The Relationships among Students' Personal Innovativeness, Compatibility, and Learning Performance: A Social Cognitive Theory Perspective

Wei-Tsong Wang* **and Ying-Lien Lin**
Department of Industrial and Information Management, National Cheng Kung University, Taiwan // wtwang@mail.ncku.edu.tw // r38021019@gs.ncku.edu.tw
*Corresponding author

(Submitted July 31, 2020; Revised August 21, 2020; Accepted January 12, 2021)

ABSTRACT: Although online learning systems (OLSs) are widely discussed with regard to most forms of higher education, they are still immature in terms of their development and compared to mainstream teaching and learning activities, and their implementation remains a challenge. Few studies have investigated the factors that contribute to students' learning performance in the context of the adoption of OLSs in higher educational institutions. Additionally, among the handful of studies that focus on this research issue, investigating the influences of environmental factors and personal innovativeness on students' learning performance and adoption of OLSs has received very little attention. Consequently, by integrating social cognitive theory and innovation diffusion theory, this study developed a theoretical model of OLS adoption. It empirically validated the model using data collected from 151 undergraduate students who used OLSs. The results showed that key compatibility (as an environmental factor) and personal innovativeness (as a personal factor) had significant direct and/or indirect influences on students' learning performance and continued intentions to use OLSs. Theoretical and practical implications are also discussed.

Keywords: Social cognitive theory, Innovation diffusion theory, Personal innovativeness, Compatibility, Learning performance

1. Introduction

The use of information technology systems (ITSs) via electronic devices can help students accomplish learning tasks. ITSs can transform how students learn new things and enable them to obtain the sophisticated domain knowledge that is needed to develop the higher-order critical thinking skills and necessary to cope with various conditions in real-world practices. Such skills are not easy to obtain. Using online learning systems (OLSs) may help students in higher educational institutions learn more effectively by providing useful functions to complement traditional, classroom-based educational arrangements. OLSs have various advantages for students, including accelerating the delivery of materials, accessing course content, increasing the flexibility and convenience of schedules, and removing geographic constraints (e.g., Hsu, Chen, & Ting, 2018; Novotny, Stapleton, & Hardy, 2016). Many universities have been using OLSs (i.e., Moodle, Blackboard) to facilitate students' learning and deliver online courses to improve students' learning performance or processes (e.g., Cheng & Yuen, 2019; Damnjanovic, Jednak, & Mijatovic, 2015; Risner & Kumar, 2016).

In the higher education field, a substantial body of studies has investigated OLSs. The purpose of this study is to investigate students' learning performance and continued intention in online learning based on the model of social cognitive theory (SCT). Few studies aim to understand the relationships among personal factors, environmental factors, and behavioral factors in the context of online learning. Therefore, the proposed model of this study includes two paths, namely, the person-belief-behavior path (personal innovativeness → perceived usefulness → continued intention or learning performance) and the environment-belief-behavior path (compatibility → perceived usefulness → continued intention or learning performance). Some researchers have examined the effects of compatibility and innovativeness on perceived usefulness and continued intention (e.g., Cheng, 2014; Huang, Yu, Tang, & Chang, 2019; Wang, Jung, Kang, & Chung, 2014). However, most of them do not address students' OLS learning experiences in ways that can improve students' learning performance in healthcare education settings. We extend the extant research and investigate personal innovativeness and compatibility, affecting students' learning performance and continued intention.

OLSs allow for active and self-directed learning as they provide students with the freedom to conveniently access, share, and discuss subject information, lecture notes, and other learning resources (Smart, Ross, Carollo, & Williams-Gilbert, 2020). OLSs have various advantages for students over conventional methods, including accelerating course content delivery, increasing the flexibility and convenience of schedules, removing

geographic constraints, and promoting students' learning performance and continued intention (Acosta et al., 2018; Huang et al., 2019). Nevertheless, the adoption of OLSs among students has not yet reached the expected level. An OLS with a high level of compatibility means that its functions or innovation can meet students' preferences or needs, making them more comfortable for students to use. Moreover, each online course has unique course objectives or demands that may require unique solutions through OLSs (Smith, Passmore, & Faught, 2009). Such solutions facilitate students' willingness to continue using OLSs (Panigrahi, Srivastava, & Sharma, 2018). It is critical to identify the environmental factors (e.g., compatibility and perceived usefulness) of OLSs and students' innovativeness in higher educational contexts.

