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Research Notes

Impact of an ERP simulation game on online learning

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ABSTRACT

The ever increasing use of online education dictates that the use of traditional face-to-face tools for students be expanded into the virtual classroom. Business students in online MBA courses at two universities are tasked with making decisions using SAP's ERPSim Manufacturing Game. The students are polled before and after their simulation experience on five dimensions including attitude toward SAP and several dimensions in Enterprise Resource Planning (ERP) knowledge. Students were found to have increased their attitudes toward SAP and knowledge of ERP upon completing the three-period simulation game. These results are significant for business educators of online courses because it shows that increased learning due to ERPSim not only takes place in face-to-face education classrooms but in an asynchronous environment as well. A comparison of our results with those reported in prior studies involving traditional classes revealed additional insights and potential topics for future research.

1. Introduction

The smooth operation of modern enterprises requires employees to engage in business processes that cut across functional silos. Breakdown in a process can result in lost revenues or fines and lawsuits as illustrated in several recent product defect scandals at various automobile companies (Tabuchi, 2014). In the last twenty years most large organizations have implemented Enterprise Resource Planning (ERP) systems to support integrated business processes. Potential benefits of these systems include efficiency and more transparency and compliance with laws and regulations. However, just like the business processes that they are designed to support, ERP systems are highly complex. Consequently, inadequate employee training can prevent the full acceptance of an ERP system or the realization of its major benefits (Monk & Wagner, 2008).

In response to the need to train tomorrow's business professionals to be effective users of ERP systems, many business schools have incorporated ERP software into their curriculum. However, while teaching keystrokes is easy, teaching ERP concepts remains a daunting challenge, even when an integrated software package is used. Because the software is highly complex, most exercises are designed to complete tasks contained in individual modules rather than cross-functional. Students rarely have a chance to "experience" the integration aspect of business processes as a result. To address this deficiency a simulation game using SAP ERP (ERPsim) developed by faculty at HEC Montreal (Léger, 2006) has been adopted by over 100 universities around the world. In recent years Cronan and colleagues have shown that the ERPsim game is effective in helping students better understand and embrace ERP concepts in traditional face-to-face classes (Cronan & Douglas, 2012, 2013;

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Cronan, Douglas, Alnuaimi, & Schmidt, 2011). The purpose of this research is to test for the same results in asynchronous online classes.

2. Literature review

2.1. Growth of online course demand

Learning venues are changing with asynchronous online courses gaining in popularity. The lure for many students is the ability to fit college courses around work and life schedules. Today's students require more diversity in class availabilities due to family and work schedule demands. Online offerings, also known as distance education, allow students to work asynchronously, thereby, programs with both fully online and blended components have shown dramatic enrollment increases over the years (Redpath, 2012).

In 2000 eight percent of the total students enrolled in higher education in the United States were classified as full-time, online students in the pursuit of either a two or four year degree with another two percent taking at least one online course for a total of ten percent of all higher education students involved in an online class. By 2013 over twenty-six percent of all higher education students pursuing a two or four year degree took at least one online course (Department of Education, accessed December 9, 2015). As shown in Table 1, the number of online students has increased to over a quarter of all two and four year higher education students. Although the shift has been away from the full-time online population to part-time, the increase dictates that educators not only keep pace with enrollment but continually develop quality online courses.

The U.S. Department of Education projects that by the year 2024 total enrollment in two and four year institutions will be approximately 23,135,000 students. Following the linear increases in percentage of students enrolled in at least one online course, the percentage of students in an online class would be approximately 39.82% or 9,212,357 by 2024. This number of students is staggering and begs the need for online offerings that engage students with interactive content such as simulation games.

This phenomenon is not unique to United States post-secondary academic institutions. A review of current academic publications revealed that many countries are experiencing the same need for expanding course offerings via the online venue. For example, in Spain, total college enrollment has risen with unemployment cited as the primary cause as people return to school for new skills. Online enrollment is dramatically higher (18.52%) at UNED, Spain's most developed source of distance education (Reina-Paz, Rodriguez-Oromendia, & Sevilla-Sevilla, 2012). India faces continual escalation in course requests and utilizes distance education to meet the degree demand (Overland, 2000). In Pakistan, the same continued demand for higher education exists (Ellahi & Zaka, 2015). Jung, Wong, Li, Baigaltugs, and Belawati (2011) write about the need for quality assurance in distance education due to the rapid expansion of online colleges. Between 1998 and 2003, China licensed sixty-eight new distance education colleges to help meet rising demand. They go on to specify ten other Asian countries also addressing quality assurance of online offerings due to the expanded offerings.

