How Does ERPsim Influence Students' Perceived Learning Outcomes in an Information Systems Course? An Empirical Study

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ABSTRACT

It is a challenge for business students or even employees to understand business processes and enterprise software usage without involvement in real-world practices. Many business schools are using ERP software in their curriculum, aiming to expose students to real-world business practices. ERPsim is an Enterprise Resource Planning (ERP) teaching-learning tool for business students to learn actual SAP and business processes. This study empirically examines how ERPsim enhances student learning outcomes in an IS course. The findings reveal the antecedent effects of two important IS constructs (enjoyment and cognitive appraisal) on learning behavior and learning outcomes during students' involvement with ERPsim. The study provides empirical evidence that some major IS constructs (i.e., enjoyment and cognitive appraisal of using information systems) play important roles in shaping the effectiveness of using simulation game software to learn business processes and ERP software.

Keywords: ERPsim, Learning goals & outcomes, Intention, Enjoyment, Cognitive appraisal

1. INTRODUCTION

Today, business processes and decision making depend heavily on information systems such as Enterprise Resource Planning (ERP). ERP are complex information systems, which integrate business processes and decision-making at the organizational level. Understanding business processes and being able to use enterprise software are skills in great demand by industry and many business schools require the teaching of hands-on skills in ERP. However, it is a challenge for instructors to teach and students to learn business processes and ERP software in the classroom since business students often lack knowledge of real-world business processes and have limited IT skills available to operate an ERP software application (Léger, 2006; Seethamraju, 2011). To overcome this difficulty, many business schools have introduced ERP simulation software to their curriculum. Using simulation games in business education is an innovative pedagogical approach. By playing software games, students can understand better business processes and ERP from learning by doing (Léger, 2006).

ERPsim (ERP Simulation Game) is an ERP teaching-learning software tool developed by HEC Montreal, Canada. ERPsim simulates a real-world marketplace in which virtual companies can operate business processes using a commercial version of SAP software (Leger, 2006). In the classroom, student teams operate a virtual wholesale beverage distribution company using a SAP client. Each team uses standard ERP reports and transactions to manage all business processes involved in the marketing, inventory, sales, and forecasting of various bottled water products. The teams analyze these transactions and review financial reports during the simulation and compete against each other in the same marketplace with the goal of maximizing profit. The simulated marketplace provides students with opportunities to practice their business strategies and to develop hands-on skills to manage business processes using SAP clients. "Using the SAP simulation, students also develop technical skills through direct interaction with an actual SAP client." (Cronan and Douglas, 2012, p. 4). Worldwide, over 130 universities have adopted ERPsim (https://erpsim.hec.ca/en/about/participating_universities) in their IS or other business courses.

Pedagogical evidences suggest that ERPsim improves students' learning performance in IS courses (Léger, 2006; Seethamraju, 2011; Cronan and Douglas, 2012). However, an extensive literature review indicates that little is known about causal relationships among cognitive-psychological factors, learning behavior and learning outcomes. There is also a lack of theory-supported empirical studies on the effectiveness of ERPsim in students' learning behavior and performance. In particular, no empirical study has investigated how cognitive-psychological antecedents influence students' learning behavior and outcomes when they used ERPsim as a learning tool. It is not known what these factors are and how they improve students' learning performance when using ERPsim. This study aims to close the research gap with an empirical examination of the effects of some psychological factors on students' learning behavior and outcomes when they participate in ERPsim games in the classroom. Specifically, a theoretical model is proposed to investigate the effects of enjoyment and cognitive appraisal on the behavioral intention to use the learning tool and the effectiveness of the learning tool. The effects of enjoyment and cognitive appraisal on behavior are well acknowledged in both IS and pedagogy literature (e.g., Davis, Bagozzi, and Warshaw, 1992; Venkatesh, 2000; Van der Heijden, 2004; Wakefield and Whitten, 2006; Beaudry and Pinsonneault, 2005; Fadel and Brown, 2010).

The contribution of this study is twofold. First, the researchers extend upon prior research of ERPsim by focusing on causal relations among antecedent variables and learning behavior and outcomes. Two major variables are identified in the IS and pedagogy literature and their effects on learning behavior and learning outcomes are empirically examined in a research model. The findings help IS researchers understand better SAP users'/learners' behavior. The information provided by this study can be used to improve ERP software, particularly the ERP user interface (UI) design, so as to meet users' cognitive and psychological demands better when they use the software to manage business processes. Second, this study introduces learning outcomes as a dependent variable in a research model. The empirical findings shed more light on the students' learning behavior during the use of simulation software in the classroom. With this information, business educators can design better curricula and improve pedagogical methods in teaching business processes.

2. LITERATURE REVIEW

The use of simulation and game software in the classroom has been adopted in various curricula, including business education, for many years. Simulation games are powerful learning tools in that they provide a realistic business environment within which students are involved in active learning experiences (Mortais, Hoff, and Reul, 2006). Simulation software helps students connect business concepts learned in the classroom to real-world practices and fosters their understanding of ERP usage (Léger, 2006). ERPsim, acting as a learning tool, emulates a real-world business environment in which students build up their knowledge of business processes and hands-on experiences of SAP usage. Demand for graduates who have hands-on experience of ERP is increasing in industry (Scholtz, Cilliers, and Calitz, 2012; Hustad and Olsen, 2013).

