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THE RELATIONSHIPS BETWEEN THE FACTORS OF A TOE FRAMEWORK AND STUDENT ERP SYSTEMS LEARNING: A CURRICULUM DEVELOPMENT CASE

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ABSTRACT

Aim/Purpose	The purpose of this study is to propose a curriculum development model for the integration of technology, organization, and environment (TOE) framework into enterprise resource planning (ERP) systems education. The study investigated the relationships between the three factors of the TOE framework and student learning outcomes from their ERP systems study.
Background	As the demand for ERP systems grew and spread to diverse organizations, educational institutions have attempted to integrate the ERP systems into their curriculum. Yet, lacking a conforming framework to the systems results in a considerable gap between the integrated curriculum and student learning outcomes. A pedagogical framework to bridge the gap between educators and students is needed for the ERP systems education.
Methodology	The study identified eight propositions from literature reviews and conceptualized a model with corresponding constructs to the propositions. The constructs comprise the seven predictor variables from the TOE contextual factors and one predictive variable for student learning. These constructs provide more details on the TOE factors and eight survey questions in the study. The study analyzed 133 survey responses of four semesters with a SPSS multiple linear regression.

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Contribution	The study contributes to the emerging body of ERP systems education and research by integrating the TOE framework to the technology curriculum development. The study model provides a structured approach for the selection of appropriate pedagogical contents to achieve a variety of student learning outcomes.
Findings	The findings of the study indicate the use of the TOE framework enhances student learning of ERP systems. All the three factors of the framework were found to be statistically significant predictors in the ERP systems learning. The eight propositions depicting the relationships between the seven constructs of the TOE factors and student learning outcomes are all supported.
Recommendations for Practitioners	The study recommends a practical guideline to ERP systems educators to utilize the TOE framework in their curriculum development. The guideline is aligned with typical teaching objectives for ERP systems courses.
Recommendations for Researchers	Further studies are necessary by various scholars who have noted limited research pertaining to ERP systems and information technology education. The TOE framework demonstrates a practical application of a proven theory to student learning outcomes as a feasible approach to deliberate the use of the systems education and research.
Impact on Society	This study will have a valuable impact on educators for their technology curriculum development and software vendors for their investment decisions on enterprise-wide system products.
Future Research	Relying solely on student self-reported survey responses may be prone to response bias. For future work, researchers can extend this study and undertake similar research to empirically validate the efficacy of various teaching practices for student ERP systems learning. This could include objective measures of student learning by qualitatively coding behaviors at student project meetings or from hands-on ERP system exercise results.
Keywords	ERP systems education, technology factor, organization factor, environment factor, student learning outcomes

INTRODUCTION

Business education has been facing continuous changes in the business environment and needs to enhance both business and information systems curricula. While the business environment requires knowledge workers who can recognize problems and generate solutions that cut across functional areas within an organization and its external partners, business programs and curricula in higher education are based on individual disciplines (Porter & McKibbin, 1988; Rynes & Bartunek, 2013; Weber & Englehart, 2011). Business school educators need to provide a cross-functional view of business and develop interdisciplinary pedagogy with integrated information systems for students (AACSB, 2019; Le & Lehmann, 2016; McHaney et al., 2015). In line with this need, business curricula have been placing more emphasis on interdisciplinary characteristics of business operations such as business analytics, supply chain management and communications with colleagues and partners.

Many business schools invested a significant amount of resources to launch the integrated curricula and teaching tools (Fedorowicz et al., 2004; Hepner & Dickson, 2013; Mandai & Flosi, 2012; McCann & Grey, 2009). Integrating ERP systems into the curriculum would be beneficial to business students as well as their future employers. Hardcastle (2015) suggested that many employers are interested in recruiting a team of interdisciplinary ERP systems staff with different majors such as ac-

counting, information systems and supply chain management. The business disciplines and ERP systems education have received much attention in this respect resulting in curriculum change. The ERP systems education has been lacking for a guiding framework for educators to develop integrative business and technology curriculum (Iriberri et al., 2015; Lee et al., 2002; Ruhi, 2016). The lack of a practical framework results in a considerable gap between the curriculum and student learning outcomes. A pedagogical framework to bridge the gap between educators and students is needed. However, bringing ERP systems to business education without a bridging framework is an emerging challenge for educators and researchers. The technology, organization, and environment (TOE) framework could be used to facilitate the challenge by bridging the gap. The framework has been available for technology adoption studies in different technologies (Baker, 2012), including ERP systems (Awa et al., 2017; Gutierrez et al., 2015; Ramdani et al., 2009), web applications (Oliveira & Martins, 2011) and cloud computing (El-Haddadeh, 2020). This study investigated the relationships between the TOE factors and student learning outcomes and recommends a practical guideline to ERP systems educators in their curriculum development.

