Investigating students' intention to use computer simulations

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Abstract: In this paper, we explore students' intention to use computer simulations. Computer simulations are viewed as a practical tool for supporting learners cognitively and emotionally, thus leading to improved learning outcomes. While simulations have been shown to be efficient and effective learning tools, there are few studies that investigate students' intention to use them. Accordingly, we investigate students' intention to use computer simulations in this study, based on the technology acceptance model (TAM). A total of 38 university students participated in the experiment, and the partial least squares (PLS) method was used to treat the small samples. The results showed that computer self-efficacy, perceived ease of use and perceived usefulness affect behavioral intentions indirectly, while perceived usefulness and attitude toward use have direct effects on behavioral intentions to use computer simulations.

Keywords: computer simulations, technology acceptance model, partial least squares

1. Introduction

In the past decade, computer simulations have become increasingly powerful and available for use in teaching and learning (Smetana & Bell, 2007), and they have been applied in many educational fields, including science (Eskrootchi & Oskrochi, 2010; Liu & Chuang, 2011; van der Meij & de Jong, 2006) and statistics (Liu, 2010; Morris, 2001). Computer simulations are often efficient and effective learning tools because they have the potential to support learners in achieving interactive learning, with learners able to vary the parameters of the system and thus actively control the simulated process (Yaman, Nerdel, & Bayrhuber, 2008). In this way, such simulations can help learners interact with the dynamics of the modeled system, and thus help them conceptualize complex and abstract ideas (van der Meij & de Jong, 2006). More importantly, such technologies can help learners in developing deeper knowledge and more reflective thinking than they would otherwise be able to achieve (Hennessy, Deaney, & Ruthven, 2006). Accordingly, computer simulations are seen as a practical tool for supporting learners both cognitively and emotionally, thus leading to enhanced learning outcomes (Euler, 1994; Schnotz, Böckheler, Grzondziel, Gärtner, & Wächter, 1998; Yaman, Nerdel, & Bayrhuber, 2008).

Computer simulation-assisted learning has received increasing attention in recent years, with related studies mostly examining on the effects of simulations on learning. For example, Yaman et al. (2008) developed a simulation program about the respiratory chain, and explored the effects of instructional support and on learner interest when students used the system. Similarly, Eskrootchi and Oskrochi (2010) investigated the efficacy of project-based learning integrated with a computer simulation, while Chen et al. (in press) examined the effectiveness of online scaffolds in a computer simulation to facilitate the learning of science. Rutten et al. (2012) recently reviewed the (quasi)experimental research carried out over the past decade on the learning effects of computer simulations in science education, and their findings showed that this technology can enhance traditional instruction, especially with regard to laboratory activities. Overall, the previous studies have provided robust evidence for the positive effects of computer simulations on learning.

However, while there has been much research on the effects of computer simulations on learning, few studies have examined students' intention to use them. As the educational application of computer simulations is still gaining momentum, it is necessary to examine the relationship between student perceptions of this technology and their behavioral intentions to use it, because the use of simulations is an important indicator of the their success. Moreover, a better understanding of the factors affecting the students' intention to use could help computer simulations researchers and providers to develop more effective and systems.

We developed a research model to investigate students' intention to use computer simulations based on the technology acceptance model (TAM) (Davis, 1989). Specifically, we used a well-known computer simulation, InTouch, in a university course. A questionnaire was developed to explore the students' perceptions of the computer simulation. Finally, a series of analyses were carried out to examine the model and draw several related conclusions.

2. Research design

2.1 Theoretical fundamentals: the technology acceptance model

The evaluation of technology acceptance has a key role in the development of successful e-learning systems (Chatzoglou, Sarigiannidis, Vraimaki, & Diamantidis, 2009; Liu, Chen, Sun, Wible, Kuo, 2010; Sanchez-Franco, 2010), and the technology acceptance model (TAM) is perhaps the most widely used way to achieve this (Davis, 1989; Davis et al., 1989). There are four main constructs in the TAM, perceived ease of use (PEU), perceived usefulness (PU), attitude toward use (AT), and behavioral intentions (BI). PEU refers to the extent to which a person believes that using the technology would be free of effort (Davis, 1989), while PU refers to the degree to which a person believes that using it would enhance his/her performance of a particular task (Davis, 1989). AT refers to a general feeling toward some stimulus object (Fishbein & Azjen, 1975), while BI represents the subjective probability that a person will perform a specific behavior (Chatzoglou et al., 2009). In addition to these four constructs, Davis et al. (1989) also argued that external variables, such as system characteristics, will affect intention to use and actual use. As a result, external variables are hypothesized to have direct/indirect effects on PEU and PU, PEU is hypothesized to influence PU and AT, PU to affect AT and BI, and AT to influence BI. Using TAM, researchers can understand whether a system meets user requirements, and also understand its value to them. Consequently, TAM is adopted as the theoretical foundation of this work to investigate student perceptions of the focal computer simulation.