Léger (2006) successfully incorporated ERPsim into a business curriculum. Léger (2006) reported that "the post simulation survey revealed the enthusiasm the simulation game elicited among the participants" and that after the seven-week course, "93% of the students who participated in the simulation game received their SAP certification (i.e., 35 students)." None of the participants has prior knowledge of SAP before the ERPsim game started. Léger's (2006) pedagogical practice provides solid evidence that ERPsim can be a good learning tool for students to learn business processes and ERP software usage. Following Léger's (2006) seminal study, more pedagogical studies have been conducted in both IS and education literature (Seethamraju, 2011; Cronan and Douglas, 2012; Legner et al, 2013).

Seethamraju (2011) investigated the influence of ERPsim on learning effectiveness, skills development, and decision making using self-reported assessment before and after an ERPsim experiment. In that study, student participants self-reported their knowledge on business process skills and SAP usage before and after the ERPsim game. Seethamraju's (2011) findings suggested that the students' business knowledge and SAP skills were improved after their participating in the ERPsim game.

Similarly, Cronan and Douglas (2012) used a pre-post survey instrument to test the difference of ERP knowledge before and after ERPsim. In that study, the authors used the same survey instrument (self-reported assessment) to measure students' enterprise systems management knowledge, business process knowledge, SAP transaction skills, and other variables before and after the ERPsim game in years 2008, 2009, and 2010. Their research findings suggest "a significant increase in students' knowledge about business processes, enterprise systems management, and SAP skills" (Cronan and Douglas, 2012, p. 9).

In general, the simulation game is a better teaching method than the lecture and case study in the IS curriculum (Ben-Zvi, 2007). Although prior studies found that ERPsim is an effective tool for learning business processes and ERP concepts, little is known as to why ERPsim is considered effective. In other words, what are the factors and how do they influence or foster students' learning outcomes from using ERPsim? To answer this question, a theory-based empirical study is needed to examine further the effects of cognitive-psychological variables on the learners' behavior and performance. This paper reports findings that help answer this question.

3. RESEARCH MODEL AND HYPOTHESES

3.1 Behavioral Intention vs. Learning Outcomes

There are two ways to study behavior. One method is to measure behavior directly (Thompson, Higgins, and Howell, 1991). The other method is to measure behavior indirectly, mostly using behavioral intention. The theory of planned behavior (TPB) (Ajzen, 1991) suggests behavioral intention is a motivational factor that captures how much effort a person is willing to dedicate to perform a behavior and that it is the most influential predictor of behavior. Sheppard, Hartwick, and Warshaw (1988) used meta-analysis to indicate that there is an average correlation of 0.53 between intentions and behavior. According to TPB, three types of belief impacts three behavioral perceptions, respectively, behavioral beliefs influence attitudes toward behavior, normative beliefs determine the subjective norm, and control beliefs shape perceived behavioral control. As a result, attitudes toward behavior, subjective norm, and perceived behavioral control together lead to the formation of a behavioral intention that in turn determines behavior and outcomes (Ajzen, 1991). In general, a more favorable attitude and subjective norm along with a greater perceived behavioral control indicates a stronger intention to perform the behavior (Ajzen, 1991).

In IS literature, TPB has been applied successfully to study a variety of information systems usage behaviors (Pavlou and Fygenson, 2006). In addition, education researchers have applied TPB to study the learning behavior and outcomes in various pedagogical practices (Alshare and Lane, 2011; Carswell and Venkatesh, 2002). When students experiment using ERPsim as a learning tool in classroom, these students are both IS users and learners. According to TPB, students' learning outcomes are determined directly by their behavioral intention to use ERPsim, which is affected by the three types of beliefs (i.e., behavioral beliefs, normative beliefs, control beliefs). In ERPsim usage context, the learning outcomes measure students' acquisition of business process and SAP software usage knowledge. Learning outcomes can be measured using direct assessment such as students' exam grades and/or indirect assessment such as self-reported assessment (Rajkumar et al., 2011). Self-reported assessment has been widely used to help students develop learning and problem-solving skills in IS education (Sluijsmans, Dochy, and Moerkeke, 1999; Larres, Ballantine, and Whittington, 2003). In this research, the self-reported learning outcomes are referred to as perceived learning outcomes. The detailed discussion of direct and indirect measurement of learning outcomes is provided in Section 4.1. Prior studies indicate that students' self-assessment on the learning outcomes can also reflect cognitive activities taking place while their mental model and knowledge representations change (Alavi, Marakas, and Yoo, 2002). Accordingly, the following hypothesis is proposed. The corresponding research model is illustrated in Figure 1:

H1: Behavioral intention to use ERPsim for learning business processes is related positively to perceived learning outcomes.

3.2 Enjoyment vs. Behavioral Intention

Enjoyment refers to the degree to which performing an activity is perceived as providing pleasure and joy in its own right, aside from performance consequences (Venkatesh, 2000). In the IS literature, enjoyment refers to the extent to which using a computer system is perceived to be intrinsically personally enjoyable (Davis, Bagozzi, and Warshaw, 1992). That is, enjoyment captures the joyful experience when users interact with technology.

According to Davis, Bagozzi, and Warshaw (1992), extrinsic motivation refers to "the performance of an activity because it is perceived to be instrumental in achieving valued outcomes that are distinct from the activity itself," whereas intrinsic motivation refers to "the performance of an activity for no apparent reinforcement other than the process of performing the activity per se." For example, perceived computer enjoyment is a type of intrinsic motivation, and perceived usefulness (PU) is a type of extrinsic motivation (Davis, Bagozzi, and Warshaw, 1992; Venkatesh, Speier, and Morris, 2002). Therefore, enjoyment reflects the hedonistic aspects of information systems.

