

STRUCTURAL RELATIONSHIPS BETWEEN VARIABLES OF ELEMENTARY SCHOOL STUDENTS' INTENTION OF ACCEPTING DIGITAL TEXTBOOKS

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ABSTRACT

The purpose of this study is to explore variables affecting the acceptance of digital textbooks in the elementary school environment and provide basic information and resources to increase the intention of acceptance. Based on the above research purposes. Surveys were conducted using Google Docs targeting randomly selected elementary school students using digital textbooks. In this study, we used the measurement instruments used in the previous study, after revising according to the research environment, to measure the self-efficacy in using digital textbooks, subjective norms, observability, perceived ease of use, perceived usefulness, and intention of acceptance. We used item parceling to avoid model misspecification and AMOS 20.0 for statistical analysis. The research results were as follows: first the observability and self-efficacy in using digital textbooks affected the perceived ease of use but subjective norms had no effect. On the other hand, the result that subjective norms do not affect the perceived ease of use is different from our initial hypothesis but is consistent with previous research by Oak (2013). Second, the results of investigating the effects of efficacy in using digital textbooks, subjective norms, observability, and perceived ease of use on perceived usefulness, self-efficacy in using digital textbooks, subjective norms, and perceived ease of use, affected perceived usefulness but observability did not provide significant effects. Third, the elementary school students' perceived usefulness significantly affected the intention of accepting digital textbooks. The results are consistent with previous studies (Davis et al., 1989; Kang & Kim, 2013), suggesting that the more students utilize digital textbooks and believe that a digital textbook is helpful to increase learning outcomes, the more easily they are able to accept digital textbooks.

KEYWORDS

Digital Textbook, Technology Acceptance Model, Ease of Use, Usefulness

1. INTRODUCTION

Since the introduction of Apple's iPhone and iPad in Korea in 2009, the trends of using cellular phones and tablet PCs based on iOS and Android have been observed across the economy, society, and culture. In conjunction with these trends, discussions related to the utilization of these applications are vividly increasing in educational environments (Kang, Song, Lee, & Ku, 2010). The Ministry of Education announced that they will develop digital textbooks and spent a total of \$11,859 billion in 2011 with the goal of overcoming the limitations of current textbooks, improving current class environments, and spreading individualized adaptive teaching and learning methods. They selected 144 schools nationwide (12 schools in Seoul, 63 schools in Busan, etc.) to study the effects of digital textbooks in 2013.

Technological innovations such as digital textbooks cannot be widespread with only the government's support without technology users' attitudes on preference and ability of using the technology being considered (Schwarzer & Hallum, 2008). Davis suggested the TAM (Technology Acceptance Model) to explain variables determining technology user's intention of accepting new technology. The core of TAM is that the perceived ease of use and perceived usage of new technology affect the attitude toward innovative products and users' attitudes and intentions of use (Davis, 1989). The TAM model is evaluated as a general model without limitations associated with particular information systems, users, research condition, or time and country attitudes about the use of other users' attitudes (Lou, Luo, & Strong, 2000; Venkatesh & Davis, 2000). Another opinion about new technology acceptance, according to the social influence model of

technology, is that the norms of the reference group, social environment, and personal characteristics affect a user’s new technology acceptance (Fulk, Steinfield, Schmitz, & Power, 1987).

However, there are constraints in that most previous studies consider only single factors rather than considering personal characteristics and environmental variables within a research frame. Such a frame would include interface design, ease of use, and the perceived usefulness (Hong, Hwang, Hsu, Wong, & Chen, 2011), as well as self-efficacy (Venkatesh, 2000). Thus, the current study scrutinizes the causal relationships between variables of personal characteristics, such as self-efficacy, subjective norms of environmental variables, and observable attributes of innovations by countering the above limitations.

Bandura’s self-efficacy concept has been applied to new technology and equipment, such as computer self-efficacy (Albion & Ertmer, 2002; Oliver & Shapiro, 1993) and mobile self-efficacy (Kim & Kim, 2011). People with high self-efficacy are more likely to succeed in projects (Oliver & Shapiro, 1993). Self-efficacy refers to one’s own belief in being able to complete a given project successfully (Bandura, 1982) and The current study will investigate the research regarding students’ self-efficacy on using digital textbooks. In addition, we will refer to self-efficacy in using digital textbooks as a personal characteristic variable affecting the intention of acceptance, and subjective norms as an environmental characteristic variable (Fishbein & Ajzen, 1975). This environmental variable has been shown to have an important effect on technology acceptance (Seo, 2011).

