A Structural Model of Student Satisfaction in Web-based ERP-Simulated Learning Environments

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Abstract**—**Student satisfaction in Enterprise Resource Planning (ERP) course offerings is a crucial part of the attempt to successfully promote higher education. This paper extends previous researches of the author using a structural model to investigate the relationships among attitudinal variables impacting to student satisfaction in Web-based ERP-simulated courses. This study guides university administrators, educators, practitioners, or software vendors of how to create satisfied learning and training environment for ERP in education. It also indicates that learners' satisfaction with the instructor, perceived ease of use, commitment, and perceived flexibility are respectively related to learners' satisfaction with the course. The satisfaction with the instructor is the primary correlation of commitment. Interestingly, ease of use is positively related to satisfaction with the instructor. The study confirms that these relationships represent the most important considerations for students and instructors in ERP-simulated enhanced courses.

Keywords**—** ERP, Simulation, TAM, Web-based Learning

I. INTRODUCTION

Enterprise Resource Planning (ERP) software has been implemented by organizations in industrialized countries such as Sweden and Australia [1], [2]. Currently, many organizations in developing countries such as China, Romania, and Thailand have also accelerated the implementation of ERP systems [3], [54], [4]. According to AMR Research [5], the five biggest ERP vendors—SAP, Oracle (which bought PeopleSoft, J.D. Edwards), Sage Group, Microsoft's Business Solution Group, and SSA Global (which bought Baan)—accounted for 72 percent of a $23.6 billion business in 2004. Moreover, AMR has also predicted that the growth would rise from 2004 through 2011 around 11 percent compound annual growth rate [6].

Since the global adoption of ERP is high, demand for ERP literate graduates has motivated many higher education institutions to build alliances with ERP software vendors [7]. A number of universities have integrated ERP in their business school curriculums; nevertheless, many challenges still remain such as high investment on purchasing hardware, supporting the system, and gaining the required expertise [55], [56], [57], [58]. For social perspective of ERP education, Shtub (2001) offered a framework to provide an environment that both enhanced and supported teamwork in learning the concepts of ERP based on role plays [59]. For case study perspective of ERP education, Cannon et al. (2004) described an alternative approach that made use of a fictional company simultaneously developed as a case and implemented in an ERP system [60]. For cultural perspective of ERP education, Desai & Pitre (2009) proposed a two dimensional framework by combining core MBA courses (such as marketing and finance) with international factor (such as cultural differences and language issues) [59].

For technological perspective of ERP education, a wide variety of important technological trends, such as software-as-a-service (SaaS), application service providers (ASPs), Web Service technologies, Open Source ERP, Virtual Reality, Web-based education, mobility, and Web-based ERP simulation provide opportunities for universities especially in developing countries with limited resources to become users of ERP services in classrooms. To illustrate, Andriole & Roberts (2008) suggested that more companies had rented applications from hosting vendors like Microsoft and now even SAP [61]. The demand for enterprise software was raised for software-as-a-service (SaaS) because many CIOs wanted to get out of the enterprise software acquisition, deployment, or support business [61]. It was demonstrated that SaaS (Software as a Service) applications of Nitu (2009) can facilitate students' learning performance on ERP [62]. Similarly, Becerra-Fernandez et al. (2000) suggested that

