to facilitate easy and efficient use (Anuradha & Usha, 2006; Lam & McNaught, 2009). An E-book can take the form of a single monograph or multi-volume set of books in a digital format that allows viewing on various types of monitors, devices, and personal computers. It should allow searching for specific information across a collection of books and within a book. An E-book should utilize the benefits of the internet by providing the ability to embed multimedia data, to link to other electronic resources, and to cross reference information across multiple resources (Buckley & Tritt, 2011; Lam & McNaught, 2009).

An E-book collection should be accessible anytime, anywhere via the internet, requiring no device but a personal computer to access the content. An ideal E-book should provide content of value, the ability to view online, the ability to download to a PC or view offline, and the ability to view on a handheld device or personal digital assistant (Buckley & Tritt, 2011).

THE ADVANTAGES OF E-BOOKS

Today various types of teaching technology are adopted in the classroom such as personal computers and tablet PCs. These digital tools can be used as E-book devices to assist instructors to teach in the digital form. The advantages of E-books for teaching are straightforward and include several factors:

1. Increasing interaction

Many researches have revealed that interaction is a critical factor in developing an excellent e-learning environment. E-books facilitate written and visual communication between the participants who are at different places, enabling students to interact with other students and teachers; this kind of fast communication is an important factor in the improvement of the value of e-learning (Anuradha & Usha, 2006; Buckley & Tritt, 2011). Moreover, several researchers have pointed out that the use of E-books for social interaction constitutes an important role in the emergence of internet usage (Huang, et al., 2012; Nunez-Valdez, et al., 2012).

2. Promoting learning motivation

E-books have a huge impact on learner motivation. As such information technology becomes increasingly ubiquitous in e-learning, it is important to design them to optimally impact motivation (Mock, 2004). Buckley & Tritt (2011) mentioned that student motivation is reflected by the amount of time spent on the internet**,** benefits gained from social networking, and identification of personal learning needs.

3. Encouraging student participation

It is important task for instructors to encourage active participation and contribution of each group member to successfully promote collaborative learning via E-books (Anuradha & Usha, 2006; Siozos, et al., 2009). E-book applications have resulted in increased user participation and open multimedia contents, some of which is potentially useful for learning (Derting, & Cox, 2008). In addition, many researches have indicated that awareness of the collaborative learning context through E-book devices significantly increases student participation in learning activities and improves student learning performance (Derting, & Cox, 2008; Mock, 2004; Siozos, et al., 2009).

4. Usefulness -Facilitating the understand of abstract concepts

E-books create new opportunities for teachers and have revived the scholarly monograph. The emergence of E-books has given publishers new ways to serve customers by re-purposing content and creating living books, which incorporate text, audio, video, and other resources (Derting, & Cox, 2008; Lam & McNaught, 2009; Siozos, et al., 2009), and enhance students' vocabulary, story and concept understanding (Korat, 2010).

THE DISADVANTAGES OF E-BOOKS

Several researchers have revealed that there are several challenges involving instructors experiences using E-books for teaching activities in the classroom such as how to efficiently solve problems related to using E-books, time issues, school funding and training for operating E-books (Crespo et al., 2011; Derting & Cox, 2008; Grant, 2004; Lam, et al., 2009 ; Liaw, Hatala, & Huang, 2010).

1. Technique

It is crucial not only to provide these electronic resources, but also to integrate them into school systems to streamline operations in teaching, as well as promote user adoption (Lam & McNaught, 2009; Mitra, 2007). Access challenges include the cataloguing and indexing of E-books, circulation models for the electronic

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environment, and preservation and archiving of E-books and the resources linked to them (Derting & Cox, 2008; Siozos et al., 2009).

2. Funding

The integration of E-Books into schools has not only created opportunities for students, but also created several challenges. Schools must develop innovative policies, procedures, and funding to accommodate the teaching contents to E-books. Funding and technological challenges also include E-book hardware and software technologies, digital rights management software, and user and staff training (Derting & Cox, 2008; Siozos et al., 2009).