2.2 Research model and hypotheses

0 shows the research model, based on TAM, with computer self-efficacy (CSE) is used as the external variable. The model consists of seven hypotheses, which are presented in the following paragraphs.

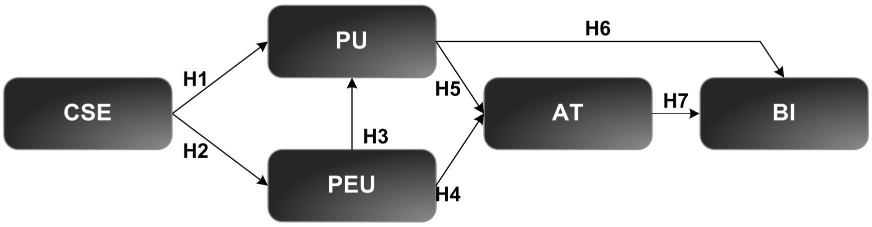

Fig. 1. Research model.

Self-efficacy is defined as an individual's personal beliefs about their capacity to carry out a particular task (Bandura, 1977). Bandura (1986) stated that a person's confidence in his/her ability to successfully accomplish a given task or activity is affected by the interactions that occur among their behaviors, cognitions, and the environment, and various studies have demonstrated that self-efficacy can be used to predict subsequent achievement outcomes (Compeau, Higgins, & Huff, 1999; Hill, Smith, & Mann, 1987). Moreover, students' confidence in their capabilities to use computers is seen as an indicator of CSE (Chou & Liu, 2005). Gong et al. (2004) showed that CSE has a positive effect on PEU in e-learning contexts, while Teo (2009) revealed that CSE positively affects both PEU and PU. Consequently, we expected that CSE would have a positive influence on PEU and PU, and thus the first two hypotheses are as follows:

H1. CSE is positively related to PU.
H2. CSE is positively related to PEU.

In the foundational studies on TAM (Davis, 1989; Davis et al., 1989), PEU is hypothesized to influence PU and AT, PU to affect AT and BI, and AT to impact BI. Consequently, the third to the seventh hypotheses are as follows:

H3. PEU is positively related to PU.
H4. PEU is positively related to AT.
H5. PU is positively related to AT.
H6. PU is positively related to BI.
H7. AT is positively related to BI.

2.3 Participants

The participants were students from a university in Tainan City, Taiwan. A total of 38 students took part in the experiment, with an average age of 22.08 (SD = 1.47).

2.4 Measurement

A structured questionnaire was developed based on a review of prior studies (Compeau & Higgins, 1995; Davis, 1989; Davis et al., 1989; Huang, Huang, Huang & Lin, 2012), as well as from feedback from 10 participants and two experts. The questionnaire included five constructs, that is, CSE, PEU, PU, AT, and BI. Table 1 shows the final questionnaire that was distributed to the students, who were asked to indicate their level of agreement with the statements based on a five-point Likert scale.

Table 1. The questionnaire.

Construct	Item
CSE	(CSE1) I can use a computer to complete a job or task.
	(CSE2) I can use a computer to complete a job or task if someone shows me how to do it first.
PEU	(PEU1) I think that the system is easy to use.
	(PEU2) I think that learning to use the system is easy.
	(PEU3) I think that the system can provide clear guide information.(PEU4)I think that the operation of the system does not require too much time.
PU	(PU1) I think that the system is useful for learning industrial applications.
	(PU2) I think that the system can improve my knowledge of industrial applications.
	(PU3) I think that the system can enhance my desire to use industrial applications.
	(PU4) I think that the system can improve my performance with regard to learning industrial applications.
AT	(AT1) I think that using the system is a smart way to learn.
	(AT2) I like using the system to learn industrial applications.
	(AT3) I have a positive attitude toward using the system.
	(AT4) I think that using the system is a good way to learn industrial applications.
BI	(BI1) If I had access to the system, I would be happy to use it.
	(BI2) I wish that I had the opportunity to often use the system

2.5 Computer simulation tool

The computer simulation used in this study was InTouch, which is a kind of industrial control software that provides users with very realistic experiences. In this study, it was used to create a computer simulation to help students learn industrial applications

2.6 Procedure

At the start of the experimental procedure, all the participants carried out a learning activity in which they used the computer simulation to learn how to control industrial equipment. When the activity was completed, the participants were asked to complete the questionnaire that examined the proposed research model.