2.2. Need for quality online courses

Numerous studies comparing student learning outcomes in traditional versus online classes have found either no differences or distance learning slightly better than traditional models (Borthick & Jones, 2000; Callister & Love, 2016; Friday, Friday-Stroud, Green, & Hill, 2006; Gagne & Shepherd, 2001; Lapsley, Kulik, Moody, & Arbaugh, 2008; Lyke & Frank, 2012; Piccoli, Ahmad, & Ives, 2001). Teaching methods in both face-to-face and online venues have in the past relied on theory based information. Critics have expressed frustration with this teaching concept especially in business classes and advocated the use of a pragmatic approach including the use of simulation based training (Lane, 1995; Salas, Wildman, & Piccolo, 2009; van der Merwe, 2013).

Students on today's campuses grew up with technology and learned much differently than most of their instructors (Prensky, 2000). Business simulations have increased in potency as technology has improved. The use of these simulations in business schools has validated improvement in both student performance and learning (Blunt, 2007; Levant, Coulmont, & Sandu, 2016). By exposing business students to simulation games using today's ERP software, they learn more than winning. Several studies published between 2011 and 2013 addressed the measurement of learning and attitudes toward ERP learning using simulation games (Cronan & Douglas, 2012, 2013; Cronan et al., 2011). The outcomes suggest that student

Table 1
Growth of online courses.

Year	Full time online	At least one online course	Total
2000	8.00%	2.00%	10.00%
2003	16.00%	5.00%	21.00%
2007	20.00%	4.00%	24.00%
2012	12.50%	13.30%	25.80%
2013	12.78%	13.59%	26.37%

Source: Department of Education, accessed Dec. 9 (2015).

participation in ERP simulation games results in enhanced student learning and increased favorable attitudes toward ERP systems. These learning activities push students to think, plan and react across organizational boundaries. The activities have students thinking like business managers where knowledge and experience are derived from sales and marketing planning, cost accounting, operations and supply chain management positions. These studies, however, involved only students in face-to-face classroom settings.

In light of the fast growing demand for online courses, it is important to explore the outcomes of ERP simulation games in an asynchronous setting. This research uses scales developed by Cronan and Douglas (2013) to measure the effectiveness of using ERPsim as a vehicle promoting ERP application knowledge in asynchronous online classes. By definition, students in an asynchronous class setting do not have direct and immediate feedback, which is fostered in the traditional face-to-face classroom. There each simulation round ends with immediate financial and inventory information as it would in the online class. The differences lie in that students in an asynchronous classroom receive instructor feedback when they sign-in to the course, which can vary widely given the timing parameters assigned by the instructor. Moreover, in the face-to-face classroom students on each team can react to market trends, inventory fluctuations, and financial results immediately, whereas in the asynchronous class, students may use asynchronous chat rooms, texting, phones and email, all of which require more time and effort and do not yield instantaneous information exchanges. Despite challenges that are inherent in playing simulation games in an asynchronous setting, it is expected that students will benefit in the same way from the games as their counterparts in face-to-face classes. Our first hypothesis is therefore:

H1. Online students will show significant improvement in learning of ERP concepts and favorable attitudes toward ERP systems after playing the simulation game.

Even though learning can improve in online classes as in traditional classes, the *magnitude* of improvement can be different due to different student bodies. Online students tend to be older, have more years of work experience and have different learning styles than traditional students (Kotey & Anderson, 2005). A substantial body of research exists that explores different learning styles and how they can affect learning outcomes (e.g., Kolb, 1981; Santo, 2006). However, the relationship between learning style and online learning is equivocal at best (Santo, 2006). An exception is the two information processing styles according to Epstein (1994), who proposes that individuals may adopt either a rational or experiential processing style in making decisions. Rational processing is conscious, logical and linear, whereas experiential processing is preconscious, holistic and simultaneous. The two styles are not static, rather, they interact and sometimes contradict to result in a struggle between thinking and feeling (Denes-Raj & Epstein, 1994). Kotey and Anderson (2005) compared course performance of online students with that of traditional students where a simulation exercise was used. They hypothesized that online students would perform better because they are more rational than traditional students, which would be instrumental in making the correct decisions required in the simulation exercise. Kotey and Anderson (2005) found that online students were indeed more rational, but the difference did not result in better course performance. Although the evidence is limited, it can be argued that if online students are better at making rational decisions, their learning improvement from a simulation game may be less than that of traditional students. Our second hypothesis is as follows:

H2. Online students will show significant less improvement in learning of ERP concepts than do traditional students after playing the simulation game.

