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Using simulation system for collaborative learning to enhance learner's performance

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Abstract: This study focuses on adoption of simulation system in rapidly changing technology and information flow. Given the prevalent popularity of simulation system, it is important to understand and adopt simulation system to develop future educational plans. This paper addresses how simulation system enhances student collaborative learning and learner performance using Technology Acceptance Model. Results were analyzed using Structure Equation Modeling technique; this study established that perceived usefulness, perceived ease of use, and perceived enjoyment all have a significant positive relationship with simulation system. The results indicate that simulation system serves as a dynamic tool to accelerate the progress of learning environments by encouraging collaboration and communication among students which strengthen their learning abilities and increase performance because students practically perform all the theories in a risk-free environment. In the competitive world, simulation system should be implementing at education level so that students can learn more before entering into a real-life career.

Subjects: Education; Teaching Methodology & Practice; Teaching Practice - Education; Education & Training; Education - Social Sciences

Keywords: collaboration, peer learning; topics, informal learning and learning environments; topics, learning technology; topics, science; content areas

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PUBLIC INTEREST STATEMENT

In today's changing and dynamic environment and economic conditions, there is a need for re-orientation and modification of educational programs, where learning progression should focus on strengthening knowledge and skills in accordance with needs and wants of the market. Conventional methods of teaching are not supportive in coping with unpredicted market dynamics and complex organization conditions. It is the requirement of time to alter teaching and educational methods. Now, many universities are hiring professors, whose main task is not only to give knowledge but also to motivate students to choose their professions according to their learning. New generation is brought up with mobiles devices, access to internet, laptops, and video games. Educational system should be modified and simulation method of teaching should be adopted in accordance with current generation habits and pleasing method of learning.

1. Introduction

Learning methods have changed; they have moved from traditional teaching model to learner-centered model that involves the learner in an active role (Garris, Ahlers, & Driskell, 2002). Now methods of learning are shifting from learning by listening to learning by doing. Kolb (1984) defined Experimental Learning Theory (ELT) that individual's learning process is the combination of experience, cognition, behavior, and perception. Use of simulation system (games, applications, and situation) has grown significantly over the last 20 years, that enhances the learner's capability to solve the problems (Douglas, Miller, Kwansa, & Cummings, 2007; Jones, 1998; Rosen, 2008).The simulation system is an artificial environmental situation in which learners perform their duties in the real world scenarios (Gredler, 2004; Jones, 1998). Interacting with one another is a collaboration; it is a fact that cooperation enhances knowledge, resources, and capabilities to perform tasks. A number of researchers found that collaborative learning has a significant positive effect not only on the academic performance of the student (Bossert, 1988; Cohen, 1994; Johnson, 1984), but also supportive in learning psychological and social aspects (Kreijns, Kirschner, Jochems, & Buuren, 2007; Sadeghi & Kardan, 2015). Researchers have agreed that simulation system enhances collaboration and performance of the students. To have learner's maximum attention towards the task, it is necessary to indulge learners in enjoyment-related activities. Bostan (2009) and Bruner and Kumar(2005) added the variable of perceived enjoyment in TAM to measure consumer's internet use.

This study examined the perceived learner performance from the use of simulation system in a collaborative environment using Technology Adoption Model (TAM). In previous studies, TAM was used to measure the intention to adopt the simulation.

2. Model adoption

Technology Acceptance Model (TAM) was proposed by (Davis, 1989) and is a commonly used theory on the practice and acceptance of new technology (Cheung & Vogel, 2012). Technology Adoption Model (TAM) is a multi-dimensional model which is used in different fields to analyze and interpret research results i.e. pure sciences (Chaurasia et al., 2016), operation research (Chena & Ma, 2016), computer sciences (Chuah et al., 2016), public health (Zakaria & Yusof, 2016), environmental sciences (Rai & Robinson, 2015), industrial engineering(Guo & Zhu, 2016), social sciences (Arifina & Frmanzah, 2015), and many more. Many research studies applied TAM to envisage the user intent to adopt technology (Pando-Garcia, Periañez-Cañadillas, & Charterina, 2015). These studies proved that this model considerably influenced the technology adoption. Sukkar and Hasan (2005) and Benbasat and Bark (2007) inquired about the appropriateness of TAM model in the case of developing countries and students' intention in adopting technology and propose modification in TAM model for making it more appropriate in this case. However, no studies have been found in the previous literature to explore the use of simulation system for collaborative learning to enhance learner's performance using modified TAM.

Technology Acceptance Model (TAM) is derivative of Theory of Reasoned Action (Ajzen & Fishbein, 1980) illustrate that the behavior of individual changes after adoption of new technologies. TAM has basically two main constructs: perceived usefulness and perceived ease of use, which assist user to build the intention to adopt new technology. For this study, perceived enjoyment is also used because of interesting and entertaining features of using simulation systems. As such, earlier studies performed by Csikszentmihalyi (1975) and Moon and Kim (2001) used perceived enjoyment as construct in modified TAM. For this study, constructs like perceived enjoyment, perceived usefulness and perceived ease of use are used to investigate the impact simulation system on collaborative learning and learner's performance using modified TAM (Figure 1).

3. Perceived usefulness

Perceived usefulness is defined as "the degree to which a person believes that using a particular system may enhance his or her job performance" (Davis, 1989). Perceived usefulness is the main construct of Technology Adoption Model (TAM), which predicts the behavioral intention of a person to use technology (Davis, Bagozzi, & Warshaw, 1992; Hart & Porter, 2004). According to Alrafi (2007),

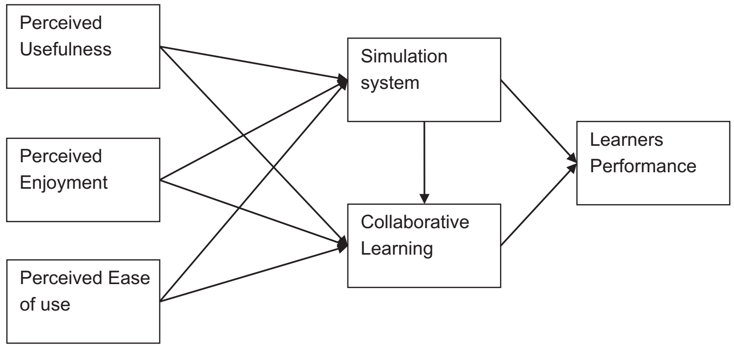

Figure 1. Technology acceptance model (Davis, 1989).

