Decision Sciences Institute

MODELS and APPLICATIONS in the DECISION SCIENCES

Best Papers from the
2015 Annual Conference

Edited by Merrill Warkentin

Models and Applications in the Decision Sciences

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Edited by Merrill Warkentin
Mississippi State University

Decision Sciences Institute

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Printed in the United States of America

First Printing December 2015

ISBN-10: 0-13-411591-0
ISBN-13: 978-0-13-411591-7

Pearson Education LTD.
Pearson Education Australia PTY, Limited.
Pearson Education Singapore, Pte. Ltd.
Pearson Education Asia, Ltd.
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Library of Congress Control Number: 2015953290

I dedicate this third volume of DSI research
to all of my co-authors and mentors,
from whom I have learned so much.

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Foreword

It is with great pleasure that I write this foreword to a collection of best papers from the 2015 DSI global conference. The Decision Sciences Institute (DSI) has long prided itself as a leader in cross-disciplinary research, spanning diverse areas in analytics, information systems and technology, supply chain operations management, and other business disciplines. This volume contains the best and most insightful research articles from more than 1,000 submissions to this year's conference. Consistent with both the charter and heritage of the DSI, the papers herein cover a rich diversity of topics in business, with a focus on decision-making at strategic, tactical, and operational levels.

Please enjoy these excellent contributions. I trust that you will find them to be interesting, thought-provoking, and helpful to your own practice and research endeavors.

Morgan Swink, Ph.D.
2015 President of DSI

Acknowledgments

I want to acknowledge all the authors who contributed to this second annual volume of research in the decision sciences. Their scholarly activities form the foundation of our community and of the contributions of our Institute to solving tough problems in business, industry, and society. These authors exemplify the excellence of DSI research, and their work has been honored by DSI as the best of this year's conference.

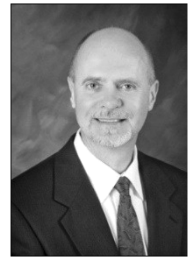
I also want to thank the reviewers of these manuscripts who provided valuable input into the authors' work and facilitated further improvements in the manuscripts. I also want to thank Shawnee Vickery, Natasa Christodoulidou, and Stephen Ostrom for helping me identify the candidate pool for this volume. Marc Schniederjans (2014 DSI President) and Morgan Swink (2015 DSI President) have been supportive of this project that honors the excellence of our DSI scholars. All the staff at the DSI Home Office in Houston are wonderful—thanks for your support.

I have acknowledged other important individuals in the last two DSI volumes—my parents, students, and others. But I also want to specifically thank my Department Head, Jim Chrisman, who helps create an environment at Mississippi State University that is conducive to engaging in our primary role as active researchers. I'm proud of our entire group and its productivity, and I appreciate the friendships we share.

My final acknowledgment again goes to my wonderful wife of over 30 years. Kim is the best life partner I could imagine, and I owe so much to her. Thank you!

About the Author

Merrill Warkentin, Volume Editor



Merrill Warkentin is Professor of MIS and the Drew Allen Endowed Fellow in the College of Business at Mississippi State University, where he is also a member of the research staff of the Center for Computer Security Research (CCSR) and the Distributed Analytics and Security Institute (DASI). He has published over 250 manuscripts, including 60 peer-reviewed journal articles, plus 10 research volumes or books. His work has been cited almost 9,000 times and his H-index is 25, according to Google Scholar in 2015. He has been ranked among the top 100 IS scholars in the world based on rankings of authors publishing in the AIS Senior Scholar's basket of leading MIS journals. His research, on the impacts of organizational, contextual, situational, and dispositional factors on individual user behaviors in the context of information security and privacy, addresses security policy compliance and violation and social media use, and has appeared in such journals as *MIS Quarterly*, *Decision Sciences*, *Journal of the AIS, European Journal of Information Systems*, *Decision Support Systems*, *Information & Management*, *Information Systems Journal*, *Communications of the ACM*, *Communications of the AIS*, *The DATABASE for Advances in Information Systems*, *Computers & Security*, *Information Resources Management Journal*, *Journal of Organizational and End User Computing*, *Journal of Global Information Management*, and others.

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Dr. Warkentin has served as a consultant to numerous companies and organizations, and has been a featured speaker at almost two hundred industry association meetings, executive development seminars, and academic conferences. He has been a Lecturer at the Army Logistics Management College and was named a "National Distinguished Lecturer" by the Association for Computing Machinery (ACM). He has been a visiting professor or an invited speaker at over 25 universities around the world, including Georgia State, Indiana, LSU, Florida State, Clemson, USF, Copenhagen Business School, McMaster, Fudan, Oulu, Jyväskylä, Zhejiang, Cape Town, and others. He has earned various recognitions for his teaching at every level from introductory courses to doctoral research seminars—his primary focus has been teaching Systems Analysis classes and Research Design seminars. His research has been funded by the UN, NSF, IBM, NSA, DoD, US Navy, Homeland Security, and others. He was previously on the faculty at George Mason University and held the Reisman Research Professorship at Northeastern University in Boston, where he was also the Director of MIS and eCommerce programs at both the graduate and undergraduate levels. Professor Warkentin's Ph.D. in MIS is from the University of Nebraska–Lincoln. He can be reached at m.warkentin@msstate.edu.