Hedonistic features of information systems have become more prevalent in recent IS research and practices (Lee, Chen, and Ilie, 2012). Prior empirical studies indicated that enjoyment was an important determinant of behavioral intention and outcomes (Davis, Bagozzi, and Warshaw, 1992; Venkatesh, Speier, and Morris, 2002; Koufaris, 2002). Enjoyment, as one of the most important intrinsic motivations in the IS literature (Venkatesh, 2000; Koufaris, 2002; Van der Heijden, 2004; Wakefield and Whitten, 2006), also influences learning behavior when students interact with educational technologies (Wu, Hiltz, and Bieber, 2010). Similarly, Blunsdon et al. (2003) found that enjoyable experiences in a course influenced their learning.

In the theory of planned behavior (TPB) (Ajzen, 1991), enjoyment acting as an intrinsic behavioral belief is a positive influence on an individual's behavioral intention and behavioral performance in a cognitive-psychological activity such as information systems usage (Davis, Bagozzi, and Warshaw, 1992; Venkatesh, 2000). Accordingly, it is believed that enjoying experimenting with ERPsim increases the intention to use ERPsim for learning business processes and thus improves the learning outcomes. Therefore, the following hypothesis is proposed, which is also shown in Figure 1:

H2: Enjoyment of experiencing ERPsim influences positively the intention to use ERPsim for learning business processes.

3.3 Cognitive Appraisal vs. Behavioral Intention

An individual deals with a situation such as using a new information system or learning new concepts in the classroom in two stages (Lazarus and Folkman, 1984), appraisal and coping. These two steps consist of the so-called coping process that involve "the cognitive and behavioral efforts exerted to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person" (Lazarus and Folkman 1984, p. 141). This study examines the effects of cognitive appraisal, the first step in the coping process. Cognitive appraisal refers to an individual's interpreting and assessing of the situation in which they are involved. Cognitive appraisal is a cognitive process followed by behavioral outcomes adopted after the appraisal (Lazarus and Folkman, 1984). Cognitive appraisal of information systems is critical because it determines the subsequent usage behavior and outcomes (Fadel and Brown, 2010).

Fadel and Brown (2010) also posit that users may evaluate information systems in many different ways. Examples of such evaluations include foreseeing if an information system brings a significant personal impact, or if it will improve work effectiveness or efficiency. Beaudry and Pinsonneault (2005) empirically explained how cognitive appraisal of an information system influences subsequent adaptive behaviors and performance outcomes. Fadel and Brown (2010, p. 110) indicated that "given the potential of IS appraisal to shape subsequent use behaviors, understanding the factors that shape the appraisal process is paramount to IS researchers and practitioners." Prior empirical studies have demonstrated how cognitive appraisal influences a user's intention to use information systems as well as subsequent usage behavior (Fadel and Brown, 2010). For example, Lee and Chen (2011) found that users' cognitive appraisals of a website positively influenced their intention to use the website. This makes sense in that users who perceive favorably an information system are more likely to engage enthusiastically with their work with the system and explore system usage for maximum outcomes (Majchrzak et al., 2000).

According to Lazarus and Folkman's (1984) coping process, students appraise the gains from experiencing ERPsim during classroom activities. If they believe using ERPsim can help them learn business concepts and software usage easily and quickly and obtain a better grade in tests or exams, they have the motivation and inspiration to explore ERPsim and the intention to learn more from it. Accordingly, the following hypothesis is proposed:

H3: Cognitive appraisal of experiencing ERPsim influences positively the intention to use ERPsim for learning business processes.

It is worthy to compare cognitive appraisal with enjoyment. Lee, Chen, and Ilie (2012) indicate that attitude consists of two distinct dimensions: affective appraisal and cognitive appraisal. Cognitive appraisal is self-assessment on the utilitarian aspect of attitude (Lee, Chen, and Ilie, 2012) while affective appraisal refers to self-evaluation on feelings and emotions (Breckler, 1984). In other words, cognitive appraisal reflects the utilitarian aspect of attitude. For example, perceived usefulness (PU) and perceived ease of use (PEOU) of information systems represent the cognitive appraisal of information systems from the utilitarian perspective. In contrast, affective appraisal reveals hedonistic experiences such as enjoyment or playfulness when individuals use information systems (Lee, Chen, and Ilie, 2012). In summary, affective and cognitive appraisal represent the two aspects of attitude and they have been widely studied in IS research (Te'eni, 2001).

A significant body of IS studies suggest that affective appraisal influences cognitive appraisal, for example, enjoyment positively influence PU and PEOU of information systems (Venkatesh, 2000; Venkatesh, Speier, and Morris, 2002; Sun and Zhang, 2006). Similarly, Yi and Hwang (2003) reached the same conclusion in an empirical study on the usage behavior of a web-based class management system. In general, enjoyment is more likely to be an antecedent to cognitive appraisal rather than vice versa. This is because enjoyment reduces the cognitive burden and hence individuals expend more effort on tasks when they are experiencing enjoyment (Agarwal and Karahanna, 2000). In addition, enjoyment often makes individuals "underestimate" the difficulty of using technologies since they simply enjoy the process itself and ignore a task's difficulty (Venkatesh, 2000). In general, a human's cognitive process such as cognitive appraisal is likely to be affected by emotion since affective appraisal comes earlier in the human brain than cognitive appraisal (LeDoux 1995; Lee, Chen, and Ilie, 2012). Based on the discussion above, it is expected that:

H4: Enjoyment of experiencing ERPsim influences positively the cognitive appraisal of experiencing ERPsim.

All four hypotheses are demonstrated in the research model in Figure 1. The research model and its hypotheses are empirically examined as follows.