several ERP vendors to selectively choose university partners to be application service providers (ASPs) who develop, support, and provide system and associated coursework to other university partners who bought web-base accesses [55]. Chen and Sun (2007) provided schema-matching services (web service technologies) for the client companies to transform data for real-time business transaction validation in China [63]. Jin (2009) proposed the model of Enterprise Application Integration (EAI) with Web Services (EAIWS) to efficiently implement the integration of diverse applications and systems within or between the enterprises in China. Moreover, the programming interfacing of C#, ASP.NET and ADO.NET with a blend of delegate and events makes the real time tracking practically happen on the Chinese shop floor [66]. Carstea (2009) presents a sustainable business model for open source software tools for concurrent economic applications in Romania [68]. Tabrizi (2010) offered the effectiveness of the Agent Based Virtual Reality (AVR) delivery system used to deliver STEM education [69]. Nistor et al. (2010) created software to support modeling and simulation processes entitled "DEMIS" (Delphi for Modelling and Simulation) for benefits of decision making in Romania [70]. Kozel et al. (2010) suggested the problem of distinguishing software and real mobility using mobility and mobile processes in education of Czech Republic [72]. Idomir et al. (2010) developed a Web-based education tool for medical students to help them in understanding the courses' content [71]. Ariffin (2010) devoted a validity and reliability of learning style instruments using e-Les online web based system [73]. Kanthawongs et al. (2010) investigated the relationship among attitudinal variables impacting to student satisfaction in ERP-simulated courses for a university in Thailand.

The growing of technology in today's society and the rapid adoption of technological solutions in every aspect of education may necessitate a paradigm shift in understanding of the classroom experience. Many researchers have suggested the use of ERP simulation as part of business studies' courses in order to assist students in understanding and aligning business goals with technical strategies that support organization's current and future needs. El-Bakry and Mastorakis emphasized that the great development of IT of current Web-based learning systems need to be as effective as human tutors [67]. The success of these teaching and learning methods is likely to have direct implications for graduates' employability and their job readiness for industry [8]. The raise of these ERP educational offerings and the impacts on students has not been examined to a great extent [53].

The utilization of ERP-simulated software allows students to obtain hands on experience in various aspects of business processes [9], [10], [11]. This way the students will be able to work through the types of transactions that would take place in a simulated business setting. Nevertheless, many questions remain. What causes some students to lost interest or motivation in a class?

This paper addresses outcomes in using classroom technologies from the students' perspectives. Ideally, research would identify variables contributing to student satisfaction. When the simulation is employed in the course structure, additional questions arise. Do students perceived the technology as assisting or impeding the learning process? What are the determinants of student satisfaction in ERP-simulated courses? Are the students readily willing to accept the addition of new technologies in a course?

A previous study made a comparison between students' learning outcome in two settings: one when students used a web-based ERP-simulated classroom environment and the other one with teamwork and role-playing method without using the ERP-simulated software [12]. Technology Acceptance Model (TAM), its extension models, and Diffusion of Innovation Theory (DIT) were applied to web-based ERP-simulation context [13], [14], [15]. Empirically, results showed that students who did not utilize web-based ERP-simulated classroom demonstrated significantly higher achievement than those who used the system [12].

Another previous study revealed attitudes of satisfaction related to using ERP-simulated systems for students enrolled in an undergraduate business course of a university in Thailand [64]. The regression model indicated three strong relationships between satisfaction with the class and a) satisfaction with the instructor, b) perceived ease of use, and c) perceived flexibility.

Therefore, the current study implements the use of a structural model to investigate relationships among two variables: satisfaction with the instructor and satisfaction with the class. The research extends the previous studies to provide another perspective of an analysis of variables that have been suggested to affect satisfaction, as they relate to satisfaction within the course in a university in Thailand.

II. LITERATURE REVIEW

2.1 Satisfaction

Satisfaction concepts have long been introduced in Marketing [74]. Customer satisfaction refers to the state of mind that customers perceive about a company when their expectations have been reached or exceeded over the lifetime of the product or service [75]. In the context of satisfaction with their choice of higher institution, this notion suggests that satisfaction is a distinct construct that is mediated by prior perceptions of service quality [16], [17]. The instructors are the source of course information and they provide central focal points for their students [18]. Haytko [19] found that hybrid course evaluations were significantly lower than traditional course evaluations for both the instructor and the course. Students reported dissatisfaction related to the interaction with the instructor in the hybrid course. Likewise,

Marks, Sibley, and Arbaugh [20] emphasizes that instructor-student interaction is the most important thing predicting effective online learning. Then, the satisfaction factor of online learning is applied to ERP-simulated learning environment. Hence,

H1: Satisfaction with the instructor is positively related to students' satisfaction with the class.