STUDY BACKGROUND

ERP systems were introduced to address fragmented legacy systems in organizations by integrating all business functions into a single system with one source of the right information (Muscatello & Chen, 2008; Ruivo et al., 2017). Making the right information available to the right people can create value and reduce costs to help the organizations make good decisions in managing the information productively across business partners (Cachon & Fisher, 2000; Shuai et al., 2007). Since 1990s, ERP systems have been adopted by many companies worldwide. Over the years, ERP systems have continued to evolve due to changing business requirements (McGaughey & Gunasekaran, 2007; Oliveira & Martins, 2011). The evolution has led to a high demand for ERP system adoptions in applying business opportunities and solutions to complex problems (Wilson, 2019). As the demand for ERP systems grew and spread to diverse types of organizations, it has become important to integrate the systems into the curriculum in higher education. Business schools have been aware of the ERP systems and employers' needs, and subsequently preparing their students with required systems skills and competencies. This will enable students to get employment they aspire to and continue to remain of relevant to the business (Hepner & Dickson, 2013; Klima et al., 2014). The job market for professionally trained ERP systems specialists in business has motivated both business schools and ERP systems vendors to form alliances for the benefits of students and organizations (Hepner & Dickson, 2013; Iriberri et al., 2015). Recent studies reported many organizations have been recruiting all levels of ERP systems specialists with different skills which are derived from the TOE factors for their ERP system adoptions (Mahdavian & Mostajeran, 2013; Ruhi, 2016).

This study explores the feasibility of integrating both the TOE framework and ERP systems into business education. The TOE framework contextually comprises technology, organization and environment factors to enhance organizational processes for ERP systems adoption (Ramdani et al., 2009; Tornatzky & Fleisher, 1990). The technology factor (TechFac) is related to the internal (e.g., functional applications) and external (e.g., Internet) technologies, and technology adoption processes (Bharathi & Parikh, 2012; Oliveira & Martins, 2011). The organization factor (OrgFac) is related to the company's culture, resources, and assets such as the company's size, hierarchy, procedures, administrative structure, human resources and connection between business processes (Chong et al., 2009; Elmeziane & Elmeziane, 2012). The environment factor (EnvFac) is affected by market characteristics such as industry composition, competition, economic situation, ERP systems vendors and government policies (Oliveira & Martins, 2011; Wu & Subramaniam, 2009). The TOE framework indicates that the adoption behavior of ERP systems should be divided into the three contextual factors (Bradford et al., 2014; Schniederjans & Surya, 2013; Walther et al., 2018). These factors have been key aspects for organizations to implement ERP systems, and the framework could be used to guide technology curriculum development.

In ERP system education, the technology acceptance model (TAM) and experiential learning theories were previously used to integrate the system to student learning (Alshare & Laney, 2011; Ruhi, 2016). This study perceives pedagogical shortcomings with an incipient aspect from the TAM's usefulness and ease of use (Davis, 1989), and with a limited scope of the experiential learning for conjectural conceptualization and experience (Kolb, 1984). Students would need to understand different aspects and broad scopes of technological topics (e.g., business processes, technologies, and people involvements) in every stage of the system implementation process. A comprehensive framework for business and technology curriculum was required to make up for the shortcomings and reduce the gap between educators and students. The integration of the TOE framework and relevant factor skills could be a proper approach to develop the ERP systems curricula. An introductory level of ERP system course in this study were developed from the three TOE factors, which has seven objectives for students to learn ERP systems with seven skills derived from the TOE factors.

The seven course objectives could help students learn technologies, organizational strategies, and business environment of an ERP system. This study identified the TOE factor skills to establish the course objectives, and student learning outcomes were developed for students to obtain and build up confidence in and adapt to the seven skills for the future (Andrew et al., 2018; Hepner & Dickson, 2013). Due to the evolving nature of the ERP systems study, the relationships between the course objectives and student learning outcomes were introduced to students by instructors in the first class day of each semester. The importance of understanding the relationships was repeatedly explained to the students almost every class day before discussing specific class topics for the day. Also, the three TOE factors and relevant skills have been in part of the course exam questions. The study aims to find out that students were able to grasp the big picture of ERP systems and gain consequential benefits from their learning. For the investigation the seven skills were mapped into the seven course objectives and corresponding TOE factors as stated in the course syllabus below.

1. Best practices in business transformation for an organization with an ERP system (OrgFac)
2. Importance of IT infrastructure for the organization to successfully implement an ERP system (TechFac)
3. Evaluation and implementation of ERP systems for the organization (OrgFac)
4. Impact of an ERP system implementation on business processes for the organization (OrgFac)
5. An integrated strategy for managing information among the organization, its suppliers and customers (EnvFac)
6. Familiarity with the basic functionalities of SAP ERP system (TechFac)
7. ERP systems trends to expand their capabilities for business analytic, cloud computing, supply chain management (SCM), and other new technologies (EnvFac)

DEVELOPMENT OF RESEARCH QUESTIONS

This study attempted to develop a conceptual model for the integration of a holistic TOE framework into ERP systems education. To understand existing ERP system curriculum developments, the study conducted a systemic literature review. The review included a combination of applicable theories from business management education (Brown & Robin, 2017), ERP systems education (Kolb, 1984; McCarthy, 2016; Ruhi, 2016), experiential learning (Caza et al., 2015; McCarthy, 2016), interdisciplinary pedagogy (Ducoffe et al. 2016; Nisula & Pekkola, 2019), and technology adoption (Bharathi & Parikh, 2012; Davis, 1989; Oliveira & Martins, 2011), The next eight propositions for the model development follow from further discussions of the relationships between the course objectives and student learning outcomes.