There have not been enough research efforts to investigate the personal or environmental factors of learning technologies that can better meet students' needs in higher educational contexts, especially in the areas of healthcare and nurse education (e.g., Smart et al., 2020; Zayim & Ozel, 2015). Prior studies have often been conducted from a technology-acceptance or motivation-theoretical perspective, and their contributions have thus been limited in providing a comprehensive understanding of the current study's focal issue. Therefore, this study adopts social cognitive theory (SCT), a comprehensive theory for understanding various types of human behaviors, as its primary theoretical base. We incorporate innovation diffusion theory (IDT) (Rogers, 1995; Rogers, 2003) to identify key personal factors and critical environmental factors based on the central premise of SCT to develop our research model. Additionally, the findings of this study can offer further insight for the developers of learning systems into the development of guidelines that enable the design and delivery of high-quality OLSs, including effective online mechanisms for students to obtain better learning outcomes. The results of the current can also assist policymakers in effectively allocating educational resources and enable instructors to teach in a manner that better supports students' learning activities. The research question (RQ) of this study is thus summarized as follows:
RQ: How do student-related personal, environmental, and behavioral factors influence students' learning performance in online courses supported by OLSs?

2. Review of the relevant literature

2.1. OLSs in higher education

Academics use various terms, including e-learning, distance learning, m-learning, virtual classroom, virtual learning environment, and web-based learning, which are often used interchangeably to denote online learning systems/tools (e.g., Panigrahi et al., 2018; Raman, Achuthan, Nedungadi, Diwakar, & Bose, 2014). These technology-supported learning systems are also called learning management systems, e-learning systems, or OLSs (Hill, Chidambaram, & Summers, 2017). In this study, we use the term "online learning system (OLS)."

The online courses supported by OLSs offer learner-centered instruction that can facilitate students' active learning, collaboration, and communication based on individual levels of innovativeness. Such OLS courses, especially clinical training courses, enhance students' self-confidence to improve their professional cognitive reasoning abilities to make decisions or judgments when they experience a significant challenge in real-world problem-solving. However, challenges remain for the effective use of OLSs. OLS developers must address challenges regarding all forms of special learning needs, such as the design of user-friendly interfaces and the sequence of learning tasks, for the sake of students. Additionally, design issues related to various platforms (e.g., iOS and Android); hardware manufacturers (e.g., Apple, Google, and Samsung); unfriendly user interfaces; and usability limitations must be carefully considered (Song, Singleton, Hill, & Koh, 2004). In online courses, students constantly utilize visual imaging tools and respond to simulated scenarios to enhance their cognitive reasoning abilities. Thus, the developers of OLSs should develop useful and compatible systems to assist students' learning tasks. Compatibility refers to students' fitness of beliefs, learning preferences, and values (e.g., critical thinking, information, and communication skills) with regard to online courses using OLSs (Cheng, 2014).

Al-Azawei, Parslow, and Lundqvist (2017) stated that eliminating learning barriers, matching learners' needs, and integrating instructional technology into e-course designs can improve learners' perceptions and beliefs. Consequently, Hansen (2018) argued that online learning with a flexible and self-paced model is an excellent way of accommodating students' learning needs from the point of view of the online competency-based education model. To address students' concerns regarding the use of an OLS, the OLS must provide a positive experience for its users and a positive linkage between students' learning performance and their willingness to continuously use OLSs.