The Decision Sciences Institute, Sponsor

The Decision Sciences Institute (DSI) is an independent nonprofit educational multidisciplinary professional organization of academicians and practitioners interested in the application of quantitative and behavioral approaches to all managerial decision-making in business, government, and society.

Through national, international, and regional conferences; competitions; and publications, DSI provides an international forum for presenting and sharing research in the study of decision processes across disciplines. DSI also plays a vital role in the academic community by offering professional development activities and job placement services.

Five regional subdivisions in the United States, as well as regions representing Europe, Mexico, Asia-Pacific, and the Indian subcontinent, operate independently within DSI. Each region has its own elected officers and holds annual meetings.

DSI's members specialize in functional areas such as information systems, finance, marketing, management, accounting, manufacturing/service management, supply chain management, and decision support processes, as well as institutional areas such as healthcare, public administration, resource management, and higher education. They use leading rigorous research techniques, including experimental designs, empirical quantitative analysis, optimization, simulation, surveys, and other scientific methods, while also valuing innovative methodological horizons.

DSI's goals are to:

1. Enrich the diverse disciplines of the decision sciences
2. Integrate these disciplines into bodies of knowledge that are effectively utilized for decision-making
3. Develop theoretical bases for such fundamental processes as implementation, planning, and design of decision systems
4. Improve educational programs in the decision sciences

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Introduction

This is the second *Annual Volume of Research in the Decision Sciences*, which is the third scholarly book sponsored by the Decision Sciences Institute (DSI). It represents a range of leading-edge research projects conducted within the multi-disciplinary fields of decision sciences. Decision sciences scholars and practitioners apply a range of rigorous quantitative and behavioral approaches, frameworks, and methodologies to support and solve decision challenges experienced by individuals, organizations, and societies. They draw from functional areas such as information systems, manufacturing management, service operations management, supply chain management, finance, marketing, management, accounting, and decision support, as well as institutional areas such as health care, public administration, resource management, and higher education. Decision sciences scholars employ leading rigorous research techniques, including experimental designs, empirical quantitative analysis, optimization, simulation, surveys, and other scientific methods, while also valuing innovative methodological horizons. This volume will provide decision makers with a set of practical and successful approaches to address the decision challenges they face.

The authors of these manuscripts submitted their work to be considered for the Annual Conference held in Seattle, Washington, during November 2015. The reviewers selected a subset of all the submitted papers to be considered for "Best Paper" awards, and these chapters are drawn from that subset. The authors have further refined their work for this annual volume. We encourage the members of DSI to submit their best work to future conferences.

Together, these manuscripts represent outstanding analyses and solutions that are not only very interesting, but which offer promise to real-world individuals and organizations who face important decision challenges. Please enjoy this set of interesting and valuable research manuscripts!

Merrill Warkentin, Volume Editor

1

Central Role of Knowledge Update in the ERP Training

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Hongyan Liang, *Kent State University*
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Abstract

This study explores the mediating role of knowledge update in the context of an enterprise resource planning (ERP) simulation game, that is, a gamified ERP training. Drawing on the expectancy-confirmation model, this study suggests relationships among individual effort, perceived knowledge update, and involvement, which finally influence willingness to learn ERP systems. The hypotheses were tested using 166 subjects who participated in an SAP ERP simulation game. This study finds the significant effects of individual effort on perceived knowledge update and involvement. Also we find that perceived knowledge update significantly influences involvement and willingness to learn ERP systems.

Introduction

The implementation of an enterprise resource planning (ERP) system is one of the more popular and radical organizational changes that can result in significant modifications to nearly 30% of key routines in contemporary firms (Davenport & Beck, 2013; Herold, Fedor, & Caldwell, 2007). Some other estimates also show high adoption rates of ERP systems, such as 75% among service-oriented companies, 60% in medium-to-large manufacturing firms, and 80% among Fortune 500 firms (Phelan, 2014). Prior studies have found that ERP systems result in multiple benefits including lowering costs and reducing inventories, enhancing firm's productivity (Olson, 2003), improving in operational efficiency (Häkkinen & Hilmola, 2008), gaining competitive advantage (Beard & Sumner, 2004), and promoting internal resources' restructuring (Stratman, 2007). In addition, past research highlights the critical role of ERP systems as organizational resources and indicates their importance in designing the information system (IS) of a company (Ko, Kirsch, & King, 2005; Xu & Tian, 2014).