Finally, given the positive learning outcome derived from the simulation game, students are expected to show more favorable attitudes toward ERP systems. There is no reason to expect any difference between online students and traditional students in this regard. Thus, our third hypothesis is as follows:

H3. Online students will show the same degree of positive attitudes toward ERP systems as traditional students after playing the simulation game.

3. Methodology

Following the studies of Cronon and colleagues, this research uses the SAP ERP Simulation Manufacturing Game. Student teams of four or five compete in three rounds lasting thirty simulation days. Their objective is to obtain the highest profit in the cumulative final report at the end of round three. In the first round, students manipulate pricing and marketing while monitoring their inventory and financial conditions. Each team is given a fixed inventory with the goal of maximizing profits by adjusting pricing and marketing strategies. In the second round, each team gets to replenish its inventory with a given amount of raw materials. Production mix must be aligned with inventory and sales in order to compete effectively. Finally, in the third round, each team is allowed unlimited raw material but whose availability depends on the proper execution of planning and procurement operations. At the end of each round, financial results of all teams are posted by the instructor. Discussion of results among team members and adjustments of strategies can be made via phone calls, texts, emails or chats.

Online MBA students at two universities participated in this study. At one university the game was played over three weekends. The first round was played from 8 a.m. to 8 p.m. on a Saturday and then again on Sunday. Due to scheduling conflicts the next two rounds were played on a Saturday only. At the second university, the online MBA students played rounds where each was spread over seventy-two hours. Each round began at 8 a.m. Monday and ended at that same time on Thursday. The students gained permission from their employers to spend work time checking in to the simulation, creating

Table 2
Simulation learning results.

	Attitude*		EOU		BP		ES		SAP	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Pre	5.28	1.05	5.32	1.01	4.39	1.01	4.65	0.98	3.33	1.49
Post	5.92	0.86	5.48	1.00	4.92	0.92	5.09	0.93	4.82	1.05
t-statistic	4.94		1.30		4.51		2.97		8.01	
p-value	0.00		0.10		0.00		0.00		0.00	

* Attitude: attitude toward SAP; EOU: SAP ease of use and usefulness; BP: Business process knowledge; ES: Enterprise systems knowledge; SAP: SAP transaction knowledge.

Table 3
Improvement in enterprise systems knowledge.

	Mean	Standard Error	90% CI Lower Limit	90% CI Upper Limit	Z-Value	P-Value
Traditional	0.83	0.07	0.71	0.94	11.94	0.00
Online	0.41	0.14	0.17	0.65	2.85	0.00

analyses and making recommendations to their team members. Thursday through Sunday was set aside for teams to collaborate on sales and inventory analyses, subsequent tactical changes and implementation schedules.

Students filled out a pre-game survey in the first week of classes. This survey asked questions related to students' existing knowledge about ERP and their attitude toward SAP. After round three, they submitted a post-game survey, which contained the same questions as the pre-game survey but with additional questions related to their simulation experience. A few students completed the pre-game survey but not the post-game survey and others did the opposite. Those pre- and post-surveys that could not be matched up were discarded. In the end, fifty-two usable responses were obtained and analyzed.

In sum, the current research replicated the studies of Cronon and colleagues by using the same research instruments. The measures used were shown to have high reliability, with a Cronbach's Alpha over 0.90 reported in all prior studies. In addition, these self-assessed measures were found to have a significant correlation with objective measures of learning (Cronan, Léger, Robert, Babin, & Charland, 2012). The major difference is that the sample population in the current research was comprised of MBA students in an asynchronous online environment rather than undergraduate students in a face-to-face setting used in all previous studies.

4. Results

Table 2 contains the pre- and post-game results. The first two measures are related to attitude toward SAP and the next three measures are related to ERP knowledge. As shown in Table 2, the mean in each measure increased from pre- to post-game, indicating a positive effect of the game on learning. A paired *t*-test was conducted and the improvement was significant in all but one measure, as shown at the bottom of Table 2.