There are practical difficulties for students in using OLSs, such as environmental factors and personal factors, which create significant challenges to instructors and OLS developers (Ma & Lee, 2019; Song et al., 2004). Several researchers have reported that the primary barriers to OLSs are administrative issues, technological issues, social influences, and individual differences rather than the design of the learning materials themselves (e.g., Ali, Uppal, & Gulliver, 2018; Mckimm, Jollie, & Cantillon, 2003). Such barriers may decrease the level of students' acceptance of OLSs. Inappropriate technologies, inadequate facilities (e.g., file format compatibility, video size/clip, and storage), insufficient technical support, a lack of learning skills, and a lack of training programs are the primary barriers to OLS success (Al-Azawei et al., 2017).

The adoption of OLSs by students is becoming increasingly popular because OLS-supported online learning tools and activities allow students to gain knowledge beyond the textbook and provide profound and meaningful learning experiences. From a nontechnological perspective, several studies have examined the effects of beliefs and characteristics on students' continued intentions (Cheng, 2014; Damnjanovic et al., 2015). Consequently, we believe that environmental factors and personal innovativeness are key factors influencing students' learning performance in OLS use.

2.2. The integrated theoretical model for building positive learning behaviors

The central premise of SCT is that there is a relationship between cognitive or personal factors, environmental factors, and behavior. Currently, SCT is widely used as a theoretical model in various fields such as academic achievement (Hill et al., 2017) and with regard to learners' continued intention to use an OLS (Iqbal & Bhatti, 2017). Based on the above discussion, we believe that SCT is an adequate framework for understanding students' learning performance because it incorporates the effects of both personal and environmental factors on the continued intention to use OLSs.

Additionally, it is argued that IDT, which is grounded in the sociological perspective, is a useful model for understanding the process by which the use of innovations spreads within and between social systems (Rogers, 1995). Agarwal and Prasad (1998) pointed out that personal innovativeness has diverse forms of effects on adopting new technologies. Personal innovativeness can be integrated into research models to measure educational innovation, which is an efficient way to analyze users' critical factors. Moreover, OLSs with a high compatibility level that matches users' needs can lead to high user-perceived usefulness levels (Cheng, 2014).

Because every theory has distinct roots and, thus, limited explanatory power, a theoretical framework that appropriately integrates various theoretical perspectives to comprehend a specific research issue is beneficial in advancing our understanding of the focal issue. Based on the discussion presented above, this study adopts SCT as the theoretical foundation and integrates IDT as part of the theoretical framework to extend the SCT model to investigate students' learning performance and behavioral intentions regarding OLS use in the context of higher education.

3. Research model and hypotheses

Based on previous studies, the SCT framework assumes relationships with its three factors associated with students adopting OLSs and learning performance in an online learning environment (e.g., Ifinedo, 2017; Iqbal & Bhatti, 2017). Although SCT is a triadic reciprocity model, we only used three SCT factors to examine students' continued intention and learning performance. Thus, the proposed hypotheses have no path loops. This study is a cross-sectional investigation and mainly examines the effects of two paths, i.e., the person-belief-behavior path and the environment-belief-behavior path, as shown in Figure 1.

