Predicting the Perceived Usefulness of eBook among Mathematics Teachers

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Abstract : The introducing of the one-to-one eBook for each students were said to be an important move to encourage technology integration in mathematics classrooms. This study sets out to examine the perceived usefulness of the eBook among Mathematics teachers, where the affects of four predictors, namely the critical mass, learning opportunities, facilitating conditions and personal innovativeness were assessed. Using validated questionnaires, a survey was conducted involving 304 mathematics teachers. Structural Equation Modeling (SEM) was used to analyse the data obtained. The result showed that 62.6% of variance of perceived usefulness was explained by the four exogenous variables. Critical mass, learning opportunities and facilitating conditions were found to significantly affecting perceived usefulness while the personal innovativeness did not.

Keywords : eBook, Mathematics teachers, perceived usefulness, critical mass, learning opportunities, facilitating condition, personal innovativeness

1. Introduction

The effort to integrate technology into mathematics teaching and learning depends firmly on the teachers' perception on its usefulness. Assuming that, teachers who do not believe that technology utilization will fulfill their needs and also their students', would most probably avoid using technology in their lessons (Teo, 2012). One predictor factor that was found to strongly predict the teachers' attitude towards using technology is the perceived usefulness. The attitude, which is either positive or negative, will in turn influence the behavioral intention to use a specific technology.

Many experts in educational technology believed and agreed that technology use in school could not reach the maximum effectiveness until the computer is no longer shared (Bebell & Kay, 2010). Since a decade ago, a new educational transformation has emerged when more than 40 countries across the world have provided laptops to teachers and students without sharing (Mo et al., 2013). In Malaysia, the state Terengganu was among the first to introduce this concept of one-to-one laptops in 2009 in the vision to produce techno-savvy citizen (Wan Muhammad Amir et al., 2013). The eBook provided in the initiative is a low-cost netbook computer or a mini laptop, able to connect to the Internet and also installed with the digital textbook softwares. Students nowadays, dubbed as the generation Y preferred a flexible learning environment, yet not replacing the traditional teaching but enhancing the students' learning experience(Jazihan, Ahmad Fauzi, & Wong, 2012)

Despite the large amount of money spent, the use of computers by teachers in classrooms remains minimal and inefficient (Ministry of Education, 2013; Teo, 2009). In addition, students and parents reported that the time spent by mathematics teachers using laptops in the classrooms is half the time spent using laptops for other subjects such as Science and English (Zuber & Anderson, 2012). Numerous studies on one-to-one laptop consistently reported that utilization in mathematics classroom has the lowest rate compared to other subjects without elaboration of the reasons (Bebell & Kay, 2010).

Hence, this study is based on the Technology Acceptance Model (TAM) which rooted from Theory of Reasoned Action (Fishbein & Ajzen, 1975) that posits that users' technology acceptance is determined by their perceptions on the usefulness and the ease of use of technology (Davis, Bagozzi, & Warshaw,

1989). The model was designed to explain and predict users' acceptance on any types of technology and have been widely tested in series of empirical studies for validity. Recent educational research using TAM in Malaysia include studies by Jazihan, Ahmad Fauzi, & Wong (2013) and Ariff, Yeow, Zakuan, Jusoh, & Bahari (2012). In the recent study, perceived usefulness is highlighted as it is the core determinant of behavioral intention in TAM, which is the main factor that may affect the use of a technology (Davis et al., 1989). Perceived usefulness could possibly be affected by numerous external variables depending on the needs and research area (Davis et al., 1989). In this study, four external variables were carefully selected based on literatures and research needs namely the critical mass, learning opportunities, facilitating condition and personal innovativeness.

A person will use a certain technology if it is useful in helping him/her perform better in his job (Davis, 1989). In the context of education, perceived usefulness can also be seen in the students' test performance. Scales were refined and developed by Davis (1989) and defined explicitly as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989). An important social factor identified on adoption and acceptance of technologies is the perceived critical mass. The adoption and communication media use were then explained in the critical mass theory where a technology value boost exponentially to the total number of the users (Lou, Luo, & Strong, 2000). In the context of technology adoption, Bourgonjon et al., (2013) describes critical mass as the idea that a technology's utilization rate is slow until a certain number of users have used and accepted the technology. Learning opportunities, however is the learning process and the opportunities given in the process, defined as 'the degree to which a person believes that using a particular system can offer him or her opportunities for learning'(Bourgonjon, Valcke, Soetaert, & Schellens, 2010). Other professionals may work hard towards personal effectiveness, but most teachers strive to inspire their students to reach the learning goals. Next, Teo, Lee and Chai (2007) defined facilitating conditions as factors present in the surroundings that may affect an individual's desire to perform a task which may involve skill training, administrative support and the availability of materials and sufficient information on technology usage. Another predictor factor is personal innovativeness. Agarwal & Prasad (1998) introduced the term 'personal innovativeness in the domain of information technology' which is described as the willingness to take up and try a new information technology introduced. Personal innovativeness acts as the identifier of individuals who would possibly accept technology earlier than the others. Hence, the hypotheses of this study are:

H_1 : Critical mass positively affect perceived usefulness
H_2 : Learning opportunitiespositively affect perceived usefulness
H_3 : Facilitating conditionspositively affect perceived usefulness
H_4 : Personal innovativeness positively affect perceived usefulness

2. Methodology

Respondents selected to participate in this study were 304 mathematics teachers in primary schools across Terengganu, Malaysia. A survey study was administered, where previously validated questionnaires were adapted and used in this study. Selected with the proportionate stratified sampling, the mathematics teachers then provided their demographics details and responded to 20 items which comprises of four items in perceived usefulness, three items for critical mass, five items for learning opportunities, facilitating conditions (three items) and three items for personal innovativeness. Each item was measured on a five-point Likert scale with 1(strongly disagree) to 5(strongly agree). These adapted items from numerous published sources have demonstrated good reliability in measuring the constructs employed in the present study. In this study, the reliability test conducted also yielded sufficient Cronbach's alpha value for perceived usefulness (.956), critical mass (.876), learning opportunities (.948), facilitating condition (.892) and personal innovativeness (.812) indicating good reliability in the adapted questionnaire.

3. Results

The respondents' general demographic information is that, from 304 Mathematics teachers participated, 126 (41.4%) of them are male teachers and 178 (58.6%) are female. Experienced teachers with more than 20 years of teaching mathematics are only 16.8 percent of those who took part in this study while most of them are between 11-20 years of experience in teaching mathematics. Almost all (95.1%) mathematics teachers in this study have Internet access at home. However, most of them only spend less than three hours a day to surf the internet. A small minority of 6.3% spent more than five hours a day surfing the net. It also shows that around 57.6% of the teachers use the eBook only about an hour or less in a day and the ones who use the eBook regularly more than 3 hours a day consist of only about 12.5% of the teachers surveyed.

Normality is one of the most important assumptions to be tested in a multivariate analysis for it refers to the normal data distribution for individual metric variables (Hair, Black, Babin, & Anderson, 2010). The assessment of univariate normality using AMOS is done by reporting the statistical skewness and kurtosis and the assumption of normality was met and fulfilled for each construct. Convergent validity determines the value of common variance in the indicators of each construct. As suggested by Hair et al.(2010), there are three ways to estimate convergent validity which is by assessing the factor loading, average variance extracted (AVE) and Construct Reliablitiy (CR). The size of the factor loading should be 0.5 or larger. In this study, as shown in Table 2, all factor loadings are more than 0.7. The second measure is calculating the AVE and the criterion value of AVE accepted is 0.5 or higher (Hair et al., 2010). Thirdly, similar to the Cronbach's alpha values, the construct reliability is met if the values of CR are 0.7 or higher. In this model, all values of CR are more than 0.7 and therefore, the initial measurement model satisfies the convergent validity.

Table 2. Results of the measurement model

Construct		Factor loading	AVE (>0.5)	CR (>0.7)
CM1	Most teachers in my school use eBook frequently	0.892	0.736	0.893
CM2	Most mathematics teachers I know use eBook frequently	0.872		
CM3	My friends who are teachers in other schools use eBook frequently	0.808		
LO1 LO2	eBook allows my students to experience things that they learnt about in the mathematics classroom	0.809	0.724	0.929
	eBook offers opportunities for my students to interact with each other	0.785		
LO3	eBook offers opportunities for my students to think critically	0.878		
LO4	eBook offers opportunities to motivate students to learn mathematics	0.900		
LO5	eBook helps my students to explore mathematical ideas	0.878		
FC1	When I need help to use the eBook, someone is there to help me	0.767	0.590	0.891
FC2	ICT Coordinator is always available to give advice on eBook usage in teaching	0.864		
FC3	Executive Information Officer (EIO) is always available when there are technical problems	0.713		
FC4	Guidance is available for me in the selection of software to choose for my mathematics lessons	0.72		
PI1	I want to explore the new eBook introduced	0.817	0.699	0.874
PI2	I like to experiment with new technologies	0.849		
PI3	I think it is very interesting to try out new technologies	0.842		
Use1	Using the eBook can improve my teaching performance in the mathematics classrooms.	0.855	0.811	0.945
Use2	Using the eBook increases my teaching effectiveness in mathematics.	0.926		
Use3	Using the eBook makes my mathematics teaching easier	0.92		
Use4	Using the eBook helps my students to achieve better marks in mathematics	0.899		

The model fit of the research model in this study was tested using AMOS 21.0. Researchers usually employ different indices to determine model fit (Brown, 2006). Hair et al. (2010) suggested to at least test and report the one index from the incremental fit, one from the absolute fit index, one goodness-of-fit, and one badness-of-fit. Therefore, in the present study, the researcher has chosen to use four fit indices which are the CFI, TLI (incremental fit category), RMSEA (absolute fit category) and Chisq/df (parsimonious fit category) to test the model fit.