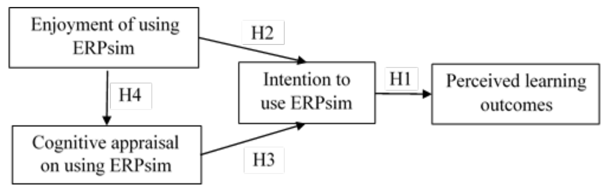

Figure 1. The Behavioral Model for Learning Outcomes

4. RESEARCH METHODOLOGY

4.1 Instrument Development

To test these hypotheses, a survey instrument was developed based upon prior research findings in the IS literature. Enjoyment was measured by adapting instruments from Ghani, Supnick, and Rooney (1991) and Davis, Bagozzi, and Warshaw (1992). Cognitive appraisal was measured with the instrument developed by Lee and Kozar (2009). Intention to use ERPsim was measured with the adaption of the instrument originally developed by Venkatesh (2000) and Francis et al. (2004).

Learning outcomes can be measured with direct and indirect assessment methods. Rajkumar et al. (2011, p. 538) describe the measures as follows: "Direct measures involve a systematic and objective examination of actual student products to determine the extent to which the students are able to do what the program's student-learning outcomes state they should be able to do" and "Indirect assessment measures perceptions of students' abilities." Self-assessment is the most popular method in indirect assessments. This self-assessment method collects and reports students' self-perceived or self-reported learning outcomes that will be referred to as perceived learning outcomes in the rest of this paper. The perceived learning outcomes are gathered often via methods such as surveys and interviews, among others and have been found to be of useful in research (Rajkumar et al., 2011, p. 539).

In IS education, self-assessment has been widely used to help students develop learning and problem-solving skills in professional development and life-long learning (Sluijsmans, Dochy, and Moerkeke, 1999; Larres, Ballantine, and Whittington, 2003). In addition, students' self-assessment on the learning outcomes can also reflect cognitive activities taking place while their mental model and knowledge representation are changing (Alavi, Marakas, and Yoo, 2002).

Harper and Harder (2009) suggested that learning outcomes for IS programs can be measured from four dimensions: technical, analytical, communication, and managerial. The learning objectives of ERPsim in the IS course are a good fit to these four dimensions. In this study, students were asked to report their perceived learning outcomes (self-assessment) after completing ERPsim activities. The perceived learning outcomes measure the five-item learning objectives that have been adopted by the IS course for many years and have undergone constant improvement to meet an AACSB measureable learning outcome standard. These five items reflect students' understanding of business processes and SAP software usage skills. All measurements used 7-point Likert scales. The measurement items are shown in the Appendix 1.

4.2 Survey Administration and Data Collection

The survey was administered to college students who were taking the introductory IS course. The course covers fundamental IS knowledge that is necessary for business major students to prepare for their future business curriculum based on the AACSB standard. The entire ERPsim learning experiment took place in three classes (Monday, Wednesday and Friday) during one week.

Prior to this week, the instructors spent several weeks introducing supply chain management (SCM), customer relationship management (CRM), and enterprise resource planning (ERP). Students are supposed to have fundamental knowledge about various business processes undertaken on the business value chain. For example, they understood how a company implements inventory forecasting and replenishment, material procurement, and sales transactions as well as how these processes are implemented and executed by ERP software.

During the ERPsim experiment week, students are required to apply what they have learned to conduct real-world transactions in a simulated open market in ERPsim. Students worked in teams operating a wholesale beverage company, and competed against the other teams in a bottled water simulated marketplace. Each team operated the full business process of a distribution company from planning, procuring to selling. The products in the ERPsim experiment are bottled water shown in Figure 2.


Cost, inventory & initial pricing

Material	$$-B01	$$-B02	$$-B03	$$-B04	$$-B05	$$-B06
Name	1L ClearPure	1L Spritz	1L Lemon Spritz	500mL ClearPure	500mL Spritz	500mL Lemon Spritz
Size	1L	1L	1L	500mL	500mL	500mL
Number of bottles in package	12	12	12	24	24	24
Cost	€11.99	€14.99	€16.99	€16.99	€19.99	€22.99
Initial price	€14.99	€17.99	€19.99	€19.99	€22.99	€25.99
Initial stock	1,000	1,000	1,000	1,000	1,000	1,000

Figure 2. The Products in ERPsim (https://erpsim.hec.ca/)

Just as for working for a real distribution company, students used real-life SAP clients to generate reports, analyze the necessary information to make and implement their decisions, and enter or adjust information in SAP. The SAP screenshot is shown in Figure 3. The SAP clients are connected to the ERPsim simulation software that simulates a real-world marketplace to allow teams to compete in selling bottled water. The entire ERPsim experiment takes place over three rounds, one round in each class on Monday, Wednesday, and Friday, respectively. The first round is focused on sales and marketing only; in addition to the sales and marketing in round one, students must replenish inventory in round two; on top of round two, students must do inventory forecasting in round three. Therefore, students completely operate a distribution process in the third round.

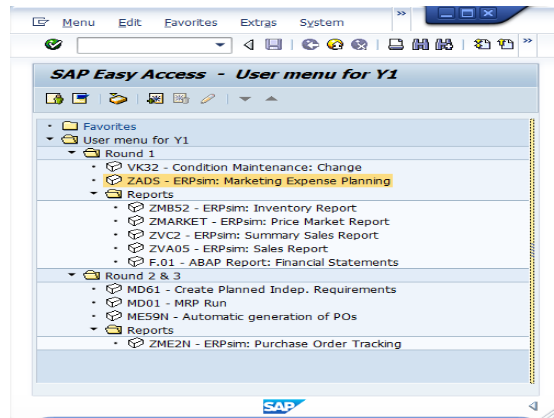

Figure 3. SAP Client Screenshot (https://erpsim.hec.ca/)

After completing the third round of simulation on Friday, students went through a debriefing on the ERPsim experience from the instructor. Following the debriefing, they filled out the survey questionnaire that measured the perceived learning outcomes (see the measurement items in the Appendix 1). 164 complete questionnaires were collected. The demographics of the subjects are shown in Table 1.