this construct can predict system acceptance, user intentions and continual use of the system. Perceived usefulness has frequently been used by many researchers (Alrafi, 2007; Dulcica, Pavlicb, & Silicc, 2012; Fagan, Kilmon, & Pandey, 2012; Liu & Huang, 2015); they argue that perceived usefulness enhances attitude and encourage people to adopt simulation system in future for better understanding and learning. Researchers explore that there is a positive impact of perceived usefulness on user satisfaction. In this research, perceived usefulness is viewed as an instrumental need to accomplish tasks like learning, education, research and other experimental tasks (Bhattacherjee, 2001; Chea & Luo, 2008; Hong, Thong, & Tam, 2006; Thong, Hong, & Tam, 2006). By above discussion following research hypotheses are suggested:

H1: There is a significant positive relationship between perceived usefulness and Simulation system

H2: There is a significant positive relationship between perceived usefulness and collaborative learning

4. Perceived ease to use

Perceived ease of use is defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989). From the definition, ease means freedom with great effort or difficulty. The effort is a limited resource which a person can allocate for activities for which he/she is answerable (Radner & Rothschild, 1975). If the use of the system is easy, people are willing to learn it and have positive intention to use in future (Chiu & Wang, 2008). Designing of games or system should be user-friendly and easy to use, it has a positive impact on the intention of individuals to learn from that system (Hamida, Razak, Bakar, & Abdullah, 2016). Perceived ease of use will affect the individual's satisfaction which leads user's loyalty i.e. repeated usage or continuous buying of product (Zhao, Chen, & Wang, 2016).There is a non-linear relationship between the ease of use and behavior intention of individual in case of simulation system (i.e. sports, simulation system, Strategic games, adventure and fighting games). If simulation system is easy to use, it has no challenging effect and user may get bored; and if the system is too difficult to use, the user may get offended and not willing to learn from it. If the system is too easy or too difficult, learner is unable to learn from simulation system (Davis & Lang, 2012).

H3: There is a significant positive relationship between perceived ease of use and simulation system

H4: There is a positive significant relationship between perceived ease of use and collaborative learning.

5. Perceived enjoyment

Perceived enjoyment is defined as "the degree to which the activity of using technology is perceived to be enjoyed in its own, right apart from any performance consequences that may be anticipated"(Davis et al., 1992). Perceived enjoyment has a significant positive effect on individual behavior towards his/her task (Heijden, 2003; HsuL & Lin, 2008; Pe-Than, Goh, & Lee, 2014). It can be concluded that perceived enjoyment has a positive significant behavioral intention to use the hedonic system. According to Davis et al. (1992), perceived enjoyment is similar to intrinsic motivation which boosts up the performance of an individual. Venkatesh and Speier (2000) compared two methods of training, i.e. traditional training methods (lectures, theoretical knowledge) and simulation-based training methods (simulation system) and they found simulation system-based training enhances intrinsic motivation which results in the behavioral intention of the individual in gaining knowledge from this system again and again. Hung, Tsai, and Chou (2016) stated that users perceive less enjoyment when they interact with a system having utilitarian benefits as compared to the system which has high hedonic characteristics (Nysveen, Pedersen, & Thorbjørnsen, 2005; Xu, Lin, & Chan, 2012). There is still a question that simulation system provides learner enjoyment and helps them in collaborative learning. From the above discussion, following research hypotheses are proposed:

H5: There is a significant positive relationship between perceived enjoyment and simulation system

H6: There is a positive significant relationship between perceived enjoyment and collaborative learning.

6. Simulation system

The simulation system is designed by constructivist learning theory, as user learns or constructs new knowledge from his/her conceptual understanding (Dewey, 1938; Vygotsky, 1978). Simulation is a reliable and exciting system which provides students learning-based experience which motivates and encourage them to learn. This system offers students information-rich environment where they work together in groups, brainstorm and share their ideas, and make a decision in certain situations while working in the risk-free but practical environment. Simulation system has many dependent variables, the main aim of simulation system is that all participants have some roles and all have to react according to the situation and give their feedback to achieve the desired goal (Gredler, 2004). Simulation system has some set of rules and roles which students need to follow which gave them an essence of working in the real-based scenario but risk-free (Leemkuil, Jong, & Ootes, 2000).

Simulation systems are based on theories and application which need to be implemented by students to enhance their learning performance by engaging themselves in a real situation. Mawhirter and Garofalo (2016) stated that simulation systems are the creative and innovative way to increase students' interest in learning. Simulation system not only helps students in reducing stress but also assist in knowledge retention (Popil & Dillard-Thompson, 2015). According to Blakely, Skirton, Cooper, Allum, and Nelmes (2010), simulation system in education helps the student to enhance learning with enjoyment, interest, and interacting with other students. According to (Thavikulwat (2004), simulation system let students step into the case with the complicated real-life situation. Gredler (2004) defines essential characteristics of simulation: (1) student actively interacts with complicated real-life condition; (2) clear rules, regulation, responsibilities, and position is defined to student; (3) students can apply different strategies by keeping themselves within limitations outlined earlier;(4) problems and situations change while performing the simulation system task so that students can deal with changes. Hughes and Scholtz (2015) stated that simulation system provides students an experimental way of learning, simulation system creates opportunities for students to gain more knowledge by keeping themselves in a real-world context. Students digest the knowledge which they have experienced through simulation system. Simulation system can be classified as gaming, training, discrete, continuous or combined events, workshops, and modeling (Lean, Moizer, Towler, & Abbey, 2006).