3. Time

Since the internet knows no boundaries, teachers must also contend with challenges created by the emergence of the E-book. These include extra loading time (Lam & McNaught, 2009). Providing feedback on student assignments can be a very time consuming task whether students are in face-to-face classes or online (Huang, et al., 2012).

4. Facilitated operation

E-books pose special problems with services to teachers and their equipment with work stations permanently accessible to the people who attend them and the teamwork of teachers (Buckley & Tritt, 2011; Crespo et al., 2011; de Jong & Bus, 2002).

USING E-BOOKS TO DEVELOP THE TPACK OF TEACHERS

In the present study, TPACK was investigated within a particular type of technology-based learning environment, the E-book (Mock, 2004). The current success of the use of the educational technology reinforces the choices we have made, particularly the flexibility offered through the personalization of online environments and the ability of teachers to create learning communities (Grant, 2004; Grimshaw et al., 2007; Shamir & Shlafer, 2011).

On the technical side, the implementation choices for using the E-book devices have led to open sources and flexible platforms which are easy to maintain and extend. Moreover, it allows easy integration or interoperability with existing resources and platforms in classrooms (Shamir & Shlafer, 2011). Digital inking of E-books provides the option to handwrite comments on a student's electronic document. The ability to write on students' digital files in order to provide precise and efficient feedback may be the most time saving and effective use of this tool we have found to date. Feedback via E-books may be especially helpful when teaching online as digital inking simulates the handwritten comments students are accustomed to receiving. Hand written digital comments on a student's document may increase social presence, and can provide a more human touch to feedback and online interaction (Nunez-Valdez, et al., 2012; Sneller, 2007).

These observations align with the TPACK notion of a transformative learning experience and integrative teacher knowledge. Teachers with TPACK know how to incorporate the three different knowledge domains of technology, pedagogy and science (or mathematics) into different situations and themes (Jimoyiannis, 2010). For example, Jang (2010) found that science teachers used IWBs as instructional tools to share their subject matter knowledge and to express students' understanding. In addition, the IWBs helped the science teachers who encountered teaching difficulties in the traditional classroom to better implement their representational repertoires and instructional strategies. Therefore, we propose that E-books may be another current technology for teachers to use and develop their TPACK in elementary schools.

Thus this study used integrative views of TPACK with E-book technology to develop an instrument and survey teacher' reasons for using or not using E-books and the E-book-based TPACK of current elementary mathematics and science teachers in Taiwan.

METHODLOGY

SURVEY INSTRUMENT

The study used a questionnaire to collect data from instructors at elementary schools in Taiwan. We adopted a three-part survey in this study: a research-based background survey to collect demographic information and survey of the reasons for using E-books and not using E-books. The first part of this survey included three variables: gender, teaching experience, and teaching subjects in order to gather participants' background information. One open-ended question was included in the first part to gather more information about their use of other technologies.

In the second part of the survey, there were four closed-ended questions for teachers who reported they were using or not using E-books and one open-ended question for these teachers to describe other reasons not listed in the survey (see Table 1). The questions of the survey were developed based on an overview of the discussions

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from prior research related to the benefits and drawbacks of using E-books. Participants rated the survey items in this section on a 3-point rating scale from 1 (Disagree) to 3 (Agree). Since each reason can explain an individual point in relation to both benefits and drawbacks, each reason was rated separately. In order to ensure their readability and comprehensibility, the draft questions were reviewed by five teachers to correct any ambiguous language. The questionnaire was then sent two science education scholars and two educational technology specialists for content review.