The last variable that we incorporated in this study is observability. Rogers (1983) studied individual differences in the speed of new technology acceptance. As a result, Rogers discovered that five perceived innovative traits significantly affect new technology acceptance. The five traits are relative advantage, suitability, complexity, testability, and observability (Rogers, 1983). However, previous research revealed that relative merits and suitability are similar to perceived usefulness, and the concept of ease-of-use and that of ease of use are the same concept (Lee, Hsieh, & Hsu, 2011).

In this study, we included observability but excluded testability, given that the reliability in measuring testability would be compromised as the subjects had already been using digital textbooks for the semester. Thus far, although numerous previous studies have investigated the variables affecting the receiver’s intention to accept innovative techniques based on the TAM model, these studies were conducted based largely on e-learning and mobile environments (Lee, 2012; Gong, Xu, & Yu, 2004; Leung & Wei, 2000). However, research reflecting educational environments is rare.

The purpose of this study is to explore variables affecting the acceptance of digital textbooks in the elementary school environment and provide basic information and resources to increase the intention of acceptance. Based on the above research purposes, we established the following research questions.

Research Question 1: Does self-efficacy in using digital textbooks, subjective norms, and observability affect the perceived ease of use?

Research Question 2: Does self-efficacy in using digital textbooks, subjective norms, observability, and perceived ease of use affect the perceived usefulness?

Research Question 3: Does perceived ease of use and perceived usefulness affect the degree of acceptance? The hypothetical research model based on above hypotheses are as follows in Figure 1 as follows:

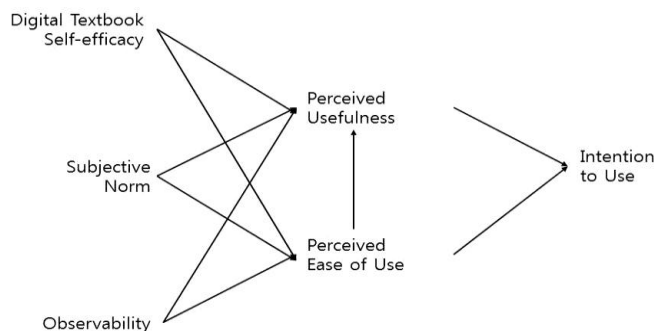


Figure 1. Hypothetical Research Model

2. RESEARCH METHODS

2.1 Subjects

Aside from seven incomplete survey responses, 319 out of 326 survey responses were analyzed. Out of 319, 160 subjects were female (50.19%) and 150 were male (49.84%). There were nine third graders (2.82%), 131 fourth graders (41.07%), 127 fifth graders (39.81%), and 52 sixth graders (16.30%) respectively. Among the schools selected for research, the K, O, P, and W Elementary Schools started using digital textbooks in March 2012, and Y and G started in March 2013. Depending upon the principal's preference, two schools used digital textbooks in Korean and English subjects and five schools used digital textbooks in social studies and science subjects by using tablet PCs, Netbooks, and Notebook Computers.

2.2 Research Procedures

In this study, we conducted online surveys using Google Docs targeting randomly selected students using digital textbooks to explore the variables affecting elementary students' intention of accepting digital textbooks, from November 25, 2013 to December 24, 2013. Subjects self-reported based on their own experience of using digital textbooks.

2.3 Measurement Instrument

In this study, we used the measurement instruments used in the previous study, after revising according to the research environment, to measure the self-efficacy in using digital textbooks, subjective norms, observability, perceived ease of use, perceived usefulness, and intention of acceptance. All items used a 5-point Likert scale (1 point: not at all, 2 points: no, 3 points: usually, 4 points: yes, 5 points: very much so).