2.2 Technology Acceptance

The Technology Acceptance Model (TAM) suggests that the primary determinants of whether or not a technology would be adopted are beliefs and attitudes toward that technology [14], [49]. In the context of web-enhanced courses, this model suggests that perceived usefulness and the ease of use of the delivery medium would enhance students' satisfaction with the medium and with their online course experience. The variables of the TAM model are suggested to influence the users' attitudes toward the technology and thereby their decision to adopt the technology. The model is also well accepted in the information technology literature and has been demonstrated to be a valid predictor of the use of computer software [50]; email [51], and the World Wide Web [52].

Arbaugh (2000) offered this one step further by claiming that in the context of web-based courses, the TAM suggested that perceived ease of use of the delivery medium would enhance students' satisfaction with the medium and with their online course experience [22]. More specifically, Arbaugh (2005) informed that both perceived usefulness and ease of use were positively associated with student satisfaction ratings in online MBA courses [20]. As additional technology is adopted in the classroom, it is wise to observe the impact of these variables in conjunction with more traditionally accepted drivers of satisfaction in the delivery of education.

2.3 Ease of use

The Technology Acceptance Model (TAM) is one theoretical model that attempts to explain use of computer based technologies, with the primary explanatory variables being perceived ease of use and perceived usefulness in adapting TAM to predict user's acceptance of information technology and defined perceived ease of use as "the degree to which a person believes that using a particular system would be free of physical and mental effort" [14], [21]. Arbaugh [22], [23] claimed that in the context of web-based courses, the TAM suggested that perceived ease of use of the delivery medium would promote students' satisfaction with the medium and with their online course experience. The researcher further revealed that perceived ease of use was positively associated with student satisfaction ratings in online MBA courses. Gefen [24] had already applied TAM model to the ERP context by examining how trust and ERP usefulness were built during ERP implementation. Additionally, ease-of-use has been cited as one key factor in designing successful ERP-simulation software [25]. Many researchers suggest that the embedded simulation is an integral part in enterprise applications providing powerful and simulation-based decision making capability [10]. Hermans et al. [18] suggested the most important considerations for students and instructors in Internet enhanced courses with the triad relationships among student's satisfaction with the instructor, perceived ease of use of the course technology, and satisfaction with the course. Based on this past research, it is hypothesized that:

H2: Ease of use is positively related to students' satisfaction with the class.

2.4 Flexibility

Previous literature research on computer mediated communication emphasizes that the flexibility inherent in web-enhanced courses are likely to "help groups reach relational intimacy high enough to compare to face-to-face groups, though taking a longer time to develop" [26]. This view suggests that flexibility in the course is a result of the medium "being both time and place independent, allowing course interactions to continue over time and through any interruptions" [27]. Due to this independence, students have "a high degree of flexibility in regard to when and where they access web-enhanced courses and what course tools they choose to utilize." This flexibility is likely to attract a more competent type of student or a non-traditional student. Having the flexibility, which students see as "freedom" should be related to both ease of use and satisfaction. This leads to the following hypotheses:

H3: Perceived flexibility is positively related to students' satisfaction with the class.

2.5 Commitment

While commitment has been shown to be strongly related to social interaction it may be more of an antecedent to satisfaction with the course. When web-based interaction replaces face-to-face interaction, social opportunities are diminished, and a student's acceptance of the technology, self-commitment to education, and in turn satisfaction with the course may be compromised [18]. In web-enhanced courses, students are likely to have more responsibilities placed upon them than traditional face-to-face learning environments. For instance, students may be required to download course materials, access Internet links, or participate in on-line discussions that do not correspond with class lectures. Thus, students should become active rather than passive learners. Self-motivation and self-discipline require students to commit to the technology and to the course. Past research suggests that students with strong commitment will be more successful and are likely to learn the most in web-enhanced courses than those with less motivation [28]. Student's commitment is a major factor that impacts the attrition and completion rates in the web-enhanced course and a lack of commitment is linked to high dropout rates [29]. Additionally, Eom, Wen and Ashill (2006) found that student motivation was positively related to perceived student satisfaction with the web-