Overall, students in this research showed significant learning improvement and more favorable attitudes toward ERP software with the use of simulation games. Hypothesis 1 was supported.

To test Hypotheses 2 and 3, three years' results reported in Cronan and Douglas (2012) were averaged and compared with those produced in the current study as shown in Tables 3–9.

Table 3 shows the standardized mean *t*-statistic from different studies, along with the standard error and ninety percent confidence interval for the expected mean. The p-value indicates that in both groups, the expected mean is significantly different from zero, confirming the significant learning improvement reported by Cronon and colleagues and the current study. The confidence intervals of the two groups provide evidence as to whether the two groups differ in the true effect size

Table 4
Improvement in business process knowledge.

	Mean	Standard Error	90% CI Lower Limit	90% CI Upper Limit	Z-Value	P-Value
Traditional	0.76	0.10	0.60	0.93	7.65	0.00
Online	0.63	0.15	0.38	0.88	4.13	0.00

Table 5
Improvement in SAP skills.

	Mean	Standard Error	90% CI Lower Limit	90% CI Upper Limit	Z-Value	P-Value
Traditional	1.04	0.23	0.65	1.42	4.46	0.00
Online	1.11	0.18	0.82	1.40	6.30	0.00

Table 6
Attitude about SAP.

	Mean	Standard Error	90% CI Lower Limit	90% CI Upper Limit	Z-Value	P-Value
Traditional	0.13	0.06	0.03	0.23	2.08	0.04
Online	0.38	0.14	0.14	0.61	2.63	0.01

Table 7
Attitude about SAP's ease of use.

	Mean	Standard Error	90% CI Lower Limit	90% CI Upper Limit	Z-Value	P-Value
Traditional	0.26	0.06	0.15	0.36	4.05	0.00
Online	0.64	0.15	0.39	0.89	4.21	0.00

Table 8
Attitude about ERP.

	Mean	Standard Error	90% CI Lower Limit	90% CI Upper Limit	Z-Value	P-Value
Traditional	0.15	0.06	0.04	0.25	2.35	0.02
Online	0.41	0.14	0.17	0.64	2.82	0.01

Table 9
Attitude about integrated business process.

	Mean	Standard Error	90% CI Lower Limit	90% CI Upper Limit	Z-Value	P-Value
Traditional	0.20	0.06	0.09	0.30	3.13	0.00
Online	0.49	0.15	0.24	0.73	3.31	0.00

(Hunter & Schmidt, 2004). Specifically, if the two confidence intervals do not overlap, the evidence supports that one group performed better than the other; otherwise, the two groups are considered to have equal performance. Because the two confidence intervals in Table 3 do not overlap, evidence suggests that greater improvement in enterprise systems knowledge can be expected in traditional classes than in online classes, supporting Hypothesis 2.

Table 4 displays the results of improvement in business process knowledge. The improvement was also significant in both groups as indicated by the p-values. The difference between the two groups was non-significant, however, as suggested by the overlapping confidence intervals. Table 5 displays the results of improvement in SAP skills. Similar to the results shown in Table 4, the improvement was significant in both groups; however, there was no significant difference between the two groups. Results in Tables 4 and 5 do not support Hypothesis 2.

Tables 6–9 display the results on attitude questions. Again the results indicate that both groups exhibited a significantly more favorable attitude after playing the game. The difference between the two groups was non-significant except in their attitude about the ease of use of SAP. As shown in Table 7, online students had a more favorable attitude toward ease of use of SAP than did traditional students. Overall, our results support Hypothesis 3 with one exception.

Table 10 summarizes hypothesis testing results. Implications for teaching and research in ERP instructions are discussed next.

5. Discussion

ERP systems are complex artifacts and to reap the expected benefits users need proper training. In recent years many business schools have incorporated ERP courses into their curriculum. However, given the complex concepts involved, students often lack the opportunity to experience the integration aspect of ERP systems. As a result, simulations such as ERPsim games have been adopted and shown to have a positive effect on student learning of ERP concepts.

Table 10
Hypothesis testing results.

Hypothesis	Result
H1: Online students will show significant improvement in learning of ERP concepts and favorable attitudes	Yes except for SAP's ease of use and usefulness
H2: Online students will show significant less improvement in learning of ERP concepts than will traditional students	Yes for enterprise systems knowledge; no for business process knowledge and SAP skills
H3: Online students will show the same degree of positive attitudes toward ERP systems as traditional students	Yes except for attitude about SAP's ease of use

Table 11
Simulation experience question results.