Variable	# of Subjects	Percentage (%)
Gender: Male	90	55
Female	74	45
Age: 19-24	157	96
25 and above	7	4

Table 1. Subject Profile

4.3 Data Analysis Techniques

The partial least squares (PLS) (Wold, 1974) method was employed to analyze the sample dataset. PLS is a prevalent statistical technique for testing structural equations. PLS is suited for theoretical development and prediction in a causal relation model (Chin, 1998; Gefen, Straub, and Boudreau, 2000). PLS enables researchers to focus on the explanation of endogenous constructs (Henseler, Ringle, and Sinkovics, 2009). Therefore, PLS is a suitable statistical method for testing the research model in this study. PLS can test both the measurement model and the structural model (Fornell and Larker, 1981; Lohmoller, 1989). The measurement model is used to test the relationships between observed variables (indicators) and their underlying latent variables (constructs). The structural model is used to test the hypothesized relationship among studied constructs, including estimations of path coefficients and their levels of significance.

The structural model (also called path analysis) is one of the most important statistical tools to specify and test prior hypotheses about causal relationships among variables (Kline, 2005). There are two distinct types of path analysis techniques in the model testing, covariance-based structured equation modeling (SEM) and component-based partial-least-squares (PLS). PLS and SEM are different in that they have different analysis objectives, statistical assumptions, and natures of the fit statistics (Gefen, Straub, and Boudreau, 2000). SEM is usually used to test a priori specified model or a sound theory-based model using sample-derived estimates against the population. In contrast, PLS is suited for predictive applications and theory building (Gefen, Straub, and Boudreau, 2000). PLS is often recommended in an early stage of theoretical development to validate exploratory models and therefore helps researchers explain endogenous constructs (Henseler, Ringle, and Sinkovics, 2009). Henseler, Ringle, and Sinkovics (2009) recommend that PLS is used in the following research cases:

- The sample size is small in regards to the number of latent variables
- The model is complex and has many latent and manifest variables
- The model has less stringent assumptions about the distribution of variables and error terms
- The model has both reflective and formative variables

Accordingly, there are several advantages of using PLS in path model testing. PLS requires a relatively small sample size and allows the model to have less stringent assumptions about the distribution of variables and error terms (Henseler, Ringle, and Sinkovics, 2009). This is because that PLS applies principal component regression only on those latent variables that are closely connected and looks for local optimization among them and thus it requires fewer observed variables/indicators to be involved (Chin, 1998; Chin, Marcolin, and Newsted, 2003). Although there are no formative variables in the research model, PLS can test both reflective and formative variables (Henseler, Ringle, and Sinkovics, 2009). The objective of this study is to examine the effects of endogenous constructs (i.e., enjoyment and cognitive appraisal) on the behavioral intention to use ERPsim and behavioral/learning outcomes and thus this study is more explanatory and prediction-oriented than theory building. Therefore, PLS is an appropriate choice of statistical tool to analyze a complete survey dataset in this study.

In path analysis or hypothesis testing, PLS applies either a jackknife or a bootstrap approach to estimate the significance (t-values) of the paths. This study used the bootstrap approach with 500 re-samples to test the significance of path and hypotheses in the model. Efron and Tibshirani (1993) suggested that 500 resamples be sufficient for the general standard bootstrap method in most cases. Similarly, Manly (1997) indicated that 200 re-samples generally gave a relatively small error margin in bootstrap estimation and thus the 500 re-samples is recommended in the bootstrap approach (Chin, 1998).

SmartPLS software (http://smartpls.de) was used to perform both instrument validation and structural path modeling. This study conducted reliability and validity analyses of the measurement model before we performed the path analysis and hypothesis test.

5. RESULTS AND DISCUSSION

5.1 Measurement Reliability and Validity

Prior to testing the research model, the reliability and validity of the measurement was examined. There are two types of measurement of a construct or latent variable in a structural model, formative and reflective. The formative measurement views the construct as the cause and the indicators its manifestations and thus the construct's variations are directly reflected in the indicators (Edwards and Bagozzi, 2000). The direction of the causal relationship in the reflective measurement is thus from the construct to its indicators. The reflective measurement model requires the indicators to be observable and highly correlated and interchangeable and thus their reliability and validity should be examined (Petter, Straub, and Rai, 2007). That is, the indicators' outer loadings (i.e., self-loading, cross-loading) composite reliability and Average Variance Extracted (AVE) need to be examined and reported. In contrast, the formative measurement assumes that the indicators determine or cause the construct (Edwards and Bagozzi, 2000). That is, the causal relationship is from the indicators to the construct. Since the formative indicators independently variables determine the construct, they can have positive, negative, or even no correlations among each other (Petter, Straub, and Rai, 2007). Consequently, the indicators' reliability and validity are not needed or do not make sense in the formative measurement. In PLS, the formative constructs are processed differently from the reflective constructs. For more about the formative measurement, refer to Petter, Straub, and Rai (2007) and Edwards and Bagozzi's (2000) papers.