enhanced course [30]. Students who are committed to their education beyond just being committed to one course should be more satisfied with their experiences. While commitment has been shown to be strongly linked to social interaction it may be more of an antecedent to satisfaction with the instructor and course. When web-based interaction is likely to replace face-to-face interaction, social opportunities are diminished. Then, a student's acceptance of the technology, self-commitment to education, and in turn satisfaction with the course may be compromised. Thus, the following hypotheses are offered:

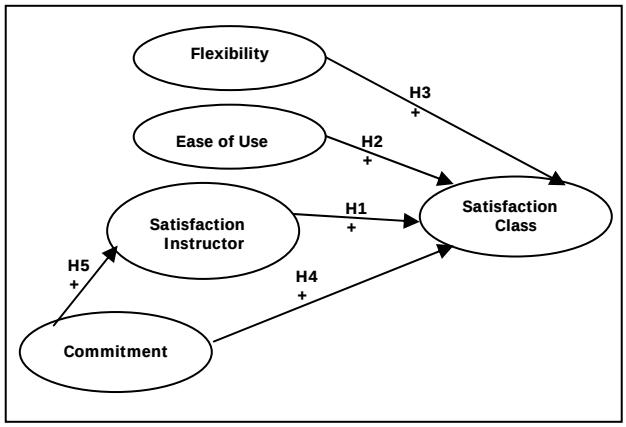
H4: Commitment is positively related to students' satisfaction with the course.

Sager and Johnson (1989)'s findings indicated that socialization and satisfaction with superiors are the primary correlates of commitment [45]. In a cross-cultural study of workers, it was revealed that commitment was strongly related to personal characteristics including socialization [46]. Burbach and Thompson (1971) and Dean (1961) revealed that students who engaged themselves in their studies, without leaving time for socialization (and/or a job) may earn very good grades, yet feel a sense of alienation from the school experience [47], [48]. Thus, while commitment has been shown to be strongly tied to social interaction it may be more of an antecedent to satisfaction with the course and instructor. Thus, the following hypotheses are conveyed:

H5: Commitment is positively related students' satisfaction with the instructor.

The TAM is one theoretical model that attempts to explain use of Web-based ERP-simulated technology in classroom environment. The hypothesized model presented in Figure 1 integrates variables from the TAM with variables traditionally thought to influence student satisfaction. The variables included from the TAM include: ease of use and flexibility. The attitudinal variables traditionally suggested to influence a student's satisfaction with a course includes: satisfaction with the instructor and commitment.

Figure 1: Hypothesized Relationships



III. Methodology

Initially, theoretical literature from various sources was reviewed to design a quantitative research framework. The target population for this study was undergraduate students enrolling in a business computer course conducted through a traditional in-class lecture with the use of web-based ERP-simulated system, the university's learning management system, and e-Mail system. These systems were used to handle interactive communication between an instructor and students and enhance administrative functions such as assigned reading materials, ERP-simulated interactive exercises, grade books, interactive multiple-choice questions for each chapter, general information about the course syllabus, assignment schedules, class policies and projects, and web-site links associated with assignments. A survey questionnaire assessing the constructs in the current study was developed from published scales of previous research as stated in the literature review. All of the scales were measured on a 5-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. The cross-sectional survey was conducted on the last day of the class on 30 April 2010. A total of 91 self-administrated questionnaires were distributed to all students in a business computer class at a university in Thailand and 83 of usable surveys were returned giving an overall response rate of 91%. The response rate was high, mainly due to the fact that the questionnaires were collected right after the respondents completed the forms on the last day of the class. Respondents were almost evenly split by gender, 50.6% were female and 49.4% were male. Based on age, 39% of respondents were 22 years old and another 34% were 21 years old.