The scope of simulation system is in many fields like life sciences, information technology, mathematics, business studies, physics, aerospace, engineering, language, culture, emergency studies, and many more (Chittaro & Sioni, 2015; Ebner & Holzinger, 2007; Mawhirter & Garofalo, 2016; Strahilov & Damrath, 2015). Conventional teaching methods like lectures, case studies, and discussions provide student theoretical insights of topics but lack in providing real-world experience and the feel of actual practices and processes. Simulation system plays a role in the development of a student's learning skills, as the student has to make decisions by looking at the environment and other students' decision-making choices (Lainemaa & Nurmib, 2006). Simulation system works as the bridge between theory and practice, which helps the student to enhance their technical and critical thinking skills (Bell & Loon, 2015). Simulation system increases motivation (Fripp, 1997), experimental learning (Adobor & Daneshfar, 2006), develops critical thinking (Doyle & Brown, 2000), works on real-world scenario but in the risk-free environment (King & Newman, 2009), develops time management, and working-in-team skills (Doyle & Brown, 2000).

H8: There is a significant positive relationship between simulation system and learner performance

7. Collaborative learning

Collaborative learning can be defined as two or more people working together to create or achieve a particular objective. In many fields or disciplines including business, management, medicine, sports, entertainment, and much more, collaborative learning is permitted (Hmelo-Silver, Chinn, Chan, & O'Donnell, 2013). Collaborative learning encourages institutes to think out of the box and also help people to learn and innovate (Lytras et al., 2015).There is a difference between collaborative learning and cooperative learning; their outcome of performance and learning also differ; in cooperative learning, members in group divide or split their work into subtasks and then join their work to form a result (Sadeghi & Kardan, 2015). According to Lytras et al. (2015), collaborative learning is multi-dimensional; the world is measuring the performance of the students through static, monolithic approach (Dascalu et al., 2015; Zhuhadar, Yang, & Lytras, 2013).The world should adopt new grading system in which students should not only evaluated by memorization of concepts but also tested on critical collaborative thinking. Simulation-based collaborative learning enhances students' learning in the real-world scenario. It is observed that students show better performance when they collaboratively learn through simulation system as compared to the non-simulation system (Ke & Carafano, 2016). From above, following hypothesis is presented:

H9: There is a significant positive relationship between collaborative learning and learners' performance

8. Learner performance

Many studies show that simulations improve the learning performance of individuals (Gaba, Howard, & Fish, 2001; Grantcharov et al., 2004; Shapiro et al., 2004). Simulation system prepares learners to deal with unanticipated events, which in turn increase their confidence in real-world work performance Lateef (2010). Simulation system is a multidisciplinary system in which individuals with different technical responsibilities collaborate with each other to solve the given problem efficiently and effectively. Simulation system provides learner an eye to recognize the problem and adopts a proactive approach to solving it. According to Junco, Heiberger, and Loken (2011), there is a significant positive relationship between collaborative learning, learning performance, and engagement with work. Learners can learn very fruitful concepts by indulging themselves in simulations. Madge, Meek, Wellens, and Hooley (2009) urged that use of this technology can work as a bridge between learners, instructors, and other participants, where all can learn from each other by sharing their ideas and experiences.

9. Research methodology and data collection

This research measures the effect of perceived enjoyment, collaborative learning from simulation system which results in learner performance using Technology Acceptance Model. To perform statistical analysis, data were collected from multi-national under-graduate, graduate, and post-graduate students of four different disciplines i.e. business management students, pure sciences, information technology, and engineering from University of Science and Technology China, Tsinghua University and Shanghai Jiao Tong University, who know stimulation games/system. 400 questionnaires were circulated among students out of which 360 surveys were found accurately filled. Questionnaire was adapted from different research articles, such as perceived usefulness and perceived ease of use (Davis, 1989), perceived enjoyment (Moon & Kim, 2001), collaborative learning (Fraser & Treagust, 1986), and learner performance (Nale, Rauch, Wathen, & Barr, 2000), with modifications of words and sentences in accordance with the current study. Seven Likert scales are used where one strongly disagrees, four neutral, and seven strongly agree.

10. Data analysis

Data was collected from the classified respondents, according to gender, education, the field of study and the students who know simulation system/systems. Gender was classified as male and female; respondents were 55.8 and 44.2%, respectively. Education level was classified as under-graduate, graduate, and post-graduate, respondents were 26.38, 28.05, and 45.55%, respectively, and respondents of the field of study were 35.27% management sciences, 19.72% pure sciences, 18.61% information technology, 20.83% Engineering, and 20% others shows in Table 1. All these respondents have knowledge and have at least used simulation system once.

For the examination of measurement and structural model, structural equation model (SEM) employing the AMOS-21 was used. AMOS is a powerful technique which coalesces Principle component Analysis and regression simultaneously from the assessment of measurement and structural model. AMOS is better in dealing with evaluation of formative measurement and in testing moderating relationship. AMOS software not only can originate developmental model for a latent variable but also can show the graphical representation of interpretation. For these strong reasons, AMOS-21 software was used for the examination of measurement and structural model (Anderson & Gerbing, 1988).

Table 1. Demographics of respondents

Demographics	Frequency	Percentage
Gender		
Male	201	55.8
Female	159	44.2
Educational level		
Under-Graduate	95	26.38
Graduate	101	28.05
Post-Graduate	164	45.55
Field of study		
Management Science	127	35.27
Pure Sciences	71	19.72
Information Technology	67	18.61
Engineering	75	20.83
Others	20	0.55

11. Measurement model

For the examination of the measurement model, stepwise processes were followed. First, Explanatory factor analysis (EFA) was performed to examine factor loading using SPSS whether the benchmark values are above 0.4 (Hair, Anderson, Tatham, & Black, 1998). EFA is used to confirm the accuracy of items and if factors are matching and are ready for factor relationship analysis. Results verify the validity of hypothesized model as the indices of factor loading are between 0.719 and 0.902. All values of indices are above the recommended values which shows lack of concern about cross-loading except for three items which were excluded from the data.

Next step, to perform CFA tests to measure the convergent validity, factor loading, Cronbach α, Average Variance Extracted (AVE), and composite reliability (CR) (Flynn, Sakakibara, Schroeder, Bates, & Flynn, 1990). CFA results indicate that loading of all items is above 0.7. To examine the reliability and validity of data tests like Cronbach α, AVE and CR values are extracted using SPSS. Cronbach α and CR values should be above than 0.7, which make data considerable for further analysis. Results indicate that Cronbach α values are between 0.778 and 0.932 and CR values are between 0.784 and 0.909. AVE value should be equal to or higher than 0.5. In this research study, AVE value ranged between 0.554 and 0.728. Results indicate that there are no convergent validity and reliability issues with data (see Table 2).