In the research model, all constructs are reflective and thus their measurements must undertake reliability and validity testing. The reliability with Cronbach's α and composite reliability was assessed. The accepted values for both Cronbach's α and composite reliability are 0.70 or higher (Nunnally, 1978). Table 2 illustrates the reliability testing from SmartPLS. All Cronbach's α and composite reliability values listed in Table 2 are greater than 0.70, indicating the measurement instrument is reliable.

Convergent validity and discriminant validity are two construct validities. Both convergent and discriminant validities are assessed by SmartPLS in the study. Convergent validity describes the degree to which a measure is correlated with other measures in a single variable measurement. Discriminant validity refers to the degree to which the measurement for one variable does not correlate with the measurement for another variable. Both convergent and discriminant validities are inferred if the following conditions are met: 1) the measurement indicators load higher on their measured construct than on other constructs; that is, the own-loadings are higher than the cross-loadings, and 2) the square root of each construct's Average Variance Extracted (AVE) is larger than its correlations with other constructs. Table 3 represents the item loadings on their measured constructs. All items are well loaded on their constructs; that is, their own (on their measured construct) loadings (in bold font in Table 3) are higher than the cross loadings (on other constructs). Table 4 shows the AVE values for all constructs. The accepted AVE should be above 0.5 in order to achieve convergent and discriminant validities (Fornell and Larker, 1981). The results of both cross loadings and AVEs suggest that all construct measurements have adequate convergent and discriminant validities. Overall, the measurement model used in this study exhibited acceptable construct validity and reliability.

Construct	# of Indicators	Cronbach's α	Composite Reliability
Cognitive Appraisal	5	0.935	0.951
Enjoyment	4	0.966	0.975
Intention	3	0.909	0.943
Learning Outcomes	5	0.917	0.939

Table 2. Reliability Testing: Cronbach's α and Composite Reliability

	Cognitive Appraisal	Enjoy-ment	Intention	Out-comes
CA_1	**0.874**	0.697	0.668	0.778
CA_2	**0.914**	0.695	0.755	0.733
CA_3	**0.934**	0.736	0.732	0.757
CA_4	**0.937**	0.740	0.756	0.729
CA_5	**0.796**	0.660	0.658	0.670
ENJ_1	0.762	**0.932**	0.717	0.769
ENJ_2	0.760	**0.964**	0.725	0.765
ENJ_3	0.734	**0.948**	0.736	0.774
ENJ_4	0.758	**0.966**	0.731	0.782
INT_1	0.819	0.765	**0.893**	0.818
INT_2	0.718	0.679	**0.946**	0.705
INT_3	0.652	0.646	**0.919**	0.662
LO_1	0.804	0.747	0.708	**0.921**
LO_2	0.779	0.714	0.734	**0.902**
LO_3	0.791	0.776	0.760	**0.901**
LO_4	0.483	0.568	0.550	**0.708**
LO_5	0.675	0.705	0.705	**0.900**

Table 3. Validity Testing: Cross Loadings

Note: refer to Appendix 1 for the long form of the first column items.

	AVE
Cognitive Appraisal	0.796
Enjoyment	0.906
Intention	0.846
Learning Outcomes	0.766

Table 4. Validity Testing: Average Variance Extracted (AVE)

5.2 PLS Path Modeling and Hypotheses Testing

Figure 4 shows the path coefficients and their corresponding t-values. As recommended by Chin (1998), bootstrapping with 500 sub-samples was performed to test the significance of paths and hypotheses in the path model. A one-tailed t-test was used since all hypotheses are directional in the study. According to the one-tailed t-test (df = 500), the 99% significance level or $p<0.01$ requires a t-value > 2.34 and the 99.9% significance level or $p<0.001$ requires a t-value > 3.10. When df >100, the t-test is actually very close to a z-test. As illustrated in Figure 4 and Appendix 2, all hypotheses are supported at the 99.9% significance level or $p<0.001$. Figure 4 also represents R square values for learning outcomes, behavioral intention, and cognitive appraisal. According to R square values, behavioral intention explains 64% of the variance in learning outcomes. Enjoyment and cognitive appraisal together explains 68.7% of the variance of behavioral intention. Enjoyment alone contributes 62.6% of the variance of cognitive appraisal.

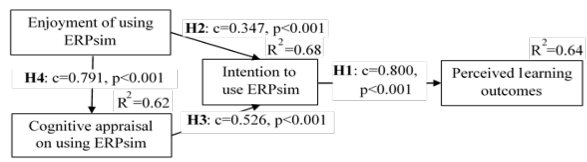

Figure 4. The Behavioral Model Testing Results

The results significantly support hypothesis H1 that behavioral intention to use ERPsim is related positively to learning outcomes at the level of $p<0.001$. This study further confirms the TPB's declaration that behavioral intention is highly related to actual behavioral outcomes. The findings suggest that TPB is a theory well suited to the study of learning outcomes associated with using ERPsim.

Hypothesis H2 which indicates enjoyment positively impacts behavioral intention is highly supported at the level of $p<0.001$. During experimenting with ERPsim, students are information systems users who use SAP software and learners who learn business processes by managing and operating the selling of bottled water. Enjoyment has been widely identified as one major intrinsic motivation in information systems usage (Venkatesh, 2000; Koufaris, 2002; Van der Heijden, 2004; Wakefield and Whitten, 2006) and in influencing the learning behavior and outcomes when students interact with educational technologies (Wu, Hiltz, and Bieber, 2010). The test result for hypothesis H2 thus provides more evidence for the behavioral effects of enjoyment on the use of information systems and learning outcomes in one model. In fact, the learning behavior and information systems usage behavior are integrated and interweaved to produce one behavioral outcome when students interact with information technology in their learning processes. This is similar to prior findings on the effects of enjoyment on students' behavior in computer-mediated learning processes (Blunsdon et al., 2003; Wu, Hiltz, and Bieber, 2010). This is also consistent with the proposition that studying information systems usage behavior should be focused on "users' adaptation, learning and motivation behaviors around a system (Benbasat and Barki, 2007, p. 215). The researchers thus believe that a study of combining usage behavior and learning behavior around an information system will be of benefit to both the IS literature and business education since information technology has been integrated well into business processes and students' learning processes.