IV. Results

Factor analysis was implemented to consider the underlying dimensions of the constructs. Maximum likelihood extraction with oblique rotation was employed to extract the factors because of interdependence among measures. As determined, when selecting eigenvalues greater than 1, five factors associated with each of the multi-item dependent and independent variables resulted. Coefficient alphas [35] range from .68 to .85 indicating that all of the scales were acceptable [31] [32]. Total variance explained by the 5 factors is 69%.

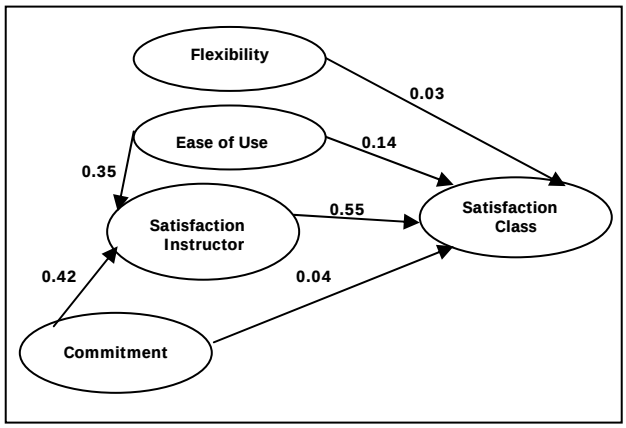
V. Structural Model

The significance of the relationships among the explanatory variables was determined by examining their t-values and standard errors. Relationships were tested using LISREL [36]. LISREL compares a specified model to a *pxp* covariance matrix incorporating all observed variables, testing for goodness of fit between the model and the matrix. The structural model identifies significant relationships between constructs. For the specified model, R^2 statistics and modification indices revealed that variation among constructs

for some paths proved to be statistically insignificant, while other paths were suggested that improved model fit.

The results of the structural model are presented in Figure 2, which indicates all significant relationships between constructs. The final model with suggested modifications revealed a chi-square of 258, with 219 degrees of freedom (p<.001). Although the goodness of fit statistics indicate a significant chi-square, the sample size and number of variables included in the model revealed that the chi-square statistic suspect [37], [38]. Because the chi-square statistic, along with other fit indices (i.e. GFI and AGFI), are subject to bias resulting from sample size [39] and degrees of freedom [40] additional comparisons were required. In this case CFI = .94, NNFI = .93, PGFI = 0.62, and RMSEA = .047 are within acceptable ranges [41], [42] suggests that a RMSEA value of less than .05 is indicative of close fit. Steiger (1990) suggests that a RMSEA value of less than .05 is indicative of close fit. MacCallum, et al. (1996) additionally recommend the use of confidence intervals (CI) to interpret RMSEA. A very narrow CI associated with RMSEA supports the interpretation of close fit. For this model, the 90% CI range is .014 to .069, a very narrow interval around the estimate.

Figure 2: Structural Model of Student Satisfaction in Web-based ERP-Simulated Learning Environments



Note: Significant paths (p<.05) between constructs are shown with standardized beta weights.

Fit Statistics
$X^2 = 258^{***}$, df = 219
CFI = 0.94
NNFI = 0.93
PGFI = 0.62
RMSEA = 0.047

Construct R2
Satisfaction Class = 0.45
Satisfaction Instructor = 0.40

As hypothesized, figure 2 indicates a positive and significant relationship between satisfaction with class and several of the hypothesized variables, satisfaction with instructor (B = .55, p<.001), ease of use (B= .14, p<.001), commitment (B = .04, p<.001), and flexibility (B = .03, p<.001). Ease of use is also shown to be positively related to satisfaction with instructor (Y = .35, p<.001). Commitment is positively related to satisfaction with instructor (Y = .42, p<.001).