Table 2. Result of confirmatory factor analysis

Constructs	Factor loading	CR	AVE	Cronbach's α
Use of simulation		0.889	0.728	0.889
SIM1	0.860			
SIM2	0.859			
SIM3	0.824			
Perceived usefulness		0.796	0.568	0.789
PU1	0.852			
PU2	0.737			
PU3	800			
Perceived ease of use		0.909	0.715	0.932
PEU1	0.902			
PEU2	0.875			
PEU3	0.854			
PEU4	0.878			
Perceived enjoyment		0.831	0.623	0.827
PEN1	0.784			
PEN2	0.815			
PEN3	0.795			
Collaborative learning		0.825	0.611	0.823
CL1	0.807			
CL2	0.762			
CL3	0.784			
Perceived learning		0.784	0.554	0.778
PEL1	0.770			
PEL2	0.842			
PEL3	0.719			

Next step is to measure the discriminant validity of the hypothesized measurement model; it is measured by comparing the AVE Square root of each construct with inter-correlation of constructs. Values of AVE square root should be higher than inter-correlation of constructs (Hair et al., 1998). Results indicate that discriminant validity is established. Hence, data is fit for further analysis of the structural model. Meanwhile, we also measure variance inflation factor (VIF) to examine the multi-collinearity concerns. Results show that the values of VIF ranges between 1.53 and 2.715 which is below the threshold value of 10 (Hair et al., 1998). Thus, results show no multi-collinearity concerns (see Table 3).

12. Measurement and structural model analysis

Structural Equation Modeling (SEM) has become one of the important techniques for researchers across disciplines, and social sciences researchers are also adopting these methods to validate their research results (Hooper, Coughlan, & Mullen, 2008). To see if the model fit, researchers need to examine fitness indices like chi-square, GFI, AGFI, TLI, CFI, and RMSEA. Barrett (2007) and Hu and Bentler (1999) recommend value for goodness of model Chi-square should not be less than 2.0 or higher than 5.0 (Tabachnick & Fidell, 2007) depending upon the sample size. RMSEA value should be less than < 0.10 (Arbuckle, 2003) and according to Steiger (2007), upper limit is 0.07, and according to McQuitty (2004), upper limit should be less than 0.08. According to Miles and Shevlin (2007) GFI and AGFI indices values can be >0.90 and >0.80, respectively (Arbuckle, 2003). Hu and Bentler (1999) and Arbuckle (2003) state that CFI and TLI indices values can be >0.90 and >0.95, respectively. In this research paper, SEM technique is used along with AMOS 24 and CFA (Confirmatory Factor Analysis) to measure the goodness-of-fit model using indices. According to above references, indices for this research show the goodness-of-fit model where values of chi-square, GFI, AGFI, CFI, TLI, and RMSEA are correct shown in Tables 4 and 5.

13. Hypotheses testing

After examining the validity of the structural model, next step is to test hypotheses relationship using SEM Figure 2. Results show that perceived usefulness ($\beta = 0.343$, $p < 0.001$, perceived ease of use ($\beta = 1.60$, $p = 0.001$), and perceived enjoyment ($\beta = 0.213$, $p < 0.001$) have the positive effect of the

Table 3. Descriptive statistics, correlation matrix, reliability and square root of AVE

	M(SD)	PEL	PEU	SM	CL	PEN	PU
PEL	4.30(1.38)	**0.744**					
PEU	4.91(1.40)	0.329	**0.845**				
SM	4.10(1.48)	0.491	0.347	**0.853**			
CL	4.79(1.43)	0.488	0.494	0.456	**0.782**		
PEN	4.42(1.34)	0.523	0.477	0.403	0.526	**0.789**	
PU	4.59(1.24)	0.377	0.226	0.519	0.425	0.351	**0.753**

Table 4. Fitness of measurement model

Model	χ^2	df	χ^2/df	GFI	AGFI	CFI	TLI	RMSEA
Base	308.954	134	2.306	0.917	0.882	0.943	0.955	0.60

Table 5. Fitness of structural model

Model	χ^2	df	χ^2/df	GFI	AGFI	CFI	TLI	RMSEA
Base	1,391.798	488	2.852	0.862	0.935	0.954	0.952	0.061

Figure 2. Result of tested model.

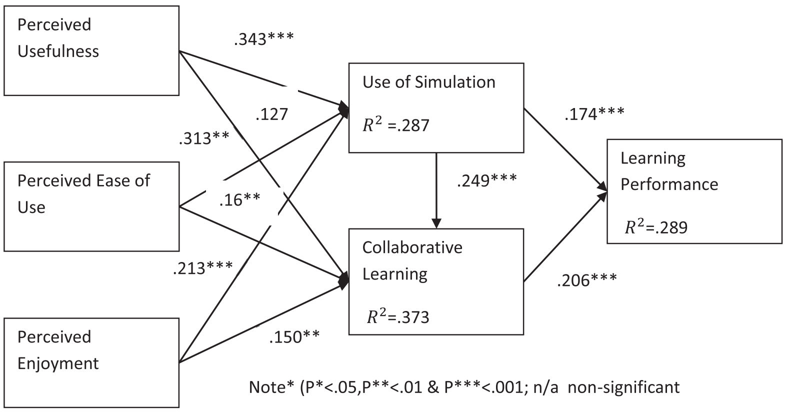

Table 6. Hypotheses testing results

Hypotheses	Independent	Relationship	Dependent	Estimate	S.E.	CR	*p*	Result
H1	PEU	⟶	SM	0.160	0.049	3.230	0.001	Supported
H2	PEN	⟶	SM	0.213	0.051	4.165	***	Supported
H3	PU	⟶	SM	0.343	0.047	7.258	***	Supported
H4	PEU	⟶	CL	0.313	0.047	6.666	***	Supported
H5	PEN	⟶	CL	0.150	0.049	3.057	0.002	Supported
H6	PU	⟶	CL	0.127	0.047	2.673	0.008	Supported
H7	SM	⟶	CL	0.249	0.049	5.029	***	Supported
H8	SM	⟶	PEL	0.174	0.052	3.360	***	Supported
H9	CL	⟶	PEL	0.206	0.053	3.913	***	Supported

Notes: PEU = perceived ease of use; PEN = perceived entertainment; PU = perceived usefulness; SM = use of Simulation; CL = collaborative learning; PEL= perceived learning.