To maximize the benefits of implemented ERP systems, it is crucial to enhance individuals' expertise and skills in employing such systems by providing proper training (Gardiner, Hanna, & LaTour, 2002) because ineffective utilization of systems is mainly due to insufficiency of training (Henriksen & Andersen, 2008). Training has been of importance because of its significant effect on the success of IS (Chou, Chang, Lin, & Chou, 2014). In the case of ERP systems, users have to learn both a new package, and also a totally novel way of conducting business. In a recent study, Sykes, Venkatesh, and Johnson (2014) found support for this argument contending that for maximal benefit, organizations could design training interventions and support services so that the early focus is on the technical side of the systems, with later stages focusing on routines and processes.

In the last decade, researchers have encouraged the use of simulation games for the purpose of learning and instruction (Hainey, Connolly, Stansfield, & Boyle, 2011; Kebritchi, Hirumi, & Bai, 2010). Anecdotal and empirical findings suggest that computer-based simulation games are effective for enhancing employees' skill sets. Companies such as Canon and Cold Stone Creamery developed simulation games to teach their employees various technical and managerial skills. Employees who played the game obtained 5% to 8% higher training assessment scores than those trained with older techniques, such as manuals (Sitzmann, 2011). Learning the concepts and developing competencies underlying an ERP system is a difficult task. Researchers found that adopting a learning-by-doing approach through employing simulation games to train ERP users is an effective method (Léger et al., 2011). This process focuses on guiding the learning experience in a situated context through a series of realistic and potentially complex open-ended problems. Such problem-based learning motivates the participant to gain a set of competencies by actively resolving the task (Merrill, 2007).

The ERP simulation game (ERPsim) has been designed based on the concept of situated cognition. Prior research suggests that such a realistic learning environment is associated with higher levels of learner involvement and motivation, which leads to higher understanding and better knowledge transfer (Lave & Wenger, 1991). An active learner is highly involved and plays a dynamic and self-motivated role in how and what needs to be learned (Trigwell, Ellis, & Han, 2012). Prior research has found that simulation games improve the learning process of individuals by promoting their psychological involvement (Anderson & Barnett, 2011). However, the complexity of ERP systems limits the amount of knowledge those users can absorb before they actually use an ERP system (Yi & Davis, 2003). Users have to continue to learn to obtain the knowledge and skills required for effective ERP usage.

The key objective of the study is to examine the shift of individual's knowledge perceptions from the pre-training to the post-training stage to understand the change in user's belief. In doing so, the study highlights that limited attention has been given to users' perceptions of knowledge update offered by the IT artifact in prior longitudinal studies. We defined perceived knowledge update as individuals' perceptions of their improved abilities to perform their daily work using the ERP system after taking the relevant training programs. Although perceived knowledge and training were found to promote an individual's ability in performing challenging tasks (Torkzadeh, Pflughoeft, & Hall, 1999), there has been little research on how updated knowledge leads to continuous learning intentions and what determines individual's perception of knowledge update in ERPsim setting. In other words, the difference between an individual's knowledge about ERP before attending an ERPsim training session and after that, as we argue, has positive relationship with learning behaviors.

Given the research gaps mentioned previously, our study answers the following questions: What influences a user's perception of knowledge update? What are the consequences of perceived knowledge update? To answer the research questions, our model is based on the expectation-confirmation model (ECM) (Bhattacherjee, 2001), which was used as an analytical lens to explain how an individual's judgment of his/her improved knowledge affects his/her involvement, which in turn influences continuance intention. As ECM highlights the prominence of both pre- and post-behaviors of individuals in their subsequent usage behaviors, we recognize the variance of pre-training and post-training knowledge levels and test the levels' central role in learner's post-training behavior.

The chapter is organized as follows: First, we provide the theoretical background for the study. Next, we present the research hypotheses and methodology for our research followed by the analysis and the results. Finally, we conclude with a discussion of research findings and implications for theory and practice.

Theoretical Background

In the early stage of an ERP implementation, that is, acceptance of system phase, employees begin to learn and understand how to apply the new technology to the updated work practices. Through the accumulation of relevant skills in early stages, individuals are able to use the system in a more sophisticated manner. A successful learning process provides them with the ability to exploit the fullest potential of the ERP, and to innovate with the system to meet existing needs and apply them to new job demands—in the later stages of ERP usage. Highlighting the importance of the learning outcome of ERP, this study explores the importance of knowledge update and identifies its antecedent and consequences in the context of an ERP simulation game.