Table 4. Fit indices for the research model

Fit Indices	Values	Recommended values
χ^2/df	2.381	< 3.0
TLI	.949	≥.90
CFI	.958	≥.90
GFI	.900	≥.90
RMSEA	.068	<.08

Hair et. Al (2010), (Schumacker & Lomax, 2010)

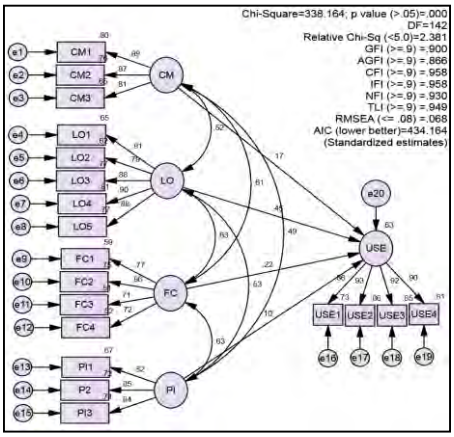

Figure 2. The Structural Model

Discussion

Employing the Structural Equation Modeling, fitting our data to the model explained 62.6% of the variance in perceived usefulness of eBook use among mathematics teachers in Terengganu. The study also found that critical mass ($\boldsymbol{\beta}$=.170, p<.01), learning opportunities ($\boldsymbol{\beta}$=.454, p<.001) and facilitating conditions ($\boldsymbol{\beta}$=.215, p<.01) have significant positive effects on teachers' perceived usefulness of eBook use in teaching and learning. This findings are in congruent with current research (Bourgonjon et al., 2013; Moses, Wong, Kamariah, & Rosnaini, 2013). Learning opportunities were found the strongest determinant of perceived usefulness, which was seen parallel to the previous studies (Bourgonjon et al., 2013; De Grove et al., 2012; Roslina, et al., 2011).

Personal innovativeness however, was found not significant in affecting the perceived usefulness ($\boldsymbol{\beta}$=.096, p>.05). This contradicted the findings of many studies previously done, including studies by Bourgonjon et al. (2013), Smet et al.(2012) and Liu, Li, & Carlsson (2010). This might be because that Mathematics teachers who are innovaters, high in personal innovativeness are always willing to try new technologies and wanting to be the first to try something new, have seen more advanced technology such as the tablets and updated laptops and have become too familiar with computers such as the eBook, making them see the limited usefulness of the eBook as an effective learning tool. This however, could be validated by further research.

Conclusion

The study confirmed critical mass, learning opportunities and facilitating conditions as strong predictors of perceived usefulness of eBook among mathematics teachers. It is of significance relevance to the Ministry of Education and Education Department which are responsible for ushering in new developments and

technologies in the education system. Overcoming the teachers' resistance to change has always been a major issue in managing changes. Hence, in ensuring smooth technology acceptance in a changed education scenario, such as this one-to-one eBook, the study clearly implied the need to seriously consider on holding carefully planned trainings and guidance for teachers, specifically on samples of good mathematics teaching and learning using the eBook and most importantly the digital textbook provided. Certain infrastructures such as the slow internet connection and the insufficient power supply to charge the individual eBook batteries were also brought up during the school visits. To show that the eBook provide high learning opportunities, information should be easily accessible, the digital textbook should not only consists of text and diagrams, but instead, complete with videos and animations that would get the students to see how to apply mathematics in everyday life, get to experience and experiment with their mathematical knowledge and explore mathematical ideas. Regarding critical mass, the encouragement and support from superiors and seeing successful usage among peers will motivate utilization of eBook by mathematics teachers. This research is however, done in a quantitative approach where the instruments used were only self-report questionnaires. It is recommended that the study could be more in depth, if done using more instrumentation such as interviews, classroom recordings and also observations. Future studies could be done using the mix method study, also including the quantitative part or could also be totally qualitative. This could provide more comprehensive insights and understanding of the students and also teachers on the acceptance of eBook in mathematics lesson.

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