***$p < 0.001$.

use of simulation. Therefore, *H1*, *H2*, and *H3* are supported. Similarly, perceived usefulness, perceived ease of use, and perceived enjoyment have the positive effect on collaborative learning. Therefore *H4*, *H5*, and *H6* are supported. Use of simulation system has ($\beta = 0.249$, $p < 0.001$) which shows that the use of simulation system has a positive impact on collaborative learning and *H7* is supported. Use of simulation system and collaborative learning has ($\beta = 0.174$, $p < 0.001$) and ($\beta = 0.206$, $p < 0.001$) respectively which shows the use of simulation system and collaborative learning has a positive impact of learning performance of student; thus *H8*, *H9* are also supported Table 6.

Figure 2 show that 28.7% of variance exists in use of simulation system and 37.3% of variance exists in collaborative learning, and 28.9% of variance exists in learning performance of students.

14. Conclusion and future implication

The primary aim of this study is to examine the impact of simulation system on the learning performance of the students. As traditional methods of teaching just focus on class lectures, giving lectures on theories and concepts, simulation systems allow students to work practically but in a risk-free environment. The research was performed on students who belonged to different fields to determine the learning performance of the students with a simulation system. The result of the study examined whether student learning performance improves by using simulation system, by involving them in collaborative studies in groups, easy to use system, useful and fun learning environment. In this paper, Technology Adoption Model (TAM) is used to examine learning performance of the students who applied or have some know-how about simulation system. Data was collected from students of different fields like management sciences, pure sciences, information technology, and engineering; results show that simulation is a useful and easy system, and the element of fun also helps them to learn different concepts efficiently and efficiently. This paper also examined that collaborative environment enhances the learning performances of the students. Hence, the all hypotheses were supported.

Simulation system provides a collaborative environment which enhances learning performance of students. The simulation system is an opportunity for students to build a number of skills to work in groups like leadership skills, teamwork skills, conflict management skills, and negotiations skills, and learn from each other. According to Wood, Beckmann, and Birney (2009), learning leadership skills, teamwork skills, conflict management skills, and negotiations skills helps students in their practical workplace where people from different areas, culture, and personalities are working together. Simulation system allows students to link theory with practice. Simulation system can enhance students' learning performance by adopting different strategies for the implementation of various approaches and logic. Simulation systems allow students to learn how they can apply these theories and concepts in the practical workplace, which could generate better results for them.

Simulation-based studies are a useful, easy, and fun way of learning, which help students to think critically. There is a need to shift from traditional model of instruction (for examples lectures) to learner-based models, that support students to learn more while engaging themselves in the practical implication of theories. Simulation-based studies are considered as the supplement in classrooms learning, that enhances collaboration among students, and they involve and help each other in the learning process (Otting, Zwaal, & Gijselaers, 2009). Educators should put their efforts to generate students' attention and interest towards the studies. It is essential for educators to use simulation-based learning method so that students can get a better understanding of theory in a comfortable and fun environment. According to Pratt and Hahn (2016), fun elements maximize the learning process. Educators should take feedback from students regarding usefulness, easiness, and learning, so that course can be modified accordingly.

There are lots of challenges in the implementation of simulation-based learning. There is a need to train educators and instructors to learn new technologies and method of teaching so that they can enhance students' creativity and learning performance. People are always reluctant to adopt a new way of doing things, so there is a need to create awareness of simulation system adoption and its benefits for both students and instructors. Future research can be done in different departments to test the change in intention and attitude to adopt the field of study in which they used simulation system and how simulation system motivates and encourages students to choose the field of education in which they use simulation system.

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References

Adobor, H., & Daneshfar, A. (2006). Management simulations: Determining their effectiveness. *Journal of Management Development, 25*(2), 151–168. https://doi.org/10.1108/02621710610645135

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behaviour*. Englewood Cliffs, NJ: Prentice-Hall.

Alrafi, A. (2007). *The technology acceptance model a critical analysis with reference to the managerial use of information and communication technology (ICT)* (Doctoral Dissertation). Leeds Metropolitan University, Leeds.

Anderson, J., & Gerbing, D. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin, 103*(3), 411–423. https://doi.org/10.1037/0033-2909.103.3.411

Arbuckle, J. (2003). *Amos 5.0 Update to the AMOS User's Guide* (Doctoral Dissertation), Cicago, IL: Small Waters Corp.

Arifina, Z., & Frmanzah, . (2015). The effect of dynamic capability to technology adoption and its determinant factors for improving firm's performance; toward a conceptual model. In P.-S. Sciences (Ed.), *11th International Strategic Management Conference 2015* (pp. 786–796). Indonesia: Elsevier.

Barrett, P. (2007). Structural equation modelling: Adjudging model fit. *Personality and Individual Differences, 42*(5), 815–824. https://doi.org/10.1016/j.paid.2006.09.018

Bell, R., & Loon, M. (2015). Reprint: The impact of critical thinking disposition on learning using business simulations. *The International Journal of Management Education, 13*(2), 1–9.

Benbasat, I., & Bark, H. (2007). Quo vadis TAM? *Journal of the Association for Information Systems, 8*(4), 7.

Bhattacherjee, A. (2001). Understanding information systems continuance: An expectation-confirmation model. *MIS Quarterly, 25*(3), 351–370. https://doi.org/10.2307/3250921

Blakely, G., Skirton, H., Cooper, S., Allum, P., & Nelmes, P. (2010). Use of educational games in the health professions: A mixed-methods study of educators' perspectives in the UK. *Nursing & Health Sciences, 12*(1), 27–32. https://doi.org/10.1111/nhs.2010.12.issue-1

Bossert, S. (1988). Cooperative activities in the classroom. *Review of Research in Education, 15*, 225–253.