Expectation-Confirmation Model

Individuals are likely to engage with a new technology if they perceive that the new system has benefits for them. If potential users understand that the technology is useful for them, they will more likely accept and use it in the future (Bhattacherjee, 2001). In the literature, the intent to adopt again is referred to as continuance intention. The ECM has been widely used to examine continuance intention. Originally, ECM was drawn upon expectation-confirmation theory (Oliver, 1980), the technology acceptance model (TAM; Davis, 1989; Davis, Bagozzi, & Warshaw, 1989), and the theory of planned behavior (TPB; Ajzen & Fishbein, 1980). The aforementioned theories focus on the motivations of users in accepting a new technology, instead of continual usage of that technology. Deriving from these theories and consumer behavior literature, ECM focuses on three main variables—expectation, satisfaction, and confirmation in determining continued usage intention (Bhattacherjee, 2001). This model suggests that initial use does not automatically result in continued use, which has a more vital role in determining the success of a system than initial use. Confirmation indicates a cognitive belief that is salient to IS usage. It is defined as the degree to which an individual's initial expectation about the performance of a system is being confirmed after having an experience with the system (Bhattacherjee, 2001). Confirmation describes individual's affective state and is the consequence of a cognitive assessment of the potential discrepancy between initial expectation and experienced performance. Individuals in the later stage form a level of satisfaction based on their degree of confirmation and expectation on which that confirmation was established. Finally, all these interactions may lead to continued and repeated usage of a system. In sum, the difference between expectations (pre-usage) and perceived benefits (post-usage) determines the confirmation or disconfirmation level, which consequently affects satisfaction and usage continuance behavior.

The ECM and its adaptations have been applied to various technology-related contexts (Brown, Venkatesh, & Goyal, 2012; Stone & Baker-Eveleth, 2013). Moreover, the ECM has been used to improve our understanding of the role of the technology on learning and adoption. For example, Limayem and Cheung (2008) included IS habits in ECM and studied their interaction with continuance intentions in context of Internet-based learning technologies. In an e-learning context, Chiu et al. (2005) found that the components of perceived performance, usability, quality, and value influence satisfaction and consequently intention to continuance and ultimately intention in an e-learning environment. On realizing the earlier mentioned applications of the ECM from the literature, we adopted and contextualized the main relationships of ECM elements into our study's setting, an ERP simulation game.

Perceived Knowledge Update

The critical issue pertains to the assessment of how user perceptions about knowledge of a new system evolve over time. Prior studies on IS acceptance have relied on TAM and

ECM to understand the change in user perceptions. They have highlighted the belief change process as the core theme and proposed that a better understanding of how user beliefs evolve from the pre-usage to the post-adoption stage is critical (Kim & Malhotra, 2005). TAM-related studies show that the influence of perceived usefulness on intention to use persists at the post-adoption stage (Venkatesh & Davis, 2000). ECM delves deeper into the belief change process and proposes confirmation as an intermediate process between pre-usage and post-adoption perceptions regarding IS (Bhattacherjee & Premkumar, 2004). In the context of learning the confirmation can be assessed by evaluating the difference between individual's knowledge improvement perceptions. In fact conformation happens when people's perceptions on their post-knowledge have been improved considerably compared to their prior training/usage knowledge perceptions. In other words, after the users gain firsthand experience by using ERPsim, their succeeding knowledge perceptions are revised to achieve better alignment between initial expectations, formed by their levels of effort, and beliefs after the actual use experience.

In the same vein, Kim and Malhotra (2005) suggested that the belief change process may be established through a sequential updating mechanism, which is grounded on the premise that a user's perceptions are updated in the context of prior perceptions. The sequential updating mechanism proposes that post-adoption perceptions are a function of pre-adoption perceptions. The basic beliefs are updated based on new information that is now available.

The literature review highlights two important gaps. First, special attention needs to be given to user knowledge perceptions regarding IS features that further determine intentions of users. Most prior studies focused on aggregate usefulness perceptions. The approach proposed in the study offers a more granular assessment of perceived knowledge as an influential determinant of individual learning behaviors in the context of ERPsim. Second, limited research focuses on how users' perceptions change over time as they gain experience in utilizing a system. Therefore, by defining perceived knowledge update as the difference between pre-training and post-training knowledge levels of a learner, we attempt to investigate the mechanism, which leads from perceived knowledge update to repeated learning behaviors.

Research Model and Hypotheses

Drawing on the background literature reviewed, we provide the research model underlying our study in Figure 1.1. The specific hypotheses are discussed later. Adapting ECM into the context of an ERP simulation game, we may observe similar patterns and relationships. As the learners put effort into engaging with the system, they build some levels of expectations about the impact of the simulation game on their skills. In the case of perceived improvement (confirmation) in their knowledge to use ERP systems, they will be satisfied, as

ECM posits. In our setting, such satisfaction will be translated into the involvement of learners, which results in continuance learning of the system by the individuals.