An ERP system comprises an integrated set of software and facilitates organizational processes for business values (Heredia-Calzado & Durendez, 2019; Markus et al., 2000). This set usually includes business functional applications called "modules" such as asset management, financial accounting and controlling, sales and distribution, materials management, production planning, and execution

processes. Each module is a business process that incorporates the industry's best practice and provides ERP system users with access to a single source of real-time data for business functions (Caglio, 2003; Dezdar, 2012). With the integration of these fundamental modules using the same data, an organization can adopt a wide variety of best practices and enhance existing business processes of the organization (Cronan & Douglas, 2012). For example, Coach Manufacturing, Hewlett-Packard, Bristol-Meyer and Baylor College of Medicine (Americas' SAP Users' Group [ASUG], 2020; Panetto & Cecil, 2013) counted on their ERP systems to facilitate business integration, interoperability, development and improvement. In fact, a multinational software vendor and researchers together have developed an ERP system not only to standardize the existing business processes of the implementing organization but also to bring in the best practices of the industry for the organization (Sudhaman & Srinarayan, 2016; Wagner & Newell, 2004). Using an ERP system, students can learn what best practices mean in business and how an organization can execute business operations in an efficient and standardized way. Investigation of the organization factor that can provide opportunities for business transformation with an ERP system is both informative and necessary. Proposition 1 follows from this discussion (P1):

P1 The TOE framework helps students understand best practices in business transformation for an organization with an ERP system.

An ERP course has been offered for students to understand what the ERP system is and how the system can be used to meet business objectives for an organization with its business partners. Students learn how a large system has been configured to support the organization with multiple functions and divisions across its supply chain. ERP system infrastructure (e.g., database, hardware and software) is a technology factor. From the technology factor students learn the configured system and relevant technologies as fundamental topics in ERP systems education (Somers & Nelson, 2004; Van Oosterhout et al., 2006). The technology factor can affect ERP systems adoption options (e.g., cloud or onsite) and selections of system packages (Gupta et al., 2019). Importantly, an ERP system entails a substantial investment in IT infrastructure for an organization. The IT infrastructure is one of the most important technology components required for an ERP system adoption. Its investment has been a major part of organizational requirements to address its business opportunities and solutions. Decision making for an ERP system implementation is also addressed through a cross-functional view of an organization and an extension toward the infrastructure for the organization's capabilities and competitiveness (Chung et al., 2011; Rodríguez et al., 2020). ERP systems education helps students understand the capabilities of business innovation with IT infrastructure in the organization. The organizational and technology implications explain the relationship between IT infrastructure, ERP system implementation and business operations for the organization. Proposition 2 follows from this discussion (P2):

P2 The TOE framework helps students understand the importance of IT infrastructure for the organization to successfully implement an ERP system

Given that ERP systems by their nature are complex, it is vital that an ERP system course establishes a pedagogical structure that facilitates learning as students use and evaluate such a system. Students need different types of knowledge that are essential for using the ERP system: business knowledge, product knowledge, technical knowledge, vendor knowledge, and project management knowledge (Chan & Rosemann, 2001; Soja, 2015). The systems education helps students know how to evaluate and implement an ERP system for an organization, and the impact of the system on business processes in the organization. Students learn the need of selecting good ERP system vendors and maintain a long-term relationship with them, as the life span of an ERP system is substantial, given a 10 to 16 year investment (Claybaugh et al., 2021). The ERP system also helps students learn how to share their knowledge about the power of integrated business processes in the organization and with its partners across the supply chain. The students learn a variety of ERP system implementation strategies (e.g., big bang or phased approach) with project management software (e.g., SAP solution manager). Business organizations around the world have considered the use of these systems as an

integral means to maintain their competitiveness. However, an ERP system is a "lock-in" suite of business applications with the organization which will experience unforeseeable challenges when it must continue to invest in following system upgrades and enhancements (Narasimhan et al., 2009). Proposition 3 follows from this discussion (P3):

P3 The TOE framework helps students know how to evaluate and implement ERP systems for an organization.