The third part of the questionnaire was developed to examine teachers' TPACK. The TPACK instrument used in this study was developed by Jang and Tsai (2012) to examine teachers involved in information communication technology teaching environments. The items of the TPACK instrument were ranked on a 5-point Likert scale from 1 (not at all true) to 5 (very true). The only difference between the TPACK items in the two questionnaires was that the term "interactive whiteboards" was changed to "E-books." The questionnaire contained 30 TPACK items and consisted of four components: 1) 5 items for Content Knowledge; 2) 9 items for Pedagogical Content Knowledge in the Context (PCKCx); 3) 4 items for Technological Knowledge; and 4) 12 items for Technological Pedagogical Content Knowledge in the Context (TPCKCx). The survey involves a 5-point Likert-type set of ordered alternatives.

Table 1 Reasons for using or not using interactive E-books

	Reasons for using	Descriptors of the reasons
1.	Using E-books can enhance students' motivation and help them to concentrate on learning.	Motivation
2.	Using E-books can help teachers explain complex and abstract concepts.	Usefulness
3.	Using E-books can increase interactions between teachers and students.	Interaction increase
4.	Integrating E-books into teaching can help teachers become more flexible and enhance students' participation.	Easy of use
	Reasons for not using	
1.	School does not have enough funds to provide an E-book for instructors.	Lack of budget
2.	E-books are not used due to lack of time to design teaching materials in my course.	Lack of time
3.	E-books are not used due to lack of professional training for the E-books functions and operation.	Lack of training
4.	E-books are not used due to frequent unsolved problems in using it in the classroom.	Unsolved problems

PARTICIPANT

A quantitative survey study exploring the instructors' views related to use or not use of E-books would be beneficial in identifying the fundamental issues that are of concern to teachers using E-books for teaching. The TPACK questionnaire was mailed to elementary schools randomly selected across different parts (i.e., North, Middle, South, and East) of Taiwan, and return envelopes were provided for completed questionnaires. There were 825 questionnaires returned in total. After deleting the questionnaires with missing data on ratings of using E-books and TPACK items, 680 accurate questionnaires were return for factor analysis of the survey.

ITEM AND FACTOR ANALYSIS

Item analysis was conducted with the 30 items. The participants scoring in the top 27% and in the bottom 27% were divided into two groups for independent sample t-tests. The difference between each item's scoring and the critical ratio of each item in the two groups was examined. Product-moment correlation and tests of homogeneity of proportions were conducted to establish criteria for retaining or deleting items. The critical ratio of all 30 items was over 3 ($p<.05$). Hence, we kept all items at this stage. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was applied to the data prior to factor extraction to ensure the characteristics of the data set were suitable for exploratory factor analysis (Field, 2009).

In this instrument, KMO was .907, above the minimum value of .5. The diagonals of the anti-image correlation matrix were all over .5 (Thompson, 2004) supporting the inclusion of each item in the factor analysis. Given these overall indicators, factor analysis was further conducted with all 30 items. Through the first factor analysis (see Table 3), the items C01, C02, C03, C04, and C05 were related to CK. The items from C06 to C14 were related to PCKCx. Furthermore, the items C15, C16, C17, and C18 were related to TK. Moreover, the items

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from C19 to C30 were related to technological application of TPCKCx. Cronbach's Alpha was computed to assess the instrument's reliability suggested as .70. Results showed that all the four subscales as well as the total scale had very high internal consistency. Internal consistency of each component was: CK (α = .875), PCKCx (α = .908), TK (α = .896), TPCKCx (α = .968), and TPACK (α = .956). We found that the four components captured even better Taiwanese elementary school contexts.

DATA ANALYSIS

Percentages of the ratings for each reason for using E-books and not using E-books were computed (see Table 2). Independent samples t-tests were conducted for the groups using E-books according to teaching subjects and teacher gender, and ANOVA was performed the group using E-books according to teaching experience (see Tables 3-5). To address the third research question in this study, an independent samples t-test was used to explore the significant differences between elementary mathematics and science teachers' TPACK according to teaching subjects and gender (see Tables 6-7). ANOVA was performed to answer research question 3 and determine the differences between teachers' TPACK according to teaching experience (see Table 8). Data from the one open-ended question was provided to understand what other technologies elementary teachers used in teaching mathematics and science.