Question	Mean	Standard Deviation
ERP Simulation was a worthwhile learning experience	6.31	0.92
I learned about Enterprise Resource Planning as a result of the ERP Simulation	5.60	1.62
I learned about SAP as a result of the ERP Simulation	5.58	1.73
I learned how to use SAP to accomplish business processes as a result of the ERP Simulation	5.79	1.45
SAP is a great system to accomplish integrated business processes	5.92	1.45

Table 12
Three types of knowledge.

Enterprise Systems	*the impact of an ERP (and the integrated information it provides) on the organization as a whole, including impacts on organizational structures and responsibilities, business processes, reporting, control (or assurance), and decision making*
Business Process	*business terminology, key operations processes, and their interrelatedness*
SAP Skills	*skills required to utilize the SAP application to perform transactions supporting business operations as well as setup and understand the associated master data*

Given the rapid growth of online education, it is critical to test whether the benefits of ERPsim games carry over to an online environment. This research takes the first step toward answering that question. As expected playing the games results in increased learning of ERP concepts and more favorable attitude toward the system.

This finding encourages other educators to explore ways to use simulations more in general and ERPsim games in particular in their online classes. The online environment is much more diverse than the traditional face-to-face classroom given the wide range of differences in student body, technology infrastructure, time and space involved. Consequently, implementation of the games may also differ in the administration of online classes as shown in the current study. However, the end result is likely to be positive as this study has found. On the post-game survey, in addition to questions that assess student learning, five questions ask about students experience with the simulation game where 1 is the least favorable and 7 the most favorable experience. Table 11 summarizes the result.

As shown in Table 11, students overwhelmingly rated their ERPsim experience very positively. Their self-assessments also indicate that they learned ERP concepts and the proper use of SAP to accomplish integrated business processes. This corroborates with the positive evidence of the use of the ERPsim game on student learning presented earlier.

Additional insight was gained when we compared results with those reported in prior studies involving traditional classes. Because online students are generally older and have more work experience than students in traditional classes, knowledge enhancement was expected to be lower in online classes. This was true regarding enterprise systems knowledge but not so for business process knowledge or SAP skills. The difference may be attributed to the different types of knowledge measured. Table 12 summarizes the three types of knowledge as described by Cronan et al. (2012).

It would seem that enterprise systems knowledge involves an understanding of a big-picture, high-level view of the role of ERP, whereas business process and SAP skills involve a lower-level, operational type of knowledge. The former is more abstract and harder to understand, whereas the latter is more concrete and easier to grasp. It is possible that online students, being more mature and with more work experience, have a stronger background than traditional students in high-level enterprise systems knowledge. As a result, the additional knowledge gain from playing the ERPSim game is smaller in online students than in traditional students. This finding needs to be further investigated before it can be generalized to other domains.

6. Conclusions

The continued expansion of online classes propelled by escalating demand due to student enrollment dictates that educators expand the content and quality of their courses. The notion that effective learning cannot be achieved through simulation games in an asynchronous environment is dispelled in this research. Student attitudes and learning are measured before and after the simulation. The findings suggest that students develop more positive attitudes toward SAP and gain increased knowledge of ERP utilization.

A limitation of the current study is that the results are based on self-reported measures. Objective measures can be used in future studies to better gauge knowledge enhancement from playing the simulation game. Another limitation is that students can also learn from other activities including lectures and ERP exercises. Because the game spans several days, it is possible that learning enhancement is due to both the game and other learning activities that take place during the same timeframe. Finally, our sample consists of online MBA students at two U.S. universities. While there is a good representation of international students, the results may not generalize to different settings where students are sampled from a different country or a different group such as undergraduate business students.

As previously suggested, the current research can be extended to study the effect of ERP simulation on learning different types of knowledge. Other research directions include replication of the current study with different versions of the games, different timeframes or different subject groups. For the dependent variable, objective measures can be used in addition to

self-reported measures in future studies. Moreover, besides learning, team performance or team satisfaction can be examined as a result of playing the simulation game. Similarly, other variables that affect team performance can be included in a future study. For example, it will be interesting to determine how some teams perform better than others. Will better teamwork and communication affect teams' financial results or team satisfaction? Finally, this research suggests that the information processing styles of Epstein (1994) play a role in online learning. It may be worthwhile to investigate the effect of other learning styles in future studies.

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