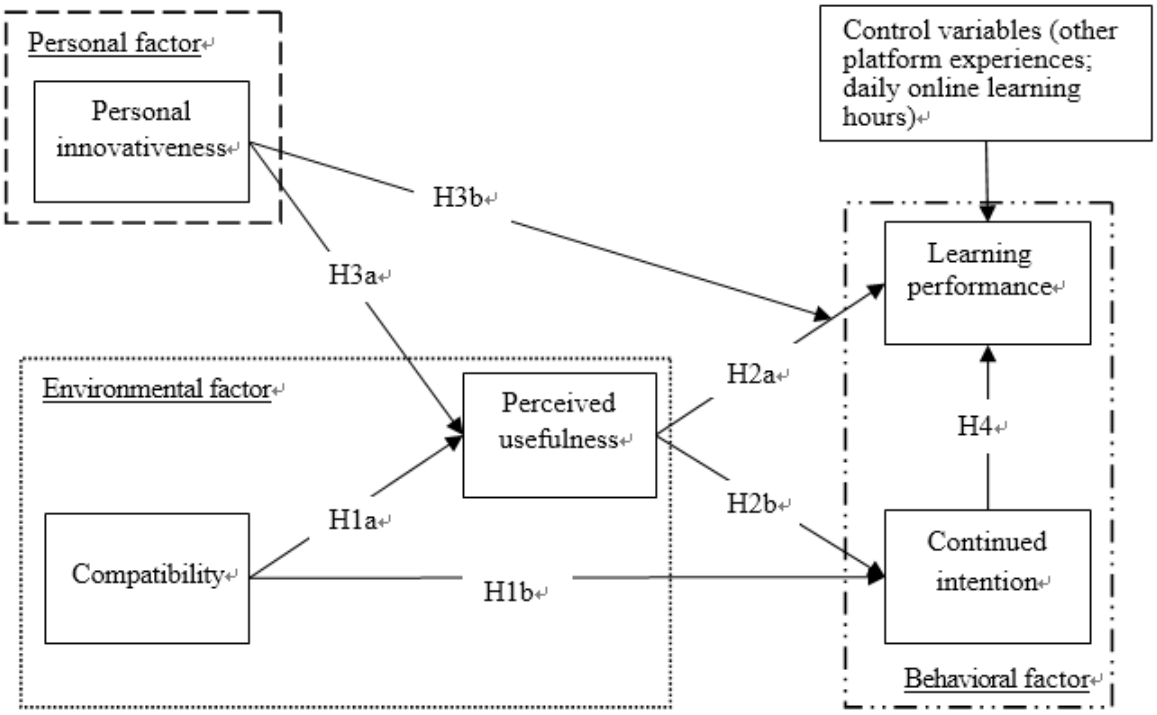


Figure 1. Proposed integrated model for online learning system adoption

3.1. Environmental factor

Based on SCT, Rogers (2003) defined compatibility as the degree to which students' use of OLSs is compatible with their current values, prior experiences, and current needs. *Perceived usefulness* can be described as the degree to which students perceive the adoption of an OLS as useful and appropriate in supporting their learning process (Park, 2009).

Compatibility is commonly regarded as a necessity for students to prevent potential conflict due to the different characteristics of various computers and learning systems (e.g., capabilities and applications) in their learning process. When an OLS has a high level of compatibility with students' preference and practice style, the willingness of those students to use OLSs will increase. This implies that compatibility can significantly affect perceived usefulness. The positive perceived value regarding the compatibility of an OLS is consistent with students' learning experiences and needs, which implies that an OLS with a high level of compatibility leads to increased continued intention (Raman et al., 2014; Cheng, 2014). Accordingly, the following hypotheses are proposed:
H1a Compatibility is positively related to the perceived usefulness of an OLS.
H1b Compatibility is positively related to continued intention to use an OLS.

The research indicates that perceived usefulness significantly affects students' learning performance (Davis, 1989). A useful OLS can provide a better learning environment and assist students in managing their learning process. The perceived usefulness of an OLS means that students' perception that OLSs will enhance their learning performance (Johnson, Hornik, & Salas, 2008; Liaw & Huang, 2016). It can be inferred that perceived usefulness is a key determinant of students' judgments regarding their learning performance in an online course as a high level of perceived usefulness will enhance students' beliefs of outcome values. Additionally, the relationship between students' perceived usefulness and their continued intentions to use an OLS has been extensively studied (e.g., Findik-Coşkunçay, Alkiş, & Özkan-Yildirim, 2018; Huang et al., 2019; Ma & Lee, 2019). Thus, the essence of perceived usefulness (e.g., a well-designed system, perceived value, and service quality) can positively affect students' continued intention to use an OLS. Therefore, the following hypotheses are proposed:
H2a Perceived usefulness is positively related to students' learning performance.
H2b Perceived usefulness is positively related to continued intention to use an OLS.

3.2. Personal factor

Individuals with high levels of personal innovativeness may be risk-takers, and, therefore, they may focus their attention on the performance of new technology (Liu, Li, & Carlsson, 2010). Innovative students are more likely to develop more positive beliefs about OLSs than those with lower levels of innovativeness. Students focus on their preferred learning pathways, which they perceive to enable them to gain various experiences and change their learning behaviors. Such positive beliefs regarding OLS performance are likely to increase students' perceptions of OLS usefulness (e.g., Huang et al., 2019; Lu, Yao, & Yu, 2005). Based on the results of these studies, this study considered personal innovativeness to be a determinant of perceived OLS usefulness. Therefore, the following hypothesis is proposed:
H3a Personal innovativeness is positively related to the perceived usefulness of OLSs.