To measure self-efficacy, subjective norms, and intention for acceptance, we revised Taylor and Todd's instrument to measure information technology usage. The TAM (Technology Acceptance Model) has the merit of combining the theory of planned behavior and the decomposed theory of planned behavior. It also reflects real life (1995). The measurement includes six items assessing self-efficacy in using digital textbooks (e.g., I feel comfortable when using the digital textbook), nine items assessing subjective norms (e.g., people who care about me think that I need to use digital textbooks), and three items assessing degree of acceptance (e.g., I would like to utilize the digital textbook for further studies). The internal consistency of the original instrument was Cronbach's $\alpha = .84$, for subjective norms $\alpha = .80$, and for intention for acceptance $\alpha = .93$. The reliability of the current study data was .93, .91, and .91, respectively.

To measure observability, we revised the instrument by Moore and Benbasat (1991), which measures the level of accepting innovative techniques in the school environment (e.g., I have seen that other friends study with digital textbooks). Since the instrument by Moore and Benbasat reflects the school environment, it was consistent with our current research environment. The reliability was Cronbach's $\alpha = .88$. Cronbach's α for the four items measuring observability was .76.

The perceived usefulness and perceived ease of use were revised and supplemented based on the instrument developed by Davis (1989); the reliability of this instrument has been demonstrated in many research studies (Agarwal et al., 1997; Chau, 1986). The perceived ease of use was measured by four items (e.g., learning with digital textbooks is simple but difficult.). The perceived ease of use was measured by four items (e.g., I believe that I can study better with digital textbooks). The reliability of the original instrument is Cronbach's $\alpha = .94$ and .91. The Cronbach's α for the current study was .93 and .86, respectively.

2.4 Data Analysis Method

We established a statistical model to investigate the causal relationships among self-efficacy in using digital textbooks, subjective norms, observability, perceived ease of use, and perceived usefulness based on a hypothetical research model and tried to measure the latent variables by using indicator measurement variables. Since all variables were shown to be single factors in exploratory factor analysis, we used item parceling to avoid model misspecification. We used AMOS 20.0 for statistical analysis.

3. RESULTS

3.1 Inter-relational Matrix and Descriptive Statistics

If each measured variable in structural equation modeling does not have a normal distribution, we would get biased estimates and an inaccurate model. Therefore, to confirm normality in the multivariate distribution, mean, standard deviation, skewness, and kurtosis were examined.

The average of values ranged from 3.11 to 3.89, standard deviation from .81 to 1.01, skewness from .11 to .62, and kurtosis from .02 to .30 respectively. If the skewness of the variables is less than 3 and kurtosis is less than 10, a normal distribution in the model can be assumed (Kline, 2011).

We examined the VIF (Variance Inflation Factor) to assess multicollinearity between variables and we confirmed that there were no problematic influencing variables, with VIF from 1.58 to 3.91 (which is required to be less than 10), and we confirmed significant correlations among the variables at the level of .05.

Clearly indicate advantages, limitations and possible applications.

3.2 Estimate of Measurement Model

We estimated the fit of the measurement variables based on the maximum likelihood method, as a second confirmatory process of goodness of fit (Kline, 2011). As displayed in Table 1, the index of TLI and CFI was .995 and .995 respectively, which satisfies the acceptable criteria. The RMSEA value was .038, which suggested goodness of model fit.

Table 1. Fit Indices of the Measurement Model (n = 319)

| | CMIN | <i>p</i> | <i>df</i> | TLI | CFI | RMSEA (90% Confidence Interval) |
|-------------------|---------------|-------------|-----------|-----------------|-----------------|---------------------------------|
| Measurement Model | 57.089 | .031 | 39 | .991 | .995 | .038 (.012~.058) |
| Criteria | | | | > .90 | > .90 | < .08 |

The results of confirmatory factor analysis provide the evidence of convergent and construct validity of the theoretical construct. When the correlation between the measured variables and the latent variable is greater than .50, convergent validity can be confirmed. When the correlation between the latent variable is less than .80, construct validity can be confirmed (Moon, 2009). As a result of examining the relationships between the latent and index variables, the standard loading factor indices of the latent variables ranged from .76 to .96, which were significant at the α .05. This suggests that the selected index variables to measure the theoretical variables in our model demonstrate convergent validity. In addition, cross-correlation between latent variables ranged from .28 to .51, which has discriminatory validity. Accordingly, it was shown that all of the latent variables of the research model have been accurately and reliably measured.