Bostan, B. (2009). Player motivations: A psychological perspective. *ACM Computers in Entertainment, 7*(2), 21–29.

Bruner, G., & Kumar, A. (2005). Explaining consumer acceptance of handheld internet devices. *Journal of Business Research, 58*(5), 553–558. https://doi.org/10.1016/j.jbusres.2003.08.002

Chaurasia, P., McClean, S. I., Nugent, C. D., Cleland, I., Zhang, S., Donnelly, M. P., Tschanz, J. (2016). Modelling assistive technology adoption for people with dementia. *Journal of Biomedical Informatics, 63*, 235–248. https://doi.org/10.1016/j.jbi.2016.08.021

Chea, S., & Luo, M. (2008). Post-adoption behaviors of e-service customers: The interplay of cognition and emotion. *International Journal of Electronic Commerce, 12*(3), 29–56. https://doi.org/10.2753/JEC1086-4415120303

Chena, H., & Ma, T. (2016). European Journal of Operational Research. *Optimizing systematic technology adoption with heterogeneous agents, 257*, 287–296.

Cheung, R., & Vogel, D. (2012). Designing web 2.0 collaboration tools to support project-based learning: An activity-oriented approach. International Journal of Systems and Service-Oriented. *Engineering,* 1–14.

Chittaro, L., & Sioni, R. (2015). Serious games for emergency preparedness: Evaluation of an interactive vs. a non-interactive simulation of a terror attack. *Computers in Human Behavior, 50*, 508–519. https://doi.org/10.1016/j.chb.2015.03.074

Chiu, C., & Wang, E. (2008). Understanding web-based learning continuance intention: The role of subjective task value. *Information & Management, 45*(3), 194–201. https://doi.org/10.1016/j.im.2008.02.003

Chuah, S. H.-W., Rauschnabel, P. A., Krey, N., Nguyen, B., Ramayah, T., & Lade, S. (2016). Wearable technologies: The role of usefulness and visibility in smartwatch adoption. *Computers in Human Behavior, 65*, 276–284. https://doi.org/10.1016/j.chb.2016.07.047

Cohen, E. (1994). Restructuring the classroom: Conditions for productive small groups. *Review of Educational Research, 64*(1), 1–35. https://doi.org/10.3102/00346543064001001

Csikszentmihalyi, M. (1975). Play and intrinsic rewards. *Journal of Humanist Psychology, 15*(3), 41–63.

Dascalu, M.-I., Bodea, C.-N., Moldoveanu, A., Mohora, A., Lytras, M., & de Pablos, P. O. (2015). A recommender agent based on learning styles for better virtual collaborative learning experiences. *Computers in Human Behavior, 45*, 243–253. https://doi.org/10.1016/j.chb.2014.12.027

Davis, F., Bagozzi, R. P., & Warshaw, P. R. (1992). Extrinsic and intrinsic motivation to use computers in the workplace. *Journal of Applied Social Psychology, 24*(14), 11–32.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340. https://doi.org/10.2307/249008

Davis, R., & Lang, B. (2012). Modeling game usage, purchase behavior and ease of use. *Entertainment Computing, 3*, 27–36. https://doi.org/10.1016/j.entcom.2011.11.001

Dewey, J. (1938). *Education and experience*. New York, NY: Macmillan.

Douglas, A., Miller, B., Kwansa, F., & Cummings, P. (2007). Students' perceptions of the usefulness of a virtual simulation in post-secondary hospitality student. *Journal of Teaching in Travel & Tourism, 7*(3), 1–19.

Doyle, D., & Brown, F. W. (2000). Using a business simulation to teach applied skills – the benefits and the challenges of using student teams from multiple countries. *Journal of European Industrial Training, 24*(6), 330–336. https://doi.org/10.1108/03090590010373316

Dulcica, Z., Pavlicb, D., & Silicc, I. (2012). Evaluating the intended use of Decision Support System (DSS) by applying Technology Acceptance Model (TAM) in business organizations in Croatia. In P.-S. Sciences (Ed.), *8th International Strategic Management Conference* (pp. 1565–1575). Croatia: Elsevier.

Ebner, M., & Holzinger, A. (2007). Successful implementation of user-centered game based learning in higher education: An example from civil engineering. *Computers & Education, 49*(3), 873–890. https://doi.org/10.1016/j.compedu.2005.11.026

Fagan, M., Kilmon, C., & Pandey, V. (2012). Exploring the adoption of a virtual reality simulation: The role of perceived ease of use, perceived. *Campus-Wide Information Systems, 29*(2), 117–127.10.1108/10650741211212368

Flynn, B., Sakakibara, S., Schroeder, R., Bates, K., & Flynn, E. (1990). Empirical research methods in operations management. *Journal of Operations Management, 9*(2), 250–284. https://doi.org/10.1016/0272-6963(90)90098-X

Fraser, B., & Treagust, D. (1986). Validity and use of an instrument for assessing classroom psychosocial environment in higher education. *Higher Education, 15*(1), 37–57. https://doi.org/10.1007/BF00138091

Fripp, J. (1997). A future for business simulations? *Journal of European Industrial Training, 21*(4), 138–142. https://doi.org/10.1108/03090599710171387

Gaba, D., Howard, S., & Fish, K. (2001). Simulation-based training in anesthesia crisis resource management (ACRM): A decade of experience. *Simulation and Gaming, 32*, 175–193. https://doi.org/10.1177/104687810103200206

Garris, R., Ahlers, R., & Driskell, J. (2002). Games, motivation, and learning: A research and practice model. *Simulation & Gaming, 33*(4), 441–467. https://doi.org/10.1177/1046878102238607

Grantcharov, T., Kristiansen, V., Bendix, J., Bardram, L., Rosenberg, J., & Funch-Jensen, P. (2004). Randomized clinical trial of virtual reality simulation for laparoscopic skills training. *British Journal of Surgery, 91*, 146–150. https://doi.org/10.1002/(ISSN)1365-2168

Gredler, M. (2004). Games and simulations and their relationships to learning. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology – A project of the association for educational communications and technology* (pp. 571–581). Mahwah, NJ: Lawrence Erlbaum.