RESULTS

1. The reasons for using or not using E-books

Based on the data of the survey, 680 elementary science and mathematics teachers responded to the survey accurately. The group of teachers who used E-books consisted of 586 (86.2%) elementary school teachers whereas the group of teachers who did not use E-books had 94 (13.8%) elementary school teachers. We computed the percentages of reasons for both using and not using E-books on a rating scale ranging from 1 (Disagree) to 3 (Agree).

Table 2 Percentages on reasons for using and not using E-books

Reasons	Yes (%)	Unknown (%)	No (%)
Use reasons (N=586)			
Reason1: Motivation	84.6	14.7	0.7
Reason2: Usefulness	92.7	7.02	0.2
Reason3: Interaction increase	72.5	24.1.	3.4
Reason4: Easy of use	86.5	13.1	0.3
Not use reasons (N=94)			
Reason1: Lack of budget	44.4	19.8	35.8
Reason2: Lack of time	44.4	29.6	25.9
Reason3: Lack of training	32.1.	29.6	38.3
Reason4: Unsolved problems	38.3	32.1	29.6

The percentages for all reasons of using E-books were high (see Table 2), indicating that most elementary school mathematics and science teachers who have used or are using E-books in their teaching agreed with the reasons in the survey for why they chose to use E-books. Elementary school teachers who reported not using E-books appeared to agree on all reasons below 50%, indicating that all reasons for them not to use E-books did seem not apparent. Because few teachers did not use E-books, we focused on the reasons for using E-books among teachers according to gender, teaching subjects, and experience in this study.

1.1 The reasons for using E-books according to gender

Table 3 Means, standard deviation, and t-test on use reasons by gender

Reasons /Group	Male (n = 180)		Female (n = 406)		
	M	S.D.	M	S.D.	*t*
Motivation	4.26	.680	4.10	.680	2.593*
Usefulness	4.23	.610	4.31	.620	2.225*
Interaction increase	3.97	.780	3.84	.720	1.994*
Easy of use	4.26	.660	4.15	.660	1.790

*p<.05

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According to Table 3, reasons 1, 2 and 3 are significantly different between male and female teachers. The results indicated that male teachers showed significantly higher ratings for the reason of "enhancing students' motivation and helping them to concentrate on learning" than did female instructors. Also, male teachers' ratings for the reason of "using E-books can help teachers explain complex and abstract concepts" were significantly higher for males than those female teachers. Additionally, male teachers showed significantly higher ratings for the reason of "using E-books can increase interactions between teachers and students" than did female instructors.

1.2 The reasons for using E-books according to teaching subject

Table 4 Means, standard deviation, and t-test on use reasons by teaching subject

Reasons /Group	Mathematics (n = 426)		Science (n = 160)		
	M	S.D.	M	S.D.	*t*
Motivation	4.13	.680	4.21	.680	-1.185
Usefulness	4.32	.620	4.40	.600	-1.373
Interaction increase	3.86	.750	3.91	.700	-.743
Easy of use	4.16	.660	4.25	.650	-1.521

According to Table 4, there were no significantly differences among these four reasons according to teaching subject.

1.3 The reasons for using E-books according to teaching experience

Table 5 Means, standard deviation, and ANOVA on use reasons by teaching experience

Reasons /Group	<5 (n = 52)		6-15 (n = 296)		16-25 (n = 184)		> 26 (n = 56)		
	M	S.D.	M	S.D.	M	S.D.	M	S.D.	*F*
Motivation	4.03	.78	4.13	.67	4.22	.66	4.36	.56	2.293
Usefulness	4.26	.70	4.34	.61	4.35	.60	4.57	.50	1.798
Interaction increase	3.73	.69	3.85	.77	3.94	.68	4.14	.80	2.737*
Easy of use	4.04	.77	4.17	.64	4.23	.67	4.36	.49	2.172

Note. $*p < .05$

According to Table 5, reason 2, "using E-books can help teachers explain complex and abstract concept" was significantly different according to teaching experiences. Other than this, no significant results appeared among the other reasons based on teaching experience.