3.3 Examination of Structural Model

Since the model estimate was theoretically confirmed and the model's goodness of fit satisfies the criteria, the fit of the regression model was estimated. The estimated results of the structural model are as follows in Table 2.

Table 2. Examination of Fit of the Initial Structural Model (n = 319)

| | CMIN | <i>p</i> | <i>df</i> | TLI | CFI | RMSEA (90% Confidence Interval) |
|--------------------------|----------------|-------------|-----------|-----------------|-----------------|---------------------------------|
| Initial Structural Model | 126.515 | .000 | 42 | .960 | .975 | .080(.064~.096) |
| Criteria | | | | > .90 | > .90 | < .08 |

The fit indices for the initial structural model were as follows: TLI = .960, CFI = .975, and RMSEA = .80. These data suggest a good fit with the estimated model. This means that the intention of acceptance, self-efficacy in using digital textbooks, subjective norms, observability, perceived ease of use, and perceived usefulness have statistically significant causal relationships.

Accordingly, the results of examining the influence between variables are as follows. The effects of self-efficacy in using digital textbooks on perceived ease of use was $\beta = .847$ ($t = 7.738, p < .05$), that of subjective norms on perceived ease of use was $\beta = -.123$ ($t = -1.446, p > .05$), and that of observability on perceived ease of use was $\beta = .126$ ($t = 2.140, p < .05$).

The effects of self-efficacy in using digital textbooks on perceived ease of use was $\beta = .504$ ($t = 4.210, p < .05$), that of subjective norms on perceived ease of use was $\beta = .228$ ($t = 2.739, p < .05$), and that of observability on perceived ease of use was $\beta = .174$ ($t = 2.179, p < .05$). The effect of perceived ease of use on intention of acceptance was $\beta = .260$ ($t = 3.731, p < .05$) and that of perceived usefulness on intention of acceptance was $\beta = .596$ ($t = 8.596, p < .05$).

However, since the relationships between subjective norms and perceived ease of use, and observability and perceived usefulness in the initial structure model were not statistically significant, we established a succinct revised model after removing those variables from the initial model, under the condition that there were no statistical differences after removing them.

We conducted a χ^2 test to confirm that there was no statistical difference between the initial structural model and the revised model since there was a hierarchical relationship between the initial structural model and the revised structural model. We selected the more succinct revised model as our final research model since there was no statistical difference ($\Delta\chi^2 = 2.885, p = .236$). Using maximum likelihood analysis, the revised structural model showed a good fit with TLI = .962, CFI = .975, RMSEA = .078 as displayed in Table 3.

Table 3. Examination of Fit of the Revised Structural Model (n = 319)

| | CMIN | p | df | TLI | CFI | RMSEA (90% Confidence Interval) |
|--------------------------|---------|------|----|-------|-------|---------------------------------|
| Revised Structural Model | 129.400 | .000 | 44 | .962 | .975 | .078(.063~.094) |
| Initial Structural Model | 126.515 | .000 | 42 | .960 | .975 | .080(.064~.096) |
| Criteria | | | | > .90 | > .90 | < .08 |

Accordingly, the results of examining effects between self-efficacy in using digital textbooks, subjective norms, perceived usefulness, observability, and perceived ease of use are as follows Figure 2.

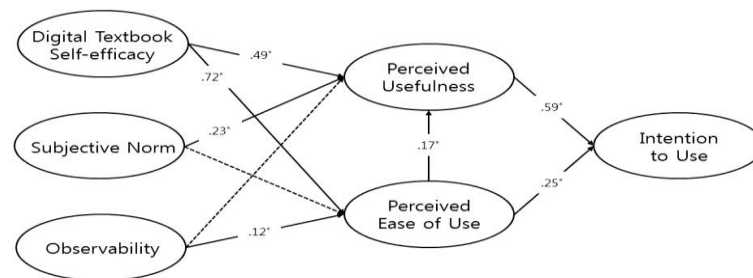


Figure 2. Standardized Path Coefficient of Revised Structural Model

The effect of perceived usefulness on self-efficacy in using digital textbooks was $\beta = .722$ ($t = 12.214, p < .05$), that of observability was $\beta = .121$ ($t = 2.104, p < .05$), that of self-efficacy in using digital textbooks on perceived usefulness was $\beta = .486$ ($t = 4.584, p < .05$), that of subjective norms was $\beta = .227$ ($t = 2.880, p < .05$), that of perceived ease of use was $\beta = .168$ ($t = 2.264, p < .05$), that of perceived ease of use on intention of acceptance was $\beta = .254$ ($t = 3.814, p < .05$), and that of perceived usefulness was $\beta = .589$ ($t =$