VI. DISCUSSION

Consistent with Hermans et al. [18] and Marks et al. [20], the most significant relationship was found between satisfaction with the instructor and satisfaction with the class. This result points out that the higher the students' satisfaction toward the instructor, the more the students' satisfaction with the overall perceptions of the course. One explanation for the strong relationship may be found in the social interaction literature. The student populations, the ages of traditional students range from 18 to 24, show psychological measures of loneliness and depression [33] [34]. This is especially true for students who are in computer related field, spend more time online, or are teenagers [18]. Kanthawongs et al. [12] study reported that students who did not utilize web-based ERP-simulated classroom demonstrated significantly higher achievement than those who used the system. The main reasons of such lower performance appeared to be lack of social interactions. Then, the development of an "interactive course" might be the key to successful ERP in higher education offerings. An interactive course offering that encourages either real time or asynchronous communication between the student and the instructor may be necessary for maintaining student satisfaction [18]. Thus, although important technological trends such as ERP simulation open opportunities for universities especially in developing countries with limited resources to become users of ERP services in classrooms, the students' satisfaction with the instructor has proved to be the most important factor in web-based ERP-simulated learning environments.

Similar to Sager and Johnson (1989), Near (1989), Burbach and Thompson (1971) and Dean (1961), commitment is strongly related to satisfaction with the instructor [45], [46], [47], [48]. In this study, although there is a slightly positively relationship between commitment and satisfaction with the class, it is consistent with Frankola [28], Eom et al. [30], and Hermans et al. [18] that the more student's commitment to the web-based ERP-simulated class, the better their satisfaction with the class.

The researcher discovers a strong relationship between ease of use and satisfaction with the instructor. It shows attitudinal ideals in students' perceptions of the learning experience. Students are willing to interact with the instructor, but also want to insure that they can easily accomplish the expected work. The result suggests that perceived ease of use of the technology is one of important factors in satisfaction with the

instructor. Thus, the TAM is related to satisfaction with the instructor.

In accordance with Arbaugh [22] [23], a significant relationship between satisfaction with the class and ease of use was reported. In the context of integrating TAM with ERP in higher education, the results of this study confirm the findings from Gefen [24] and Pittarese [11]. This research shows that the more ease of use, the better students' satisfaction with the class. Therefore, ease of use has been a key factor in designing successful ERP-simulation software.

Previous research shows that flexibility "allowing course interactions to continue over time and through any interruptions" should attract a more competent type of student or a non-traditional student [27]. The results of the study confirm the literature that flexibility factor yields both independence and freedom for enhancing students' learning environment. Thus, the flexibility is necessary for developing and fostering the successful web-based ERP-simulated classroom.

VII. Implications, Conclusions and Recommendations

The implication of this study is that the web-based ERP-simulated learning environment provides more channels and opportunities for the instructor to interact with students. The use of online forum, assigned reading materials, ERP-simulated interactive exercises, and grade book foster "a community of learners" among the members of the class [18]. However, the study reveals that the solely online learning method might not be suitable for web-based ERP-simulated learning environment. This study guides university administrators, educators, practitioners, or software vendors of how to create satisfied learning and training environment for ERP in education. It also indicates that learners' satisfaction with the instructor, perceived ease of use, commitment, and perceived flexibility are respectively related to learners' satisfaction with the course. Moreover, the socialization and satisfaction with superiors are the primary correlates of commitment. Students are willing to interact with the instructor, but also want to insure that they can easily accomplish the expected work.

While this study is useful in providing support for previous literature in addition to some new findings, it also reveals several limitations. The sample size is only from one course and one university. Clearly, this study should be replicated at other universities and other similar ERP courses to validate and compare the results in different contexts. Further studies can extend the hypotheses and the proposed model to determine what other factors are likely to affect student satisfaction.

As long as the global adoption of ERP continues to rise, the demand for ERP literate graduates persists. The use of ERP simulation provides universities with limited resources to become users of ERP services in classroom environment and allows business graduates to understand and align business goals with technical strategies and support the organization's current and future needs. However, in light of the growing needs for ERP education with different technological trends, the relationship between the learners and the instructors should be taken into an account.

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