ERP systems allow organizations to manage their business with proven benefits of improved process efficiency, reduced inventories, better data/information sharing and customer services, and increased profit margins (Fan & Fang, 2006; Nwankpa, 2015; Yang & Su, 2009). Recent studies suggested that ERP systems have been credited with reducing order cycle times, resulting from improved customer service and supply chain management (Hwang & Min, 2013; McAfee, 2002). In view of these benefits, it is easy to observe why ERP systems have been implemented as one of the most remarkable developments in the world and the most accepted standard business software of the last two decades (Dezdar & Ainin, 2011; Muscatello & Chen, 2008). While ERP systems implementations in some organizations were successes, there were also different circumstances where implementations were failures, particularly in terms of target dates and project costs. Prior research identified organizational antecedents like top management support, project management, process design, change management, user training and IT alignment with business strategies (Delone & McLean, 2003; Dezdar & Aimin, 2011; Saade & Nijher, 2016). An ERP system helps an organization integrate all its resources to improve its operational performance and enhance its competitiveness (Elsayed et al., 2021; Law & Ngai, 2007). In the end, the organization will be able to realize the benefits that come with the system implementation. Students learn the organizational benefits, the, importance of business process reengineering, and change management efforts from the successful system implementation. Proposition 4 follows from this discussion (P4):

P4 The TOE framework helps students know the impact of an ERP system implementation on business processes for the organization

An ERP system is a software package that provides the ability for integrating all the information flows throughout business functions and processes in the organization (Davenport, 1998; Kumar & Thapliyal, 2010). A typical ERP system shares a single source of transactional data, manages cross-functional processes, applies consistent business rules, and helps an organization adopt standard operating processes including manufacturing, accounting, marketing, sales, human resources, and logistics (Harrast et al., 2014; Jacobs & Weston, 2007; Kumar & Thapliyal, 2010; Léger et al., 2011). All data generated throughout the organization are accumulated to one database and made available to every function on a real-time basis. This alleviates inefficiencies associated with redundant data and communication lags and provides a foundation for integrated information system functions and business processes within the organization and across supply chain partners (Pang et al., 2019; Jacobs & Weston, 2007; Schlichter & Kraemmergaard, 2010; Scott & Vessey, 2002). An ERP system enables an organization to share common information by providing internal and external partners with a single database and technical platform. For the organization this information sharing can contribute to shortening product development cycle times and improve customer services. The one source of data is viewed as a key component of the ERP system to deal with competitions, because the organization can establish an integrated business strategy in its rapidly changing environment with the system. Proposition 5 follows from this discussion (P5):

P5 The TOE framework helps students know how an ERP system represents an integrated business strategy for managing the one source of common data within an organization and across its business partners.

ERP systems have been mainly introduced to conduct key business processes and functions in a standardized way for organizations. To a large extent, most of them have succeeded in conducting

their businesses in that way. Students going into industry need to understand what business functional and technology features of an ERP system can do their jobs for an organization. They can learn the system from a theoretical point of view and hands-on interactions with functional modules of the system. In the effort to aid the students' understanding of a process-oriented organization and cross-functional integration with an ERP system, the course in this study incorporated various pedagogical practices into the curriculum, including various organization theories, case studies (Venkatesh, 2008; Winkelmann & Leyh, 2010), and hands-on exercises with a SAP system (Jaeger et al., 2011; Pridmore et al., 2014; SAP, 2014). This learning experience with the technology features and functional modules enables the students to learn process-driven operations and a configured ERP system to the business processes. The hands-on laboratory exercises can include a business case with a list of procedural steps that are required to configure business processes offered by the system or to commit transactions on it. ERP systems educators have been offering the students these exercises as a viable teaching practice (Baumgartner & Shankararaman, 2014; Monk & Lycett, 2016; Stevenson, 2015). The practice is an effective complement to traditional lecture sessions (Baumgartner & Shankararaman, 2014). All the practical exercises can help the students build up their confidence with the business and technology features of ERP systems. Proposition 6 follows from this discussion (P6):

P6 The TOE framework helps students become familiar with the basic functionalities of ERP systems from theory to hands-on practical exercises.

The future trend of ERP systems is a variety of wide-open topics for technology, organization and environment implications. Two of the recent trends are cloud computing and business analytics. Cloud computing has possibilities to change greatly the way IT services are delivered to customers. Cloud computing is defined as both the applications delivered over the Internet as services and the hardware and systems software in the data centers that offer those computing services (El-Haddadeh, 2020; Grubisic, 2014). These IT services are referred to as a web delivery model called software as a service. Two other models of cloud computing services are infrastructure as a service and platform as a service. More recently, some ERP vendors have moved some of their offerings to the cloud (e.g., SAP Business ByDesign). However, there is still a lot to be done for customer organizations to see more services and application suites moving to the cloud (Walther et al., 2018). Another recent trend with the ERP systems focuses on how to support decision making processes, as well-informed decisions can have far-reaching consequences, affecting almost all business aspects. Decision making is only considered successful when it is measured with success indicators (e.g., effectiveness) that were initially set (Beyer & Trice, 1982; Nutt, 2008). Improving decision making requires high quality data (e.g., accurate, timely and relevant data) and proper analytical skills (Ghasemaghaei et al., 2018; Sukumar & Ferrell, 2013; Waller & Fawcett, 2013). In addition, a new trend in decision making is to involve business analytics (BA) with ERP systems. BA is closely related to improved decision making for business strategies. This study advocates an established BA definition in which BA is concerned with evidence-based problem recognition and solutions within the context of business situations (Holsapple et al., 2014). Major software vendors such as IBM and SAP believe that BA is likely to make a major contribution to organizational performance in the coming decade (IBM, 2021; SAP, 2020). Integrating the BA applications into an ERP system for the decision-making process has been a much-anticipated improvement for business education. Proposition 7 follows from this discussion (P7):

P7 The TOE framework helps students understand technology trends to expand ERP capabilities in the changing business environment.