2. The TPACK of teachers based on teaching subjects, gender and experience

Table 6 Means, Standard Deviation, and t-test on TPACK by Teaching Subjects

Components /Group	Mathematics (n = 426)		Science (n = 160)		
	M	S.D.	M	S.D.	*t*
CK	21.53	2.29	21.72	2.66	-.846
PCKCx	37.70	3.72	38.26	4.44	-1.404
TK	16.23	2.27	16.83	2.19	-2.860**
TPCKCx	49.19	7.10	50.86	5.88	-2.651**
TPACK	124.65	12.67	127.66	12.67	-2.556*

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

In order to examine teachers' TPACK according to teaching subjects (i.e., science and mathematics), a t-test was conducted for teachers' TPACK for the two subjects (see Table 6). Results indicated that there were significant differences between teachers' TK, TPCKx, and TPACK among science and mathematics teachers. Elementary science teachers demonstrated significantly higher TK, TPCKCx, and TPACK than did elementary mathematics teachers.

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Table 7 Means, standard deviation, and t-test on TPACK according to gender

Components	Male (n = 180)		Female (n = 406)		
	M	S.D.	M	S.D.	*t*
CK	21.57	2.63	21.59	2.29	-.077
PCKCx	37.50	4.45	38.01	3.68	-1.347
TK	16.78	2.40	16.22	2.17	2.807**
TPCKCx	50.04	6.74	49.47	6.86	.948
TPACK	125.90	13.90	125.28	12.19	.541

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

An independent sample t-test was conducted for teachers' TPACK by gender (see Table 7). There was no significant difference found in TPACK according to gender, except in teachers' TK. Male teachers demonstrated significantly higher TK than did female teachers.

Table 8 Means, Standard Deviation, and ANOVA on TPACK by Teaching Experiences

Components/ Group	<5 (n = 52)		6-15 (n = 296)		16-25 (n = 184)		> 26 (n = 56)		
	M	S.D.	M	S.D.	M	S.D.	M	S.D.	*F*
CK	21.01	2.48	21.58	2.16	21.72	2.63	22.36	3.02	2.564
PCKCx	36.23	4.26	37.95	3.55	38.12	4.16	39.43	4.74	6.101***
TK	15.81	2.22	16.51	2.30	16.49	2.18	16.00	2.10	2.336
TPCKCx	47.65	7.12	49.77	6.91	49.90	6.57	51.93	6.82	3.312*
TPACK	120.72**	13.08	125.81	12.45	126.23	12.48	129.71	13.85	4.843**

Note. $*p < .05$, $**p < .01$ $***p < .001$.

ANOVA was performed to examine the significant differences between teachers' TPACK according to their teaching experience (see Table 8). The analyses showed that teachers' PCKCx, TPCKCx, and TPACK were significantly different among teachers with various levels of teaching experience. Teachers who had more years of teaching experience demonstrated significantly higher PCKCx, TPCKCx, and TPACK than the teachers who had fewer years of teaching experiences.

DISCUSSION AND IMPLICATIONS

This research investigated reasons for using E-books through surveys and instructors' viewpoints of the present situations in elementary schools in order to explore user utility and potential issues. The findings of this study make significant contributions to the study of E-book use by examining elementary school teachers' perspectives on the reasons for using or not using E-books in Taiwan, as well as whether each reason differs among teachers according to teaching subject, gender, and teaching experience. The percentages of elementary school teachers' ratings for each reason in using E-books were high such as "enhancing students' motivation, explaining complex and abstract concepts, increasing interactions, and ease of use (Bierman& Rupp-Serrano, 2010; de Jong & Bus, 2002 ; Korat & Shamir, 2007).