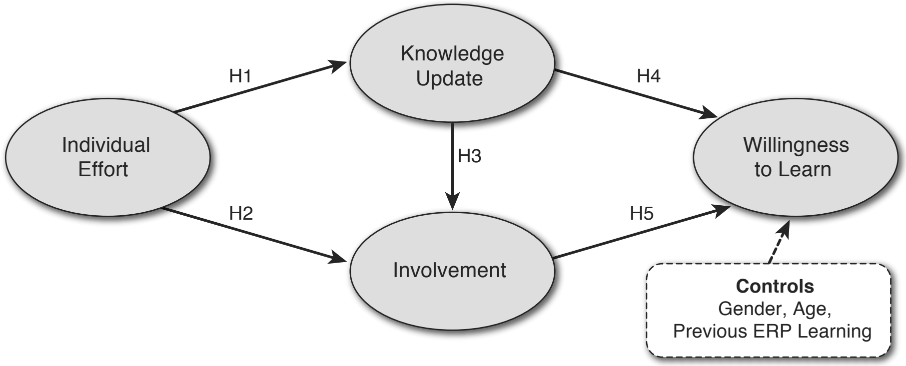

Figure 1.1 Proposed model

According to Maclnnis and Jaworski (1989) there are several levels of cognitive efforts in information processing, which demonstrate the degree of cognitive effort on the side of the individual. At higher levels of motivations to process information, users employ more cognitive capacity and try to integrate their own prior knowledge and experience to the message (that is, training in our context); also they add positive or negative attributes to it, which activates a more effortful route of processing the message. We can apply the elaboration likelihood model (ELM; Petty & Cacioppo, 1986) to describe how individuals who spend more cognitive resources and capabilities are likely to experience higher levels of knowledge update. As the ELM posits, the nature of the message determines the strength and persistence of its consequences. In the case of higher individual effort, an individual's information-processing mechanism activates higher cognitive levels by going beyond simply paying attention or comprehending the argument in the message. Such elaborative processes involve generating updated judgments in response to the information to which the learner is exposed.

In the context of ERPsim training and adapting the ELM, we argue that individuals with motivation and ability put more effort to process the external information. Likewise, they consider and evaluate the details of the arguments presented to them during the learning process, which results in creation of evaluative perceptions on the acquired knowledge through central processing. Whereas, those who engage in the training because of lack of time or resources may use lower levels of their cognitive capacity to treat the information and arguments. In this case, they will rely on their judgments on the peripheral route, which is less stable, less persistent, more prone to counterinfluence, and less predictive of long-term behaviors (Petty & Cacioppo, 1986).

Contextualization of these notions to the setting of our study, we argue that if learners invest the necessary effort to adequately scrutinize and evaluate the provided information, which reflects their level of effort in learning the new skills, they will view the acquired knowledge as being relevant and important to the target behavior and they will more likely to have higher perceived knowledge improvement.

H1: *Individual effort will be positively associated with perceived knowledge update.*

Past studies found that simulation games improve the learning process of individuals by promoting their psychological involvement (Anderson & Barnett, 2011). Moreover, higher levels of involvement in the learning process positively impact individual's understanding and promote knowledge transfer (Lave & Wenger, 1991). By applying the ELM and ECM, we attempt to describe the association between the effort invested by a person on acquiring new skills and the psychological involvement in the learning process.

According to the ELM, information recipients can vary widely in their ability and motivation to elaborate on an argument's central merits, which in turn may constrain how a given influence process impacts their attitude formation or change. Thoughtful evaluation of information activates the central processing route (Petty & Cacioppo, 1986), in which the learner processes the relevant information at higher cognitive levels. Activated central processing requires that a larger portion of the cognitive capacity of an individual needs to be engaged in scrutinizing the arguments and information. This mechanism generally results in more stable and enduring attitudes. Relating this notion to the ERPsim, we need to underscore its design specifications, which are based on the concept of situated cognition. By focusing on realistic and situated context, ERPsim provides a learning process in which individuals can identify more relevancies of communicated information. As they invest more cognitive effort to process the information, the probability that they find more connections between the arguments and prior experience and knowledge is higher, which in turn can increase the participant's involvement (that is, motivation factor in the ELM) in the process of learning. An active learner is emotionally and cognitively involved, and plays a dynamic and self-motivated role in how and what needs to be learned (Trigwell et al., 2012).

According to the ECM, user expectation is positively related to user satisfaction. The model contends that expectation is another determinant of satisfaction because expectation provides the reference level or baseline for individuals to form evaluative judgments about the focal product or service (Bhattacherjee, 2001). ECM posits that a high baseline level or expectation tends to enhance an individual's satisfaction whereas low expectation shrinks resulting satisfaction. Similarly, marketing studies found that apart from the association between expectation and perceived performance, which determines confirmation, expectations (that is, individual effort) also affect customer satisfaction (Spreng & Chiou, 2002). Drawing on this argument, a recent study of multimedia Web sites found that extensive effort leads users to involve and interact more with the content of Web sites

(Lim, Al-Aali, Heinrichs, & Lim, 2013). Thus, involvement can be seen in relation to the level of motivation of the individual in putting effort into learning a new skill.