The ERP systems course in this study facilitates students' ability to understand what an ERP system is, and how and why the system is used for an organization. Students learned how the configured system supports an organization with multiple functions and processes across its internal value chain and external supply chains. ERP systems technology trends for business operations and decision-making improvement are addressed through studying the systems use and related sources of data for organizations and their business partners. TOE framework facilitating the student learning of the

ERP systems is discussed with the first seven propositions reflected on the seven course objectives as stated above. The course objectives mapped to the TOE factors could help the students improve their learning of the system and prepare them for their future. Each proposition above is presented to help students understand both business and ERP systems as a whole. The students would be able to learn ERP systems and build up their confidence in the technology for their professional careers with technological, organizational, and environmental perspectives (Caza et al., 2015). The study posits positive relationships between all the seven independent constructs (from P1 to P7) and a dependent construct for student learning outcomes. In this context, proposition 8 on student learning outcomes follows from this discussion (P8):

P8: The TOE framework helps students understand the relationships between the factors of organization, technology and business environment from their ERP systems study

Using the eight propositions above, this study proposes a model to examine the relationships between the three TOE factors and student ERP systems learning. Table 1 depicts a summary of the propositions, research questions and the contextual factors in the study.

Table 1: Propositions, Research Questions and TOE Contextual Factors

PROPOSITION	RESEARCH QUESTION	TOE FACTOR
P 1	The TOE framework helps students understand the best practices in business transformation for an organization with an ERP system.	OrgFac
P2	The TOE framework helps students understand the importance of IT infrastructure for the organization to successfully implement an ERP system.	TechFac
P3	The TOE framework helps students know how to evaluate and implement ERP systems for an organization.	OrgFac
P4	The TOE framework helps students know the impact of an ERP system implementation on business processes in the organization.	OrgFac
P5	The TOE framework helps students know how an ERP system represents an integrated business strategy for managing the one source of data within an organization and across its supply chain partners and customers.	EnvFac
P6	The TOE framework helps students become familiar with the basic functionalities of ERP systems from theory to hands-on practical exercises.	TechFac
P7	The TOE framework helps students understand technology trends to expand ERP capabilities in the changing business environment.	EnvFac
P8	The TOE framework helps students understand the relationships between the factors of organization, technology and business environment from their ERP systems study.	Student Learning Outcomes

RESEARCH METHOD AND DATA ANALYSIS

This study operationalizes testing TOE framework factors and student learning with a deductive approach (Saunders, 2012). In line with the approach the study identified eight propositions, from a careful review of literature, and conceptualized a model with corresponding constructs to the propositions. The constructs comprised seven independent (or predictor) variables stemmed from the

TOE factors and one dependent (or predicted) variable for the student learning outcomes. The study conducted a series of surveys on the eight constructs for the propositions from ERP systems students for past four semesters. The survey consisted of eight research questions with student major and gender information, and other information was not requested in order to ensure anonymity and confidentiality for each student. It is likely that each respondent had a different perception of ERP systems as opposed to other IS/IT topic studies**.** Such a different perception may emanate from the fact that an ERP system is integrated to various business functions of an organization such as sales, purchasing, accounting, and production. The first seven questions, designed to evaluate the seven constructs, reflected on the TOE framework for the ERP systems course described earlier. The eighth question was the student learning outcomes for the eighth proposition. In order to make an inference on the findings, this study examined the relationships between the seven constructs and student learning outcomes (Locke, 2007). The Appendix shows the survey as given to the students.

SAMPLE

The survey was distributed to eight cohorts of undergraduate business students during their last ERP systems class day of each semester for the past two and a half years. The introductory 300 level course was offered mainly to junior students every regular semester for a period of 15 weeks with one or two sections of which each was allowed to have a maximum of 25 enrollments. 133 students out of a total of 142 participated in the surveys, giving a response rate of 94%. This high response rate and overall average of student learning outcomes (P8) imply most of the students were strongly interested in following the ERP systems course objectives derived from the three TOE factors (Fosnacht et al., 2017). All of them were enrolled in the same course for the past four semesters at the same business school. Similar teaching materials and instructions were used in the classes.