In the current study, innovativeness refers to an individual's inherent tendency to try new technologies (Agarwal & Prasad, 1998). Individuals with a high level of innovativeness tend to have positive performance expectancy because they are more likely to utilize new learning technologies well, to identify and access multiple sources of critical knowledge, to adopt new ideas, and then change learning styles or habits correspondingly and to adjust self-learning strategies to achieve better performance. The prior studies show that personal innovativeness is a key moderator of the effect of perceived usefulness on IT usage behavior and its consequences (e.g., Agarwal & Prasad, 1998; Cheng, 2014; Shaw & Sergueeva, 2019). Therefore, the following hypothesis is developed:
H3b Personal innovativeness positively moderates the relationship between perceived usefulness and learning performance.

3.3. Behavioral factor

In this study, continued intention refers to students' intention to use an IT-based tool (e.g., an OLS) to perform learning activities (Davis, 1989). When individuals have a pleasant experience using OLSs, they may exhibit a positive attitude toward online learning activities and are more likely to continue to use OLSs to assist them in learning. If the functions provided by OLSs are a good match with students' learning tasks, the use of those OLSs may improve their learning performance. Students will likely use an OLS to achieve a desirable learning performance (Han &Yi, 2019; Kuo & Hwang, 2015). Therefore, the following hypothesis is proposed:
H4 Students' continued intention to use OLSs is positively related to learning performance.

3.4. Control variables

Daily internet hours and experience with other online learning platforms were used as the control variables for the constructs of learning performance to avoid spurious effects and specification errors in the model as they are contextual variables that have the potential to influence issues related to ITSs.

4. Methodology

4.1. Participants and procedure

In this study, a survey approach was used to collect data about the experiences of students who enrolled in online courses. The courses used in this study are online curricula because most of the lectures are delivered online using OLSs. The lectures are organized into weekly lessons and alternate between online (14 weeks) and face-to-face (4 weeks) formats. The instructional delivery approach of the online courses is designed following school regulations. Although the online courses are based on blended curricula (e.g., Jonker, März, & Voogt, 2020; Risner & Kumar, 2016), they emphasize the online lecture delivery modality (Smith et al., 2009).

The vast majority of studies assessing online learning adoption tacitly postulate that adoption among disciplines of online learning is homogeneous (Smith et al., 2009). In this study, the online courses investigated are part of university curricula and cover essential healthcare subjects. The qualifications of the students enrolled in online courses are limited to a specific semester or department. Additionally, the online courses use similar formats of teaching materials, processes, and digital tools as those supported by OLSs (e.g., Novotny et al., 2016; Teo, Zhou, Fan, & Huang, 2019; Cheng & Yuen, 2019). The functions of OLSs include text-based content, multimedia, prerecorded video, hyperlinks, face-to-face lectures, traditional assessment methods (e.g., exams),

and communication tools (e.g., messages, e-mail, forums). We thus consider the online courses investigated in this study to be essentially homogeneous.

The survey participants were students who enrolled in six courses related to optometry, biostatistics, healthcare, medical computer applications, and multimedia design for geo-information (two classes) in two medical universities. Unlike the conventional instructional delivery approach, these online courses must be approved after a school meeting. The unique contexts require an understanding that online courses may be similar but that each student selects online courses with a slightly different set of goals and objectives. An online course can provide flexibility for students to learn at a convenient time and enhance their learning effectiveness in conjunction with other learning strategies (Smart et al., 2020). For example, students may have the opportunity to participate in an off-campus internship program in hospitals or different industries. Additionally, students can cover more material in a shorter amount of time in online courses. Further, online courses are convenient for those who must pass a national examination for licensure as an optometrist, pharmacist, nurse, or other healthcare professional. Thus, the content of online courses can be delivered more effectively to students than through conventional learning methods.