H2: *Individual effort will be positively associated with involvement with the ERP simulation game.*

Research on behavior changes (Bandura, 1997) posits that individuals' behavior is affected by their judgments of their skills and capabilities to perform a given task. It discusses that psychological procedures alter expectations of personal perceptions of abilities. Moreover, it describes the procedure of determining what actions to take, how long to preserve, and what strategies to apply when individuals attempt to balance their abilities with the challenges of a task. Consistent with Bandura's self-efficacy theory, when individuals feel a sense of mastery in a domain, they tend to believe that they can achieve a desired performance level. Hence, higher perceptions of knowledge improvement can lead to higher degrees of perceived capability for ERPsim players. This argument has been validated by empirical studies in various contexts including IS and acceptance of technology (Agarwal & Karahanna, 2000). In the context of IS, researchers (Mun & Hwang, 2003) suggest that individuals with higher degrees of self-efficacy usually form more positive perceptions of IT and have higher levels of pleasure, which lead to subjective perceptions of positive affects and satisfaction (Lim, Pan, & Tan, 2005). By finding the difference between self-efficacy levels of learners at two different times, that is, before and after conducting the ERPsim, we created a perceived knowledge improvement construct, which represents the confirmation notion of ECM.

H3: *An individual's perceived knowledge update will be positively associated with their involvement with the ERP simulation game.*

The difference stemming from different levels of self-efficacy is all the more apparent in the ERP context because the renowned complexity of an ERP system makes users feel that it is difficult to learn. Whereas, individuals with higher degrees of belief in their abilities tend to both have a higher intention of using an IS and actually use the IS more frequently (Compeau, Higgins, & Huff, 1999). In a learning context, it was found that self-efficacy motivates individuals' learning intentions through the self-regulatory processes, such as self-evaluation, goal setting, and self-monitoring (Zimmerman, 2000). Similarly, in a recent study of the role of self-efficacy in ERP learning, Chou et al. (2014) found that post-training self-efficacy significantly facilitates ERP learning outcomes; in particular, they identified that higher self-efficacy increased learning willingness and learning capability.

Furthermore, Bandura (1982) indicated that self-efficacy influences individuals' choice of activities and skill acquisition strategies. Put differently, an individual with high self-efficacy will be more willing to work harder in a committed way to acquire a skill and also will be emotionally more stable in case of any obstacle (Bandura, 1997). Translating those findings into the setting of this study, we claim that those with high perceptions of knowledge improvement and ability (that is, a greater difference between pre- and post-ERPsim self-efficacies) will exhibit more tendencies to learn challenging concepts in a more persistent way. In contrast, individuals with lower perceptions of knowledge improvement will experience more anxiety and frustration, and consequently exhibit less determination in learning a challenging task (that is, ERP system) and will consequently have lower levels of learning intentions.

H4: *An individual's perceived knowledge update will be positively associated with their willingness to learn.*

User involvement is found to be a strong predictor of continuance intention (Shiau & Luo, 2010). Empirical evidence in the simulation game field suggests that players who experience higher levels of involvement during a game will have increased learning (Sitzmann, 2011). Likewise, in the ERP setting, involvement is posited to be positively related to usage intention (Amoako-Gyampah, 2007). In the same vein, previous research suggested a direct connection between affective and cognitive dimensions of attitude and intention to use (Lee, Chen, & Ilie, 2012; Van der Heijden, 2004). The theory of reasoned action (Fishbein & Ajzen, 1975) and the TAM (Davis, 1989) also supported these relationships. Moreover, in the IS learning setting, some recent studies found that learning intention is increased by the large amount of time spent navigating in the software as well as by the high level of motivation and involvement in the activity displayed by learners (Wrzesien & Raya, 2010).

H5: *An individual's involvement with the ERP simulation game will be positively associated with their willingness to learn.*

Method

Sample and Procedure

An experimental study in a controlled environment was chosen to simulate an authentic integrated business process supported by a real ERP system (that is, SAP). Students who took an introductory level of IS class at a large Midwestern public university participated in this game as a part of the course requirements. A total of 166 undergraduate students from 6 classes participated. In each class, the participants were randomly assigned to eight teams of two to four students. The sample was composed of approximately 38% females, and the average age of the participants was 20.5 years.

The research methodology involved the use of simulation game called ERPsim (Léger, 2006; Léger et al., 2011), designed to recreate a realistic business context and manage the main business processes of an organization using the ERP system SAP. Several similar studies have used this ERP simulation (for example, Caya, Léger, Grebot, & Brunelle, 2014). Within this overall product (ERPsim), there are several different ERP simulation games (for example, distribution game, logistics game, and manufacturing game). We chose the Distribution Game (or Water Bottle Game) because student participants had little previous knowledge of or experience with ERP systems. Because of this lack of experience and because all subjects attended the same ERP training session, we were able to isolate the effect of prior experience of individuals on the relationships, which we were testing. One week before the experiment, the participants were asked to complete the pretest survey that measured their prior knowledge about ERP systems.

A threat to internal validity may occur when we assigned different participants to different teams, with different team sizes, and in different classes, which could produce groups of individuals with noticeably different characteristics. Hence, we checked assignment bias to rule out this possible confounding effect and found that there were no significant differences in knowledge of ERP systems across the six classes (F = .537, p = .780) and team sizes (F = .761, p = .469), suggesting there was no assignment bias.

Construct Measurement

The measurement items used in this study were adapted from previous studies as shown in Table 1.1.