Table 2: Student Survey Raw Data for Likert Scores

# of Participants	Proposition #	Information Systems Major			Other Business Majors			Overall		
		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
132	P1	4	7	6.1	4	7	5.9	3	7	6.0
133	P2	5	7	6.1	4	7	6.1	4	7	6.1
131	P3	4	7	6.1	4	7	5.9	4	7	6.0
131	P4	4	7	6.2	4	7	6.1	3	7	6.1
133	P5	4	7	6.1	4	7	6.1	4	7	6.1
132	P6	4	7	6.2	4	7	5.9	4	7	6.1
131	P7	5	7	6.1	4	7	6.1	4	7	6.1
132	P8	5	7	6.2	4	7	6.1	4	7	6.15
Overall		4	7	6.14	4	7	6.02	3	7	6.08

Among the respondents 73 (55%) of them were information systems students who are more interest in studying the ERP systems technology to support organizational businesses. All the others (45%) were a combination of accounting, marketing and supply chain management major students whose study interests are how to use the systems for studying real business operations. However, the response patterns from these two group of students were very similar as shown in Table 2. The survey questionnaire asked the respondents to indicate the extent to which they achieved the seven course objectives derived from the TOE factors. Their learning outcomes were measured with a seven-point Likert scale ranged from "1" for strongly disagree, "2" for moderately disagree, "3" for slightly disagree, "4" for neither agree nor disagree, "5" for slightly agree, "6" for moderately agree, and "7" for strongly agree as shown in the Appendix. Tables 2 shows the student survey raw data for the study.

ANALYSIS

One of the important entities in the study was a unit of analysis which represented each individual student learning from the ERP systems course. Previous studies suggested that the unit of study is a main entity in the study of learning (Alexander et al., 2009; Babbie, 2012). First, the data was tested for construct reliability by measuring the Cronbach alpha's internal consistency coefficient. This measure can determine how a set of the constructs are related as a group. The Cronbach's alpha value of 0.7 and above is the generally accepted level for the reliability test (Nunnally, 1978). The alpha values of all seven constructs (P1 - P7) were above 0.8 and accepted for the reliability test. Then the same data was analyzed with a SPSS multiple linear regression to examine the relationships between the seven constructs and student learning outcomes from their ERP systems study (P8). The observed p-value of 0.001 and adjusted R^2 of 0.848 indicate the group of the seven independent variables showed a significant relationship with the dependent variable. Table 3 depicts the regression model fit with the constructs.

Table 3: The Linear Regression Model Summary

R	R SQARE	ADJUSTED R SQUARE	STD. ERRORS OFTHE ESTIMATE	R SQUARE CHANGE	F CHANGE	DF	SIG. F CHANGE
0.925 *	0.856	0.848	0.257	0.856	105.824	7	0.001

Predictors: P1, P2, P3, P4, P5, P6, P7

All the seven independent variables were significantly correlated with the student learning outcomes. The correlation between the constructs is below 0.085 constructs as reported in Table 4, ruling out multi-collinearity (Bagozzi & Yi, 1988). This indicates each construct variable in the model was linearly predicted for the student learning outcomes from the others with a substantial degree of accuracy.

Table 4: Descriptive Statistics and Correlation Matrix

PROPOSITION	**MEAN**	**SD**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**
P1	6.0	0.83	1						
P2	6.1	0.76	0.57***	1					
P3	6.0	0.87	0.56***	0.42***	1				
P4	6.1	0.83	0.54***	0.51***	0.52***	1			
P5	6.1	0.81	0.42***	0.53***	0.47***	0.46***	1		
P6	6.1	0.80	0.51***	0.51***	0.54***	0.54***	0.50***	1	
P7	6.1	0.87	0.47***	0.34***	0.37***	0.36***	0.26***	0.46***	1

*** p-value < 0.001

EVALUATION OF RESULTS

This study examined the seven skills of the three TOE factors for the seven course objectives and student learning outcomes. The analysis of the study results indicated the significance of the TOE

framework which reflected on the survey questionnaires. The seven skills for students were stated in the course syllabus and reflected on the eight questions in the survey. The first seven propositions were reported with positive coefficients of the seven independent variables as shown in Table 3. The results revealed that the framework operationalized relationships between the course objectives and student learning outcomes, and the relationships increased student confidence in studying the ERP systems as reflected on Table 2. The finding implies that student evaluation of the TOE framework was dependent on their attitude and interest attributes to learn the ERP systems. Alshare and Laney (2011) suggested that students' confidence to learn ERP systems affects their attitude and interest in their systems study. The two attributes from the ERP systems study to their learning outcomes seems related to the 94% high response rate (Rogelberg et. al., 2001).

The analysis results showed all three factors of the TOE framework were significant predictors in ERP systems learning outcomes for students. All eight propositions depicting the relationships between the seven constructs of the predictors and student learning outcomes were all supported. This suggests that students enjoyed their ERP systems study with positive attitudes and strong interests and believed that learning the system would be relevant to their professional careers and increase their employability (Andrew et al., 2018; Ruhi, 2016; Teach, 2016). Also, observing high grades of student course and instructor evaluations for the ERP systems course by the university every semester, this study found out both the course theories and student hands-on SAP system experience enabled them to understand process-oriented operations and configured systems. Especially, from the hands-on lab exercises they could follow a list of procedural steps to enter business transactions on the system. Their attitudes and interests have mirrored the same student evaluations for the past four semesters with high levels of grades ranged from "B-" to "A." Consistently, a majority of students commented their perceptions of the course experience positively to match with their evaluation grades such as "well organized with theories," or "gained comprehensive knowledge." The student evaluations and comments have the potential to contribute to ERP systems course development by providing relevant information for reflection on teaching and learning (Conley et al., 2016; Darling-Hammond et al., 2012). The analysis of student learning outcomes indicated the students were well prepared with a set of skills stated in the course objectives and will be able to contribute to their future organizations from their learning. Table 5 provides more details with positive coefficient beta values to corresponding propositions supported by the regression analysis.