Hypothesis H3 is supported at the level of $p<0.001$. This result suggests that cognitive appraisal is an important determinant of learning behavior and behavioral intention when students are experimenting with ERPsim. This is consistent with prior findings of the influences of cognitive appraisal on information systems usage and adoption (Beaudry and Pinsonneault, 2005; Fadel and Brown, 2010; Lee and Chen, 2011). Human attitudes toward behavioral activities involve affective appraisal and cognitive appraisal (Lee, Chen, and Ilie, 2012). Enjoyment is more about affective appraisal than intrinsic attitude or motivation (Breckler, 1984). In contrast, "cognitive appraisals refer to the utilitarian aspect of the attitude" (Lee, Chen, and Ilie, 2012, p. 377). As with the effects of enjoyment on both information systems usage and learning behavior during ERPsim experimenting, cognitive appraisal plays a significant role in determining effects on learning outcomes.

Although both enjoyment and cognitive appraisal influence individuals' behavior and behavioral outcomes, they may not take place at the same time. Affective appraisal often comes before cognitive appraisal (LeDoux, 1995; Van der Heijden, 2002; Lee, Chen, and Ilie, 2012) and thus cognitive appraisal is likely affected by enjoyment. This is what hypothesis H4 proposes. This study significantly supports the effects of enjoyment on cognitive appraisal when students are experimenting with ERPsim. In addition, enjoyment makes individuals reduce or underestimate the cognitive burden of using technologies so that they can spend more effort on tasks (Agarwal and Karahanna, 2000; Venkatesh, 2000). Therefore, enjoyment enhances learning outcomes by increasing learning efforts.

6. CONCLUSION

This study extends prior research on the effectiveness of ERPsim in IS education. Although there are several empirical studies that examine the effectiveness of using ERPsim to teach ERP software and business processes, these studies are very fragmented and lack theory-based models that investigate factors and how they influence learning behavior and outcomes from using ERPsim. Prior studies have not revealed the causal relationship between various cognitive-psychological factors and learning outcomes. The purpose of this study is to close the research gap, that is, there is a lack of theoretical studies or empirical evidence on why and how ERPsim could improve learning outcomes. Based on an extensive literature review, two major determinants of information systems usage behavior, enjoyment and cognitive appraisal were identified. A TBP-based research model was built to empirically examine the effects of these two major IS variables on learning outcomes when students experiment with ERPsim in the classroom. Enjoyment and cognitive appraisal are found to be significant factors in creating positive business processes and ERP software usage learning outcomes using ERPsim. This study provides insight into how learning outcomes are formed and influenced by cognitive-psychological factors. In the following subsections, the researchers discuss implications for IS research and IS education, limitations of the research and suggestions for future research.

6.1 Implications for IS Research, Practice and Education

ERPsim is a useful learning tool for business students to learn business processes and SAP software. This study provides a theoretical model and shows empirical evidence of how enjoyment and cognitive appraisal influence learning outcomes obtained through experimenting with ERPsim. The findings enrich knowledge of the effectiveness of ERPsim in business education.

For IS researchers, the combined effects of enjoyment and cognitive appraisal on behavioral intention and learning outcomes are worthy of further study. In the behavioral model, enjoyment represents individuals' affective appraisal or self-assessment of emotion on the activities they are enduring; cognitive appraisal reflects individuals' self-assessment on the utilitarian outcomes from their actions. These two factors determine the behavioral intention together. Both prior studies (Venkatesh, 2000; Venkatesh, Speier, and Morris, 2002; Sun and Zhang, 2006; Lee, Chen, and Ilie, 2012) and this research suggest enjoyment influences cognitive appraisal. This is because emotion comes earlier (e.g., Lee, Chen, and Ilie, 2012) and helps reduce the cognitive burden, leading to an "underestimate" of the difficulties of the activities (e.g., Venkatesh, 2000). However, confirming this declaration needs more empirical evidence. Are there any other cognitive and psychological factors involved in the interactions among enjoyment, cognitive appraisal, and behavioral intention? The researchers believe so. What are they and how are they involved? This is not known. Therefore, more research is needed to answer such questions. In addition, the researchers believe that some other factors also play roles in shaping behavioral intention and learning outcomes. Contextual factors such as task difficulty (e.g., complex business processes; learning curve of SAP software) and personal factors such as learning styles, IT skills, level of business knowledge and concepts are all determinants. In sum, ERPsim provides a good opportunity for IS research.

For IS practitioners, ERP software design should focus on improvement of users' enjoyment and cognitive appraisal. In other words, software interfaces should be easy to use and business process management should be as straightforward as possible. Users should easily move from one screen, which manages a certain business process to another. Many users have been complaining that the learning curves of enterprise software are too steep. Therefore, the software industry should focus more on the ease of use than on the comprehension of functions.

For IS educators, business curriculum design should take into account and reflect students' cognitive-psychological style. This approach is more important in teaching ERP software and business processes since students often lack skills and knowledge in these areas and they do not have practical experience. Without "doing," it is hard to understand many business process concepts and difficult to master software usage. Teaching methods and activity management in the classroom should enhance students' enjoyment, interest, and curiosity and reduce their cognitive burden when they are operating business processes via ERP software. Classroom practices indicate that appropriate instructor intervention and explanations as well as discussions with students are all helpful in increasing students' engagement and motivation.