Table 1.1 Measurement Items

Individual effort (adapted from Hong, Thong, & Tam, 2004; Oh and Jasper, 2006) Seven-point scales anchored with "strongly disagree" and "strongly agree"	
	In achieving a higher performance.
IE1	I tried to make an accurate decision.
IE2	I extended a large amount of effort in this simulation game.
IE3	I paid a lot of attention while playing this simulation game.
Pre- and post-knowledge (adapted from Bhattacherjee and Sanford, 2006) Seven-point scales anchored with "strongly disagree" and "strongly agree" These items were measured before and after the simulation game.	
KN1	The level of my ERP knowledge is high.
KN2	The level of my ERP experience is high.
KN3	The level of my ERP competency is high.
Involvement with the simulation game (adapted from Bhattacherjee and Sanford, 2006) Seven-point semantic scales	
	For me, learning the SAP ERP simulation game is
INV1	Unimportant/Important
INV2	Irrelevant/Relevant
INV4	Means nothing to me/Means a lot to me

Table 1.1 Continued

Willingness to learn ERP systems (adapted from Davis et al., 1989) Seven-point scales anchored with "strongly disagree" and "strongly agree"	
WL1	I intend to learn about ERP systems.
WL2	I predict that I will learn about ERP systems.
WL3	I am willing to learn about ERP systems.

Data Analysis and Results

We used structural equation modeling (SEM) to analyze the proposed model. SEM is a flexible technique, applicable to both experimental and nonexperimental data (Kline, 2011). To conduct SEM, we used AMOS 22.0 because it enables us to simultaneously calculate the model parameters and it also takes into account measurement errors for each indicator, which improves its accuracy (Kline, 2011).

Measurement Model

Before analyzing the structural model, a confirmatory factor analysis (CFA) was conducted, in AMOS, to check the reliability and validity of the constructs. Composite reliability (CR) is commonly used to check the internal validity of the construct. Table 1.2 shows the CR values of the measurement items in the research model. All have CRs greater than .7, which is the normally agreed upon minimum value (Hair, Black, Babin, & Anderson, 2010). As shown in Table 1.2, average variance extracted (AVE) values are greater than .5, indicating that the model has convergent validity (Fornell & Larcker, 1981). Discriminant validity was assessed by the square root of AVE for each construct exceeding the construct's correlations with other constructs (Chin, 1998). As demonstrated in Table 1.2, the construct's discriminant validity can be concluded as acceptable.

Table 1.2 Confirmatory Factor Analysis Results

Constructs	Mean	SD	CR	AVE	Factor Loading Ranges	(1)	(2)	(3)	(4)
(1) Individual Effort	5.94	.97	.93	.81	.72–.86	**.90**			
(2) Knowledge Update*	1.31	1.70	.85	.65	.88–.95	.44	**.81**		
(3) Involvement	5.33	1.35	.94	.85	.87–.94	.33	.29	**.92**	
(4) Willingness to Learn	5.01	1.46	.93	.81	.87–.94	.67	.34	.37	**.90**

*Knowledge Update = Difference between post-knowledge and pre-knowledge.

Bold values represented diagonally are square root of AVE.

To evaluate the results of the CFA, we checked several commonly used goodness-of-fit indices (Table 1.3). As can be seen in Table 1.3, all tested indices of the model for both measurement and structural models were satisfactory (Hair et al., 2010).

Table 1.3 Goodness-of-Fit Indices

	χ^2 (DF)	χ^2/DF	GFI	AGFI	NFI	CFI	SRMR	RMSEA
Good Model Fit Ranges		<3.0	>.90	>.80	>.90	>.90	<.09	<.08
Measurement Model	64.08(48)	1.34	.94	.91	.96	.99	.036	.045
Structural Model	117.32(79)	1.19	.92	.88	.93	.98	.066	.054

Structural Model

We tested the hypothesized causal relationships among the constructs of the model. The created model yielded a good fit to the data (see Table 1.3). Figure 1.2 shows the path diagram for the model as well as the estimated standardized parameters for the causal paths, the square multiple correlations, and the level of significance of the constructs. The findings of this study support the conceptual model where all the hypotheses were supported.