As shown in Table 3, the teacher's perceptions with regard to E-books' usefulness, and ability to increase motivation and interaction were significantly different according to gender. The results indicated that male teachers gave significantly higher ratings of these reasons than female teachers. This result supports the findings of several previous studies of the gender issues of e-learning (Gonzalez-Gomez, et al., 2012; Huynh, Lee & Schuldt, 2005). The reason may be that higher percentages of male university students select academic majors related to science or information technology. Male teachers have more learning opportunities and experiences involving computing and internet technology.

The perceptions with regard to E-books' ability to increase interaction were significantly different according to teaching experience, but the other perspectives were not significantly different. This result is not surprising given that instructors who have more teaching experience are able to develop effective interaction between teachers and learners in the e-learning field (Crespo et al., 2011; Hadjerrouit, 2010). For the open-ended questions, the teachers' opinions related to E-books made very positive comments about the contribution of using E-books. Teachers usually use the online content delivery system to give exercises to the students and observe individual learning needs. Also, students can easily and efficiently report their work and documents via online content delivery systems. This function plays a critical role in increasing the interaction between instructors and students in the classroom.

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Researchers have studied the development of TPACK with in-service science teachers (Guzey & Roehrig., 2009; Jang, 2010) and in-service mathematics teachers (Lee & Hollebrands, 2008). Little is known about elementary teachers' TPACK in these two subjects. This study explores the differences between mathematics and science teachers' TPACK. The result shows that elementary science teachers have significantly higher TPACK than do elementary mathematics teachers in Taiwan. Science teachers' TK and TPCKCx were higher than those of mathematics teacher. This finding indicates that science teachers' knowledge associated with the technology related components of TPACK is higher than the knowledge of mathematics teachers. A possible reason may be that science teachers integrate more technology-related tools into their teaching than do mathematics teachers. In this way, their technological knowledge, and the knowledge of integrating technology, content, and teaching strategies can be enhanced. Therefore, it is essential to further gather qualitative data to verify this predictive reason and better understand whether science teachers use more technologies than mathematics teachers do in teaching as well as how science teachers apply various technologies.

No significant difference was found in teachers' TPACK by gender, except for the TK dimension. This finding suggests that the TK knowledge of male elementary teachers was higher than the TK knowledge of female elementary teachers. Teachers' teaching experience has been studied in relation to the PCK development of science teachers (Friedrichsen et al. 2009). Experienced teachers have more opportunities and experiences in teaching different content and applying various teaching strategies. In our study, we discovered that experienced teachers had higher TPACK than did novice teachers. Experienced teachers' PCKCx and TPCKCx were higher than those of novice teachers. This finding corresponds to the results of prior empirical studies suggesting that teachers with more teaching experience should present better knowledge by using pedagogical strategies in teaching as compared to teachers with little teaching experience (Jang & Tsai, 2012).

CONCLUSION AND SUGGESTIONS

This study is unique in that it examines in-service elementary teachers' TPACK by integrating teachers' knowledge of students' learning situations as a context factor in the proposed model. The results provide significant contributions to the research of E-book use by examining elementary teachers' current use of E-books in Taiwan and their development of TPACK. Another significant contribution is that teaching subjects and teaching experiences can play crucial roles in teachers' TPACK. The results of this study can provide researchers, policy makers, and school administrators with a better understanding of current elementary school science and mathematics teachers' perspectives.

Currently, E-books are only being used in the context of the educational establishment (Woody, Daniel, & Baker, 2010). We want to consider other contexts, for instance, the library context, and other specific services for students. This could lead to more personalization and adaptation of this object (Korat & Shamir, 2007; Shamir & Shlafer, 2011). Future studies could develop a self-learning system and apply learning models via E-book platforms for in-service teachers, and explore students' understanding and academic performance of E-book collaborative learning in real classrooms. Researchers could cooperate with teachers and students executing learning activity to evaluate the improvement of E-book performance. Future studies could also cooperate with other content-based projects and include their content, learning models and learning activity designs in E-book systems.

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