According to our investigation, approximately 50 to 60 classes are organized (approximately less than 2% of the three thousand courses every semester) as asynchronous or synchronous online courses at one of the universities but only 10 or fewer courses at the other university every semester. An invitation letter was sent to the instructors of all 10 online courses offered to request their participation. The instructors of six online courses (with approximately 300 potential participants) agreed to participate in the study. All of the students in those six courses were invited to participate in our survey, and the course instructors agreed to provide grades from the midterm and final exams for our data analysis procedures with the consent of the participating students. The data were collected using an online survey by Google Forms, which was analyzed to validate the proposed model shown in Figure 1. We used the LINE app or an email, and the questionnaires were then distributed to the students of six courses. In addition, the instructors were informed of the nature of the survey. We did not force the students to participate in the survey. If the students were not willing to provide their scores, they were not required to click the URL of the Google Form. The participants were asked to answer the survey questionnaire based on their experience in the online learning process.

The qualifications of the participants were ensured, and the instructors provided the respondents' midterm and final exam scores based on the respondents' IDs. All research procedures were conducted with the consent of the instructors who had reviewed the questionnaire beforehand. There was a short description of the study at the beginning of the questionnaire so the participants could fully understand their rights and interests. Thus, all the participants were aware that their participation was voluntary and that they could freely participate or withdraw at any time. All the respondents remained anonymous in the survey. Ethics approval of the study's procedures (Ethics Committee No. 109-088-02) was obtained through the authors' university governance framework for human research.

4.2. Instrument development

With regard to the content of the questionnaire, we invited two scholars in the field of online learning and education to examine the questionnaire. The wording of the question items was slightly modified to fit the online learning context and enhance validity. Personal innovativeness was evaluated by using the three items from Agarwal and Prasad (1998). Compatibility was measured by using the three-item scale of Duan, He, Feng, Li, and Fu (2010). Perceived usefulness was assessed by using the three-item scale of Davis et al. (1989). Continued intention was measured by using the three-item scale of Cheng (2014). The learning performance construct was evaluated based on the scores of the students' midterm and final exam, which were provided by the courses' teachers. Except for learning performance (students' midterm exam and final exam scores range from 1 to 100), other items were rated using a five-point Likert scale in which 1 means "strongly disagree" and 5 means "strongly agree."

4.3. Data analysis procedures

This study mainly concerns the effects of personal innovativeness and compatibility on learning performance. In the survey, the covariance-based structural equation modeling (CB-SEM) method was used to evaluate the structural relationships among the variables. Byrne (2006) suggested that the CB-SEM approach is appropriate and exhibits robust statistics and fit indices against the normality assumption for theory-driven empirical

research. Thus, the PROCESS macro of SPSS software developed by Hayes (2013) was used to perform the data analysis procedures for evaluating the moderating effect of personal innovativeness. Additionally, the AMOS software package was used to conduct the CB-SEM technique's data analysis procedures to examine the goodness-of-fit of the measurement and structural models of the research model and validate the developed hypotheses.

Reflective measurement instruments were used to evaluate reliability, convergent validity, and discriminant validity to ensure that their corresponding constructs were adequate. Composite reliability (CR) was used to assess scale reliability, while Cronbach's alpha coefficients were used to evaluate internal consistency reliability. The reliability of the threshold was over .7 for CR; a value of .7 for Cronbach's alpha is recommended (Hair, Black, Babin, & Anderson, 2010). If the factor loadings of the indicators are beyond the restrictive criterion of .5 or higher, they are significantly related to the corresponding constructs. If the average variance extracted (AVE) values of the reflective constructs are higher than .5, convergent validity is supported. If the squared correlations between a given construct and other constructs in the model are smaller than the corresponding AVE estimates, it suggests that the measurements are adequate for research purposes. In addition, the values of the square root of the AVE are greater than the correlation estimate of the two constructs, which shows good evidence of discriminant validity.