Table 5: Survey Analysis Results of TOE Framework and Student Learning Outcomes

TOE FACTORS FOR ERP SYSTEMS EDUCATION (PROPOSITION #)	STANDARDIZED COEFFICIENT BETA	SIGNIFICANCE *** P-Value < 0.01	PROPOSITION SUPPORT (Y/N?)
The TOE framework helps students understand the best practices in business transformation for an organization with an ERP system (P1)	0.211	0.000	Yes
The TOE framework helps students understand the importance of IT infrastructure for the organization to successfully implement an ERP system (P2)	0.178	0.000	Yes
The TOE framework helps students know how to evaluate and implement ERP systems for an organization (P3)	0.160	0.000	Yes

TOE FACTORS FOR ERP SYSTEMS EDUCATION (PROPOSITION #)	STANDARDIZED COEFFICIENT BETA	SIGNIFICANCE *** P-Value < 0.01	PROPOSITION SUPPORT (Y/N?)
The TOE framework helps students know the impact of an ERP system implementation on business processes in the organization (P4)	0.127	0.007	Yes
The TOE framework helps students know how an ERP system represents an integrated business strategy for managing the one source of data within an organization and across its supply chain partners and customers (P5)	0.188	0.000	Yes
The TOE framework helps students become familiar with the basic functionalities of ERP systems from theory to hands-on practical exercises (P6)	0.213	0.000	Yes
The TOE framework helps students understand technology trends to expand ERP capabilities in the changing business environment (P7)	0.182	0.000	Yes
The TOE framework helps students understand the relationships between the factors of organization, technology and business environment from their ERP systems study (P8)		0.000	Yes

DISCUSSION

The seven course objectives are for student learning about an ERP system implementation to understand technologies, organizational strategies, and business environment. Relating the TOE factor skills to their learning, they could acquire and build up confidence of, and adopt the seven skills for their future professional careers. This study investigated the relationships between the three TOE factors and student leaning outcomes. The findings highlight the key role of the framework to achieve the seven course objectives in student learning. The students in the study rarely had ERP systems experience as the course was named "Introduction to ERP Systems," and were judged to be more competent in their learning from the systems classes. Their class experience played a central role in experiential learning which is suggested as the process whereby knowledge is created through the transformation of theories and practices in learning (Kolb, 1984; McCarthy, 2016; Ruhi, 2016). Students' hands-on ERP systems experiences could provide them the ability to improve their technology skills while they are also equipped to adapt to their future business organization and environment. Untener et al. (2015) also suggested that students will be well prepared to enter industry through the pedagogy that provides them the ability to apply their experience and skills to their work environments. The students can increase the capabilities of their future business organizations and impact the success of the organizations. Due to the significant investments made in ERP systems and increase of the systems use throughout functional areas by most organizations, students with ERP systems education will be valuable to their employers (Scholtz et al., 2012; Surendran et al., 2006).

The study results show significant evidence that the TOE framework is an effective theoretical tool to facilitate the introduction of ERP systems in education. In order to increase students' interests and thereby maximize their ERP systems learning, educators must ensure that students' attitudes in class are positive toward the ERP systems by highlighting its usefulness and facilitating instructional efforts. The study indicates sufficient hands-on exercises help students be familiar with the ERP systems. The findings imply that students believe that learning the ERP systems provide them with tangible benefits to their programs of study and employments and will make a good amount of effort to accomplish the course objectives.

An ERP systems course should appeal to students' interests in the subject, and clearly state course objectives, and content and learning outcomes. In particular, the seven course objectives organized around a proven theoretical framework (e.g., TOE) can have an impact on students' perceptions regarding the usefulness of the ERP systems. The course contents can include practical theories, laboratory exercises and case studies that help students learn the system in a business context. Students will work harder to learn ERP systems if they believe the practical exercises help them meet their expectation from the system. The students' perceptions of the ERP systems can collectively affect their classmate attitudes for their learning. They will be able to build up their confidence in applying what they have learned from the class and be well prepared for their professional careers (Caza et el., 2015). To increase student relevance to ERP systems learning, instructors can enhance the course contents to help the students better understand real business practices. Above all, further studies are necessary by various scholars who have noted a dearth of research pertaining to ERP systems and information technology education (Alshare & Lane, 2011; Cronan & Douglas, 2012; Eden et al., 2014; Nisula & Pekkola, 2019). In the context of ERP systems course offerings, the TOE framework of this study can apply to other student learning with integrated information technology in their business studies. The findings of this study depict an insight that the three key factors of the TOE framework positively influence student learning outcomes from their ERP systems study. Overall, this study provides some evidence for educators to explore the use of existing frameworks for their curriculum development.