Guo, J.-X., & Zhu, L. (2016). Optimal timing of technology adoption under the changeable abatement coefficient through R&D. *Computers & Industrial Engineering, 96*, 216–226. https://doi.org/10.1016/j.cie.2016.03.025

Hair, J., Anderson, R., Tatham, ., & Black, W. (1998). *Multivariate data analysis*. Englewood Cliffs, NJ: Prentice Hall.
Hamida, A. A., Razak, F. Z., Bakar, A. A., & Abdullah, W. W. (2016). The effects of perceived usefulness and perceived ease of use on continuance intention to use e-government. In 5th & 7th International Economics & Business Management Conference (Ed.), *Procedia economics and finance* (pp. 644–649). Universiti Tenaga Nasional: Elsevier B.V.
Hart, M., & Porter, G. (2004). The impact of cognitive and other factors on the perceived usefulness of OLAP. *Journal of Computer Information Systems, 45*(1), 47–56.
Heijden, H. V. (2003). Factors influencing the usage of websites: The case of a generic portal in The Netherlands. *Information & Management, 40*(6), 541–549. https://doi.org/10.1016/S0378-7206(02)00079-4
Hmelo-Silver, C. E., Chinn, C. A., Chan, C. K., & O'Donnell, A. M. (Eds.). (2013). *The International Handbook of Collaborative Learning*. New York, NY: Routledge.
Hong, S., Thong, J., & Tam, K. (2006). Understanding continued information technology usage behavior: A comparison of three models in the context of mobile internet. *Decision Support Systems, 42*(3), 1819–1834. https://doi.org/10.1016/j.dss.2006.03.009
Hooper, D., Coughlan, J., & Mullen, M. (2008). Structural equation modelling: Guidelines for determining model fit. *Electronic Journal of Business Research Methods, 6*(1), 53–60.
HsuL, C., & Lin, J. (2008). Acceptance of blog usage: The roles of technology acceptance, social influence and knowledge sharing motivation. *Information & Management, 45*(1), 65–74.
Hu, L., & Bentler, P. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1–55. https://doi.org/10.1080/10705519909540118
Hughes, S., & Scholtz, F. (2015). Increasing the impact of a business simulation: The role of reflection. *The International Journal of Management Education,* 1–12.
Hung, S.-Y., Tsai, J. C.-A., & Chou, S.-T. (2016). Decomposing perceived playfulness: A contextual examination of two social networking sites. *Information & Management, 53*(6), 698–716. https://doi.org/10.1016/j.im.2016.02.005
Johnson, D. W. (1984). *Cooperation in the classroom*. Edina, MN: Interaction Book.
Jones, K. (1998). Simulations as Examinations. *Simulation & Gaming, 29*(3), 331–341. https://doi.org/10.1177/1046878198293010
Junco, R., Heiberger, G., Loken, E. (2011). The effect of Twitter on college student engagement and grades. *Journal of Computer Assisted Learning, 27*(2), 119–132. https://doi.org/10.1111/jca.2011.27.issue-2
Ke, F., & Carafano, P. (2016). Collaborative science learning in an immersive flight simulation. *Computers & Education, 103*, 114–123. https://doi.org/10.1016/j.compedu.2016.10.003
King, M., & Newman, R. (2009). Evaluating business simulation software: Approach, tools and pedagogy. *On the Horizon, 17*(4), 268–377.
Kolb, D. (1984). *Experiential learning: Experience as the source of learning and development*. (E. Cliffs, Ed.). Upper Saddle River, NJ: Prentice-Hall Inc.
Kreijns, K., Kirschner, P., Jochems, W., Buuren, H. V. (2007). Measuring perceived sociability of computer-supported collaborative learning environments. *Computers and Education, 49*(2), 176–192. https://doi.org/10.1016/j.compedu.2005.05.004
Lainemaa, T., & Nurmib, S. (2006). Applying an authentic, dynamic learning environment in real world business. *Computers & Education, 47*(1), 95–115.
Lateef, F. (2010). Simulation-based learning: Just like the real thing. *Journal of Emergencies, Trauma, and Shock, 3*(4), 348–352. https://doi.org/10.4103/0974-2700.70743
Lean, J., Moizer, J., Towler, M., & Abbey, C. (2006). Simulations and games. *Active Learning in Higher Education, 7*(3), 227–242. https://doi.org/10.1177/1469787406069056
Leemkuil, H., Jong, T. D., & Ootes, S. (2000). Review of educational games and simulations. *KITS Consortium,* 110–119.
Liu, C.-H., & Huang, Y.-M. (2015). An empirical investigation of computer simulation technology acceptance to explore the factors that affect user intention. *Universal Access in the Information Society, 14*(3), 449–457. https://doi.org/10.1007/s10209-015-0402-7
Lytras, M. D., Mathkour, H. I., Abdalla, H., Al-Halabi, W., Yanez-Marquez, C., & Siqueira, S. W. (2015). An emerging – Social and emerging computing enabled philosophical paradigm for collaborative learning systems: Toward high effective next generation learning systems for the knowledge society. *Computers in Human Behavior, 51*, 557–561. https://doi.org/10.1016/j.chb.2015.06.004
Madge, C., Meek, J., Wellens, J., & Hooley, T. (2009). Facebook , social integration and informal learning at university: 'It is more for socialising and talking to friends about work than for actually doing work'. *Learning, Media and Technology, 34*(2), 141–155. https://doi.org/10.1080/17439880902923606
Mawhirter, D. A., & Garofalo, P. F. (2016). Expect the Unexpected: Simulation Games as a Teaching Strategy. *Clinical Simulation in Nursing, 12*(4), 132–136. https://doi.org/10.1016/j.ecns.2015.12.009
McQuitty, S. (2004). Statistical power and structural equation models in business research. *Journal of Business Research, 57*(2), 175–183. https://doi.org/10.1016/S0148-2963(01)00301-0
Miles, J., & Shevlin, M. (2007). A time and a place for incremental fit indices. *Personality and Individual Differences, 42*(5), 869–874. https://doi.org/10.1016/j.paid.2006.09.022
Moon, J., & Kim, Y. (2001). Extending the TAM for a World-Wide-Web context. *Information and Management, 38*(4), 217–230. https://doi.org/10.1016/S0378-7206(00)00061-6
Nale, R., Rauch, D., Wathen, S., & Barr, P. (2000). An exploratory look at the use of importance-performance analysis as a curricular assessment tool in a school of business. *Journal of Workplace Learning, 12*(4), 139–145. https://doi.org/10.1108/13665620010332048
Nysveen, H., Pedersen, P., & Thorbjørnsen, H. (2005). Intentions to use mobile services: Antecedents and cross-service comparisons. *Journal of the Academy of Marketing Science, 33*, 330–346. https://doi.org/10.1177/0092070305276149
Otting, H., Zwaal, W., & Gijselaers, W. (2009). International hospitality management students' epistemological beliefs and conceptions of teaching and learning. *Journal of Hospitality & Tourism Education, 21*(3), 44–53. https://doi.org/10.1080/10963758.2009.10696951
Pando-Garcia, J., Periañez-Cañadillas, I., & Charterina, J. (2015). Business simulation games with and without supervision: An analysis based on the TAM model. *Journal of Business Research, 69*, 1731–1736.
Pe-Than, E. P., Goh, D. H.-L., & Lee, C. S. (2014). Making work fun: Investigating antecedents of perceived enjoyment in human computation games for information sharing. *Computers in Human Behavior, 39*, 88–99. https://doi.org/10.1016/j.chb.2014.06.023
Popil, I., & Dillard-Thompson, D. (2015). A game-based strategy for the staff development of home health care nurses. *The Journal of Continuing Education in Nursing,* 205–207.
Pratt, M. A., & Hahn, S. (2016). Enhancing hospitality student learning through the use of a business simulation. *Journal*