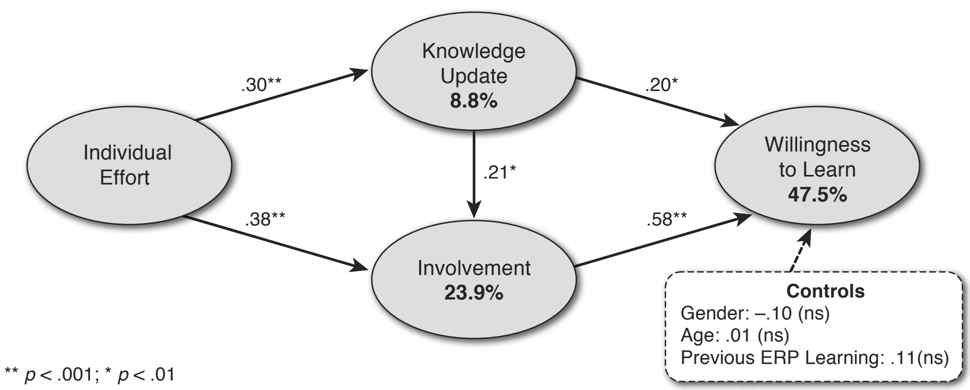

Figure 1.2 Results of structure model

On the path from individual effort to perceived knowledge update the coefficient is .30 (p < .001); to involvement the coefficient is .38 (p < .001). These coefficients, thus, support H1 and H2. The results indicate that knowledge update has significant effect on involvement ($\beta = .21$; $p < .01$) and on willingness to learn ($\beta = .20$; $p < .01$), which support H3 and H4. And finally, the relationship between involvement and willingness to learn is also significant with a positive coefficient of .58 (p < .001), supporting H5.

The structural model shows that individual effort explains 8.8% of the variance in perceived knowledge update, and those two variables together explain 23.9% of the variance in involvement. Lastly, 47.5% of the variation in willingness to learn was jointly explained by perceived knowledge update and involvement.

Discussion and Conclusion

Implications for Research

The results of this study contain several implications for researchers. The empirical findings demonstrate that employing perceived knowledge update and individual involvement would be a worthwhile extension of the ECM, as both were found to be influential in predicting behavioral intention of further learning. Specifically, alongside IS users' belief (that is, perceived knowledge update), individual involvement has a strong influence on intentions.

Our findings add to the concept of belief updating by defining a new construct, which measures the variance between pre- and post-training knowledge. This way we recognize the role of knowledge update in the process of ERPsim training. Hence, a primary contribution of this study is that it extends the temporal notion of user's perceptions, through defining and empirically testing the new concept of perceived knowledge update. Such an addition provides insights on the temporal change in user's cognitions, as ECM discusses.

We made reference to the ELM to explain the effect of individual's motivation and ability in processing the external information. By testing individual effort as the antecedent of knowledge update and involvement, we provide insight on how individuals who spend more cognitive resources and capabilities are likely to experience higher levels of knowledge update and involvement. These two constructs have been used in the study to represent the concept of elaboration likelihood, which suggests that people add something of their own to the specific information provided in the communication (Petty & Cacioppo, 1986).

Implications for Practice

ERP systems are typically complex in nature; hence, their users have to acquire new knowledge and skills to perform their jobs, presenting them with more challenges than those presented in legacy systems (Morris & Venkatesh, 2010). As a result, it is desirable for managers to encourage individuals with higher cognitive competencies to interact more with the system. On the basis of our findings, managers may consider adapting specific incentives and rewards for their target employees to motivate them to use higher levels of effort in learning the new systems. Higher effort will boost their self-knowledge perceptions and depth involvements, which in turn results in repeated learning and usage of the ERP system.

Further, to get the users excited about the new system and ensure its sustainability, it is important to design proper training courses that maximize the gap between learner's pre- and post-knowledge about a new system at the post-adoption stage. In other words, recognizing the role of knowledge update, managers should expose employees to the levels of information, which considerably increases their post-training knowledge perceptions to enhance both involvement and continual usage behaviors. For example, by offering more customized and timely training courses for individuals who are classified based on their prior knowledge levels, through reactivation of cognitive effort, learners will experience a higher level of knowledge update and involvement intensities.

In the effectiveness of simulation game in learning, this study shows that ERP simulation could be a useful tool to develop interventions that improve user's perceptions and attitudes. As the number of schools using ERP to integrate their business curricula is increasing (Cronan, Léger, Robert, Babin, & Charland, 2012), designers of similar simulation games should emphasize the features of the game that infuse high positive perceptions and beliefs, the factors that affect the success of a new system implementation in industry.

Limitations

Some limitations of the study should be noted. The study may lack external validity in the subjects and setting. We used student subjects from a large public university and conducted controlled lab experiments. Although student subjects likely represent the target population of the phenomenon being examined, additional studies with actual customers in real e-business environments are required to strengthen the generalizability of our findings. Second, we used self-reported measures to assess acquired knowledge and skills, which might be affected by self-presentation bias. However, such measures are frequently used in prior research mainly for practical reasons. Future research can use both perceived knowledge and objective knowledge (for example, examination) to measure knowledge. Third, we used Distribution Game because our sample had little knowledge of ERP systems. Future research might want to test our proposed model in other types of simulation game (for example, Beer Distribution Game).

Concluding Remarks

ERP systems hold great promise for generating organizational value, and simulation games play an important role in improving implementation outcome of such systems. However, our understanding of the process of knowledge change resulting from the training with the ERPsim games is still in its nascent stages. This work represents a step toward a better understanding of how and why the perceptions of knowledge update leverage success of ERP systems by encouraging individuals to continue learning it. Users may show more involvement in further learning if organizations design their trainings in a way that the positive change between pre- and post-training knowledge levels maximizes. We hope that this research will contribute to efforts made to gain insight into design of IS training, their use, and ultimately their contribution to organizational success.

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