LIMITATIONS AND FUTURE RESEARCH

There are several limitations to this study that should be acknowledged, along with many avenues for future research. First, the validity of the measures of each construct should be further scrutinized in the specific context of technology education, given that they originate from the field of technology adoption in organizations and have therefore been developed in the context of business environments. The fact that all the ERP systems students who participated in the study had no previous ERP systems-related work experience before enrolling in the course somewhat alleviated the concern about their learning and its applicability to their future uses in business. However, further validation on their previous experience with ERP systems is necessary. Similarly, this is the first quantitative attempt to operationalize the TOE factors in ERP systems' education with a set of the factor variables, and the measures available to this study were limited.

One of the measures could be exploratory factor analysis on associated constructs for representing each course objective of the ERP systems course. Second, qualitative research methods could also be employed to gather observational data allowing for a deeper examination of the seven objectives underlying the three TOE framework factors. This could include objective measures of student learning outcomes by qualitatively coding behaviors in student project meetings or analyzing hands-on ERP systems exercise results. Third, the relatively small sample size in the study also limited the statistical power of the data analysis and restricted this study from conducting an accurate confirmatory factor analysis on the variables of interest. Larger samples in future research will help to provide construct validity for the application of these constructs in the context of ERP systems education. In general, larger and more diverse samples will not only enhance statistical power but also provide clearer evi-

dence for the validity and causality of the relationships between the constructs explored here. For future research directions, educators and researchers can extend this study and undertake similar research to empirically validate the efficacy of various teaching practices for student ERP systems learning. Relying solely on the student self-reported survey responses may be prone to response bias. Finally, when the students start understanding the ERP systems applications and processes of the business organizations, they begin transforming from novices to business professionals diminishing the boundary between their learning and the workplaces (Nisula & Pekkola, 2019). The research could consider whether the TOE factor variables and student learning from their ERP system studies are related to the performance of business alumni in their business environments.

CONCLUSION

This study demonstrates supporting evidence for the relationships between the TOE factor skills, and ERP systems course objectives and student learning outcomes. Understanding the relationships is one of essential steps to see the big picture of ERP systems with their various benefits. The benefits that accrue from the systems studies to the business schools create a better and more practical learning environment for students. There is still a noticeable gap between educator's offerings and student learning outcomes in the technology curriculum. Incorporating a comprehensive technology adoption theory and applications into business school curricula for the ERP systems education is a worthwhile undertaking to address the gap. It requires suitable restructuring of teaching practices and redesign of engaging course offerings to ensure effective student learning across the enterprise-wide systems and business process perspectives. The study exhibits a practical application of the three TOE factors to the design of course objectives in curriculum development. Importantly, the introduction of the guiding framework helps bridge the gap between the existing curriculum and student learning outcomes with ERP systems. This study proposes a comprehensive model with a unique approach for the integration of a holistic TOE framework into ERP systems education. The proposed model can help faculty members actuate the development process for the ERP systems programs and courses.

Outlining the three TOE factors that tap into ERP systems learning for students, the study model offers a structured approach for the selection of appropriate pedagogical content to achieve a variety of student learning outcomes. The findings of this study point out that the use of the TOE framework enhances student learning in ERP systems education. The framework is applicable, comprehensive, and practical for students to learn how to conduct complex business operations with an ERP system. In addition to the framework with the course objectives, this study recommends ERP systems educators for a practical guideline to utilize the structured approach in their curriculum development. The guideline is aligned with typical teaching objectives for ERP systems courses. As such, it provides educators a pedagogical facility to select appropriate course offerings for achieving the course objectives, and to assist students' engagement with the use of ERP systems. The study contributes to the emerging body of ERP systems education and research by integrating the TOE framework to the technology curriculum development. This study will have a valuable impact on educators in developing their technology curriculum and software vendors in making investment decisions on a variety of enterprise-wide system products.

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APPENDIX

TOE Framework for ERP Systems Study Experience Survey

Your Major: _____ Gender: _____

The factors of a technology, organization and environment (TOE) framework were discussed, and applied to accomplish the seven course objectives for ERP systems learning stated in the syllabus. Please rate the value of TOE framework in the box to meet your own learning objectives below:

1	2	3	4	5	6	7
Strongly Disagree	**Moderately Disagree**	**Slightly Disagree**	**Neither Agree Nor Disagree**	**Slightly Agree**	**Moderately Agree**	**Strongly Agree**

Course Objective	TOE Framework for ERP Systems Learning	Your Rate (1 through 7)
1	Helps me understand the best practices in business transformation for the organization with an ERP system	
2	Helps me understand the importance of IT infrastructure for the organization to successfully implement an ERP system	
3	Helps me know how to evaluate and implement ERP systems for the organization	
4	Helps me know the impact of an ERP system implementation on business processes in the organization	
5	Helps me Know how an ERP system represents an integrated strategy for management the one source of data among an organization, its suppliers and its customers	
6	Helps me become familiar with the basic functionalities of ERP systems from theory to hands-on practical exercises.	
7	Helps me understand technology trends to expand ERP capabilities in the changing business environment	
Student Learning Outcomes	Helps me understand the relationships between the factors of organization, technology and business environment from my ERP systems study	

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