3. Results

The partial least squares (PLS) approach was then used to analyze the questionnaire data, due to the small sample size, and this method is frequently used as an alternative to structural equation modeling (SEM) (Chin & Newsted, 1999). The SmartPLS 2.0 software was used to assess the measurement and structural models (Ringle, Wende, & Will, 2005).

3.1 Measurement model

The measurement model was assessed with regard to its convergent validity, reliability, and discriminant validity. The convergent validity was assessed using average variance extracted (AVE), which must exceed the standard minimum level of 0.5 (Hair, Black, Babin, Anderson, & Tatham, 2006). The reliability was examined through the use of composite reliability and Cronbach’s alpha. In general, the minimum acceptable value of composite reliability is 0.7, while that for Cronbach’s alpha is 0.6 (Hair et al., 2006). The discriminant validity was assessed by using the square root of AVE and latent variable correlations. The square root of AVE of each construct should exceed the correlation shared between one construct and the other constructs in the model (Fornell & Larcker, 1981). Table 2 shows the results of the measurement model to be acceptable, since all the values meet the standard levels.

Table 2. The convergent validity, reliability, and discriminant validity of the measurement model.

	Convergent validity	Reliability		Discriminant validity				
	AVE	Composite reliability	Cronbach's alpha	Latent variable correlations				
				CSE	PEU	PU	AT	BI
CSE	0.83	0.91	0.80	0.91				
PEU	0.74	0.92	0.88	0.61	0.86			
PU	0.83	0.95	0.93	0.61	0.59	0.91		
AT	0.77	0.93	0.90	0.54	0.63	0.73	0.87	
BI	0.88	0.94	0.87	0.54	0.55	0.63	0.64	0.93

3.2 Structural model

The structural model was used to verify the hypotheses based on the path coefficients and R^2 values (Chin & Newsted, 1999). R^2 was used to assess the ability of the model to explain the variance in the dependent variables. The path coefficients were used to assess the statistical significance of the hypotheses. 0 shows the results for the structural model. The model explains 38% of the variation in PEU, 45% of the variation in PU, 60% of the variation in AT, and 47% of the variation in BI. Seven path coefficients are also given in the 0. First, the path coefficient between CSE and PEU is 0.61, $p < 0.05$, which indicates that CSE has a positive and significant influence on PEU. Second, the path coefficient between CSE and PU is 0.39, $p < 0.05$, which shows that CSE has a positive and significant influence on PU. Third, the path coefficient between PEU and PU is 0.35, $p < 0.05$, which demonstrates that PEU has a positive and significant influence on PU. Fourth, the path coefficient between PEU and AT is 0.29, $p < 0.05$, which indicates that PEU has a positive and significant influence on AT. Fifth, the path coefficient between PU and AT is 0.56, $p < 0.05$, which shows that PU has a positive and significant influence on AT. Sixth, the path coefficient between PU and BI is 0.35, $p < 0.05$, which demonstrates that PU has a positive and significant influence on BI. Seventh, the path coefficient between AT and BI is 0.39, $p < 0.05$, which indicates that AT has a positive and significant influence on BI. Based on these results, all the hypotheses are supported.

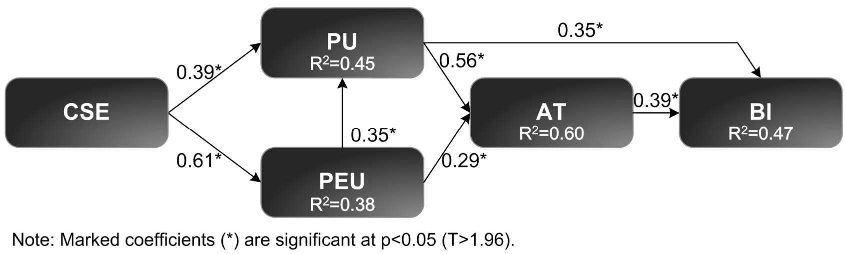

Fig. 2. The results of the structural model.

4. Conclusions

The results of this study show that CSE, PEU and PU indirectly affect BI to use the computer simulation, while PU and AT have direct effects on it. Overall, there is evidence to support existing theories and assumptions that all five variables affect the level of computer simulation acceptance among students. The limitations of this study include the type of measurements and the relatively small sample size. It should be noted that all of the measurements used in this work were limited to the students' self-reported perceptions, and future studies should introduce additional measures to explore this issue in a more objective manner. Furthermore, using a larger sample size in future research would also increase the reliability and generalizability of this study's results.

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