8.483, $p < .05$). This suggests causal relationships among self-efficacy in using digital textbooks, subjective norms, observability, perceived ease of use, perceived usefulness, and intention of acceptance.

It was also observed that self-efficacy in using digital textbooks and observability affect perceived usefulness and perceived ease of use. In addition, self-efficacy in using digital textbooks and subjective norms affect perceived usefulness. These factors also affect intention of acceptance. At the same time, since perceived ease of use and perceived usefulness simultaneously affect perceived usefulness, we confirmed the significance of indirect effects among the variables by using the Sobel test (Kline, 2011).

Self-efficacy in using digital textbooks affects perceived ease of use through perceived usefulness ($z = 2.09$, $p = .03$), self-efficacy in using digital textbooks affects intention of acceptance through perceived ease of use ($z = 3.34$, $p = .00$), self-efficacy in using digital textbooks affects intention of acceptance through perceived usefulness ($z = 3.77$, $p = .00$), subjective norms affect intention of acceptance through perceived usefulness ($z = 2.60$, $p = .00$), and perceived usefulness affects intention of acceptance through perceived usefulness ($z = 2.107$, $p = .03$), at the level of $\alpha .05$ with indirect effects. However, it was shown that the indirect effect of observability on perceived usefulness through perceived ease of use ($z = 1.527$, $p = .12$) was not significant.

4. CONCLUSION

In this study, we investigated causal relationships between elementary school students' self-efficacy in using digital textbooks, subjective norms, observability, perceived ease of use, perceived usefulness, and intention of acceptance, based on a modification of Venkatesh and Davis's Technology Acceptance Model (1996). The following implications were derived.

First, it appeared that the observability and self-efficacy in using digital textbooks affected the perceived ease of use but subjective norms had no effect. The effects of self-efficacy of digital textbooks on perceived usefulness are consistent with previous research results (Wang & Wang, 2009). This suggests that the higher the students' confidence, the less they experience dissatisfaction with using digital textbooks. In addition, observability is consistently shown in previous studies as an effective variable on self-efficacy in using digital textbooks, suggesting that the more students observe the desirable examples of teachers using digital textbooks, the more the students are able to utilize them as well.

On the other hand, the result that subjective norms do not affect the perceived ease of use is different from our initial hypothesis but is consistent with previous research by Oak (2013). This may be because students' peers and teachers were already using digital textbooks in the existing class and the expectations of their peers and teachers cannot affect their utilization of digital textbooks.

Second, the results of investigating the effects of efficacy in using digital textbooks, subjective norms, observability, and perceived ease of use on perceived usefulness, self-efficacy in using digital textbooks, subjective norms, and perceived ease of use, affected perceived usefulness but observability did not provide significant effects.

First, the results of self-efficacy in using digital textbooks on perceived usefulness is consistent with previous research (Joo et al., 2013; Albion et al., 2002). Students who actively utilize new technology with positive attitudes recognize digital textbooks as useful. In addition, it appeared that subjective norms significantly affect perceived usefulness. The positive perception of friends and teachers using digital textbooks positively affected the students' perceptions of digital textbooks. It was shown in previous studies that the perceived ease of use significantly affects perceived usefulness (Davis, 1989; Ong et al., 2003; Rogers, 2003; Venkatesh, 1999). Students perceive digital textbooks as being more useful if they think that it is easy to use them.