of Hospitality, Leisure, Sport & Tourism Education, 19, 10–18. https://doi.org/10.1016/j.jhlste.2016.05.001

Radner, R., & Rothschild, M. (1975). On the allocation of effort. *Journal of Economic Theory, 10*, 358–376. https://doi.org/10.1016/0022-0531(75)90006-X

Rai, V., & Robinson, S. A. (2015). Agent-based modeling of energy technology adoption: Empirical integration of social, behavioral, economic, and environmental factors. *Environmental Modelling & Software, 70*, 163–177. https://doi.org/10.1016/j.envsoft.2015.04.014

Rosen, K. R. (2008). The history of medical simulation. *Journal of Critical Care, 23*(2), 157–166. https://doi.org/10.1016/j.jcrc.2007.12.004

Sadeghi, H., & Kardan, A. A. (2015). A novel justice-based linear model for optimal learner group formation in computer-supported collaborative learning environments. *Computers in Human Behavior, 48*, 436–447. https://doi.org/10.1016/j.chb.2015.01.020

Shapiro, M., Morey, J., Small, S., Langford, V., Kaylor, C., Jagminas, L. ... Jay, G. D. (2004). Simulation based teamwork training for emergency department staff: Does it improve clinical team performance when added to an existing didactic teamwork curriculum? *Quality and Safety in Health Care, 13*(6), 417–421. https://doi.org/10.1136/qshc.2003.005447

Steiger, J. (2007). Understanding the limitations of global fit assessment in structural equation modeling. *Personality and Individual Differences, 42*(5), 893–898. https://doi.org/10.1016/j.paid.2006.09.017

Strahilov, A., & Damrath, F. (2015). Simulation of the behavior of pneumatic drives for virtual commissioning of automated assembly systems. *Robotics and Computer-Integrated Manufacturing, 36*, 101–108. https://doi.org/10.1016/j.rcim.2015.01.001

Sukkar, A., & Hasan, H. (2005). Toward a model for the acceptance of internet banking in developing countries. *Information Technology for Development, 11*, 381–398.

Tabachnick, B., & Fidell, L. (2007). *Using multivariate statistics* (5th ed.). New York, NY: Allyn and Bacon.

Thavikulwat, P. (2004). The architecture of computerized business gaming simulations. *Simulation & Gaming, 35*(2), 242–269. https://doi.org/10.1177/1046878104263545

Thong, J., Hong, S.-J., & Tam, K. (2006). The effects of post-adoption beliefs on the expectation confirmation model for information technology continuance. *International Journal of Human-Computer Studies, 64*, 799–810. https://doi.org/10.1016/j.ijhcs.2006.05.001

Venkatesh, V., & Speier, C. (2000). Creating an effective training environment for enhancing telework. *International Journal of Human-Computer Studies, 52*, 991–1005. https://doi.org/10.1006/ijhc.1999.0367

Vygotsky, L. (1978). *Mind in society: The development of higher psychology psychology*. Cambridge, MA: Harvard University Press.

Wood, R., Beckmann, J., & Birney, D. (2009). Simulations, learning and real world capabilities. *Education & Training, 51*(5/6), 491–510. https://doi.org/10.1108/00400910910987273

Xu, L., Lin, J., & Chan, H. C. (2012). The moderating effects of utilitarian and hedonic values on information technology continuance. *ACM Transactions on Computer-Human Interaction (TOCHI), 19*(2), 12–26.

Zakaria, N., & Yusof, S. A. (2016). Understanding technology and people issues in hospital information system (HIS) adoption: Case study of a tertiary hospital in Malaysia. *Journal of Infection and Public Health, 9*, 774–780. https://doi.org/10.1016/j.jiph.2016.08.017

Zhao, Q., Chen, C.-D., & Wang, J.-L. (2016). The effects of psychological ownership and TAM on social media loyalty: An integrated model. *Telematics and Informatics, 33*, 959–972. https://doi.org/10.1016/j.tele.2016.02.007

Zhuhadar, L., Yang, R., & Lytras, M. (2013). The impact of social multimedia systems on cyberlearners. *Computers in Human Behavior, 29*(2), 378–385. https://doi.org/10.1016/j.chb.2012.09.009