6.2 Limitations and Suggestions

Like all research, this study has limitations that can provide some opportunities for future research. This study only examines two factors in the research model. As discussed earlier, there are many other factors that can determine behavioral intention and learning outcomes of experimenting with ERPsim. To understand students' behavioral intention and learning outcomes, a more comprehensive and integrative research model is required. Such a research model should include a wide range of antecedent factors that come from the IS and IS education literature. For example, students' concentration, curiosity, innovative attitude, personal skills in IT and understanding of business processes, etc. all play determinant roles in learning outcomes. Although it is impossible to include all possible factors in one research model, a relatively comprehensive model will be able to investigate interactive effects (i.e., moderating and mediating) of factors on behavioral intention and learning outcomes. This study shows the promise of applying the theory of planned behavior (TPB) (Ajzen, 1991) to study learning outcomes of using ERPsim.

Another limitation is the students' self-reported learning outcomes. Although self-reported assessment can be useful, there are concerns about its validity (Rajkumar et al., 2011). Prior studies indicated that students exhibit overconfidence and overestimate their actual abilities (Larres, Ballantine, and Whittington, 2003; Ballantine, Larres, and Oyelere, 2007; Price and Randall, 2008). To overcome this limitation, the researchers plan to incorporate students test scores in the TPB-based research model. This will allow evaluation of the difference between self-report assessment and direct assessment while providing more accurate measure instruments in the research model. It is hoped that further empirical study of ERPsim on learning outcomes will shed more light on the efficiency and effectiveness of ERPsim in IS and business education.

Lastly, the researchers recommend future IS research to be focused on the effectiveness and efficiency of using ERPsim in teaching and learning processes. Prior studies have compared the students' learning performance before and after using ERPsim in IS courses (e.g., Léger, 2006; Seethamraju, 2011; Cronan and Douglas, 2012) and suggest that using ERPsim improves learning outcomes. This study goes a step further in discovering that two important cognitive-psychological factors (cognitive appraisal and enjoyment) positively influence learning outcomes when students experience ERPsim in an IS course. By combining these two research methodologies, we can investigate the antecedent effects of cognitive-psychological factors on the learning outcomes between an ERPsim group and a non-ERPsim group (control group). As such, the causal relationships or structural model in-between these two groups can be compared to find out what antecedent factors play critical roles in shaping learning outcomes, and how much they contribute to improving learning outcomes. With this information in mind, the effectiveness and efficiency of how ERPsim may improve learning performance, and how to better employ ERPsim into IS courses can be evaluated.

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APPENDIX 1 - The Measurement Instrument

Enjoyment of using ERPsim (adapted from Ghani, Supnick, and Rooney, 1991 and Davis, Bagozzi, and Warshaw, 1992)
1. I found the game was interesting (ENJ_1).
2. I found the game was enjoyable (ENJ_2).
3. I found the game was exciting (ENJ_3).
4. I found the game was fun (ENJ_4).

Cognitive appraisals of using ERPsim (adapted from Lee and Chen 2011)
1. I felt it was an effective way to learn about an ERP system (CA_1).
2. I felt it was a convenient way to learn about an ERP system (CA_2).
3. I felt comfortable using it as a learning tool (CA_3).
4. I felt it was helpful in learning about an ERP system (CA_4).
5. It was easy to play the ERPsim game in general (CA_5).

Intention to use ERPsim (Venkatesh, 2000; Francis et al., 2004)
1. I want to use a simulation like the ERPsim experience as a learning tool (INT_1).
2. I intend to use a simulation like the ERPsim experience in future learning (INT_2).
3. I expect to use a simulation like the ERPsim experience in future learning (INT_3).

Learning outcomes
1. I feel I have gained a hands-on understanding of the concepts underlying enterprise systems (LO_1).
2. I feel I have experienced the benefits of enterprise integration firsthand (LO_2).
3. I feel I have developed technical ERP system skills utilizing the input, process, and output methodology (LO_3).
4. I feel I have learned how to work as a team (LO_4).
5. I feel I have learned how to create, execute, and adapt a business strategy in a real-time environment utilizing the 'input, process, and output' methodology (LO_5).

APPENDIX 2 – A Summary of Testing Results

Hypothesis	Description	Testing outcome	Explanation
H1	Behavioral intention to use ERPsim for learning business processes is related positively to learning outcomes.	Supported at $p<0.001$	Behavioral intention directly leads behavioral outcomes (Ajzen, 1991)
H2	Enjoyment of experiencing ERPsim influences positively the intention to use ERPsim for learning business processes.	Supported at $p<0.001$	Enjoyment is an intrinsic behavioral belief that influences behavioral intention (Davis, Bagozzi, and Warshaw, 1992; Venkatesh, 2000).
H3	Cognitive appraisal of experiencing ERPsim influences positively the intention to use ERPsim for learning business processes.	Supported at $p<0.001$	Cognitive appraisal is a cognitive process followed by behavioral intention and outcomes adopted after the appraisal (Lazarus and Folkman, 1984).
H4	Enjoyment of experiencing ERPsim influences positively the cognitive appraisal of experiencing ERPsim.	Supported at $p<0.001$	Enjoyment is one type of affective appraisal that comes earlier in the human brain than cognitive appraisal (LeDoux 1995; Lee, Chen, and Ilie, 2012). It reduces the cognitive burden and hence individuals expend more effort on tasks when individuals are experiencing enjoyment (Agarwal and Karahanna, 2000).

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