On the other hand, the result that observability does not affect the perceived usefulness differs from the previous research by Lee, Hsieh, and Hsu (2011) and Seo (2011) but is consistent with that of Chen, Yen, and Chen (2009). We can predict that the reasons observability does not affect perceived usefulness is influenced by the environment of using a digital textbook. Subjects used digital textbooks only for certain courses within a limited period of time (twice a week, and less than two hours) under teachers' guidelines. Additionally, in several schools, students were allowed to use digital textbooks only within a limited space and constrained class hours to prevent theft and damage. Therefore, students were not likely to easily observe

peers utilizing the digital textbooks after class hours. For that reason, it is predicted that observability was not able to affect perceived ease of use in the current study.

Third, the elementary school students' perceived usefulness significantly affected the intention of accepting digital textbooks. The results are consistent with previous studies (Davis et al., 1989; Kang & Kim, 2013), suggesting that the more students utilize digital textbooks and believe that a digital textbook is helpful to increase learning outcomes, the more easily they are able to accept digital textbooks. Summarizing the above research results, we can assume that we need to increase students' self-efficacy in using digital textbooks and observability in order to increase students' perceived ease of use, self-efficacy in using digital textbooks, and subjective norms and perceived usefulness to increase perceived ease of use and perceived usefulness. The implications and practical strategies based on the above analysis results are as follows:

First, it was discovered that self-efficacy in using digital textbooks is a significant variable affecting perceived ease of use and perceived usefulness. Therefore, we need to provide enough time for students' orientation and practice regarding how to use digital textbooks to increase their self-efficacy in using them prior to introducing them nationwide and the skills and methods of how to use digital textbook should be easily provided so that students are able to easily master usage (Kim, 2013).

Secondly, subjective norms were discovered to have an effect on learner's perceived usefulness. Therefore, it is suggested that efforts be made to increase adoption by announcing and promoting the successful cases of using digital textbooks through online boards or communication at home (Joo, Kim, & Lim, 2012).

Thirdly, observability appeared to have positive effects on perceived ease of use. Therefore, teachers should provide chances to share their utilization methods or study results through activities or presentations to the class. The government should make every effort to provide more opportunities to observe various methods and results of utilizing digital textbook in a variety of class promotional activities to increase observability (Seo, 2011).

Fourthly, the Korean Education and Research Information Service needs to implement efforts to provide immediate support and guidelines when problems occur in producing and distributing digital textbooks in order to enhance the students' perceived ease of use (Joo et al., 2013). Teacher-centered workshops on how to use digital textbooks should be held so that they are able to implement the practice of digital textbook use properly for students in the field.

Finally, we need to create content based on a variety of subjects and activities so that students recognize that digital textbooks are helpful in achieving their learning goals; this needs to be carried out to improve the digital textbooks' perceived usefulness. For this, teachers need to provide students with various learning activities such as fieldtrips, cooperative learning, and project based learning to utilize digital textbooks in a variety of situations and have the chance to share regular uploads of historic animation and human QR codes regarding human body structure necessary for learning. In addition, students may perceive digital textbooks as useful for learning by having them share learning content and learning results using these textbooks through group discussions and presentations (Min, 2013). While a number of previous studies (Gong, Xu, & Yu, 2004; Leung & Wei, 2000) have discovered the factors affecting user's intentions of accepting technology based on e-learning or mobile environments, the research focusing on elementary school students' intentions of accepting digital textbooks have not been investigated. Therefore, the current study can be differentiated from other research since the main subjects were elementary school students and we investigated their self-efficacy in using digital textbooks, subjective norms, observability, perceived ease of use, and perceived usefulness and intention of accepting technology, based on Roger's diffusion of innovation theory.

The current study reflects the educational trends of the nationwide diffusion of digital textbooks. It is commendable that the current study tried to find strategies of increasing actual users' intentions of accepting digital textbooks. The limitations and suggestions for further studies are as follows: First, the current study is limited in generalizing the research results since the participants were elementary school students selected by the Korean Educational and Research Information Service. Therefore, further studies need to broaden the targets to various elementary schools, as well as junior and high school environments to increase the generalization of the study results. Second, further research needs to consider other influential variables than the factors the current study incorporated, such as technical characteristics of system quality and information quality, as well as individual characteristics such as individual innovative orientations.

ACKNOWLEDGEMENT

This work was supported by National Research Foundation of Korea Grant funded by the Korean Government (2012-045331).

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