Finally, an adequate structural model was obtained, and the significance of our research hypothesis was obtained using CB-SEM to estimate the parameter via 151 valid samples. The indices for examining the goodness-of-fit of both the measurement and structural models of our research model were examined using those recommended for CB-SEM research, including the product of the minimum-fit-function chi-square statistic divided by the degree of freedom (χ^2/df), robust confirmatory fit index (CFI), root-mean-square error of approximation (RMSEA), standardized root mean square residual (SRMR), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), normed fit index (NFI), and Tucker–Lewis index (TLI). Additionally, we examined the significance of the path coefficient estimation and the determination coefficients (R^2) of the endogenous constructs.

5. Data analysis and results

A total of 18 responses were considered invalid due to the respondents' failure to properly answer the survey questions or to obvious systemic answers, thus yielding 151 valid responses. Regarding our sample's demographic profile, 60.26% of the respondents were female; this profile is similar to those of the students at the two universities that participated in this study. All of them were between 19 and 23 years old, and more than 86.09% of them spent more than two hours per day in online learning. Additionally, 27.81% of the students had experience with other learning platforms. *For the control variables*, the results showed that daily internet/online learning hours were significantly associated with learning performance, whereas experience with other online learning platforms was not.

Table 1. The results of goodness-of-fit measure via CB-SEM

Model	χ^2	χ^2/d.f.	RMSEA	SRMR	CFI	GFI	AGFI	NFI	TLI
Measurement	107.45	1.6	.06	.04	.97	.92	.87	.93	.96
Structural	169.29	2.42	.1	.07	.94	.87	.81	.9	.92
Cutoff value	-	< 3	< .08-.1[(a)]	< .08	> .9	> .9	> .8	> .9	> .9

Note. [(a)] The criteria are acceptable (Hu & Bentler, 1999).

Measurement model. First, the content validity was established before we used the confirmatory factor analysis (CFA) technique. All constructs of the proposed model were first-order reflective constructs, and all items were based on the empirical theories of previous studies (e.g., Agarwal & Prasad, 1998; Davis et al., 1989; Duan et al., 2010; Hill et al., 2017; Ifinedo, 2017). Second, to examine the level of goodness-of-fit (GoF) of our measurement model, we examined multiple GoF indices, as presented in Table 1, and the results indicated an adequate GoF level for the proposed measurement model according to the recommended threshold values (Hair et al., 2010). Finally, the construct validity was evaluated based on the following criteria (Hair et al., 2010). As shown in Table 2, all factor loadings, ranging from .65 to .96, were statistically significant ($p < .000$) and were all greater than the cutoff value of .5. Additionally, the AVE estimates of all constructs, ranging from .62 to .85, were greater than the cutoff value of .5. Furthermore, as presented in Table 3, we found that all the square roots of AVE estimates for all pairs of constructs were higher than the correlation between the two constructs. Moreover, as presented in Table 3, the CR statistics for all constructs, ranging from .77 to .94, were higher than

the cutoff value.7. Finally, Cronbach's alpha statistics of all the constructs ranged from .75 to .94, which were all greater than the cutoff value.7.

Table 2. Results of the measurement model

Construct	Items	Factor loading
Personal innovativeness (PINN)	If I heard about a new online course, I would look for a way to gain experience with it.	.65
	Among my peers, I am usually the first to try out a new online course.	.91
	I like to experiment with new online courses.	.89
Compatibility	Using OLSs provided by the school for my learning is more suitable for my learning style.	.77
	Using OLSs provided by the school is more suitable for my lifestyle.	.95
	The learning format of OLSs provided by the school meets my learning needs very well.	.85
Perceived usefulness (PU)	Using online courses improves my learning performance.	.78
	Using online courses enhances my learning efficiency.	.83
	Using online courses can help me increase my learning effectiveness.	.83
Continued intention	I intend to use online courses to perform my learning activities and communicate with my classmates.	.92
	I would use online courses to perform different learning-related activities.	.96
	I intend to increase my use of online courses in the future.	.88
Learning performance	Your midterm exam score is:	.72
	Your final exam score is:	.85

Note. All factor loadings are significant at $p < .001$ according to CB-SEM.

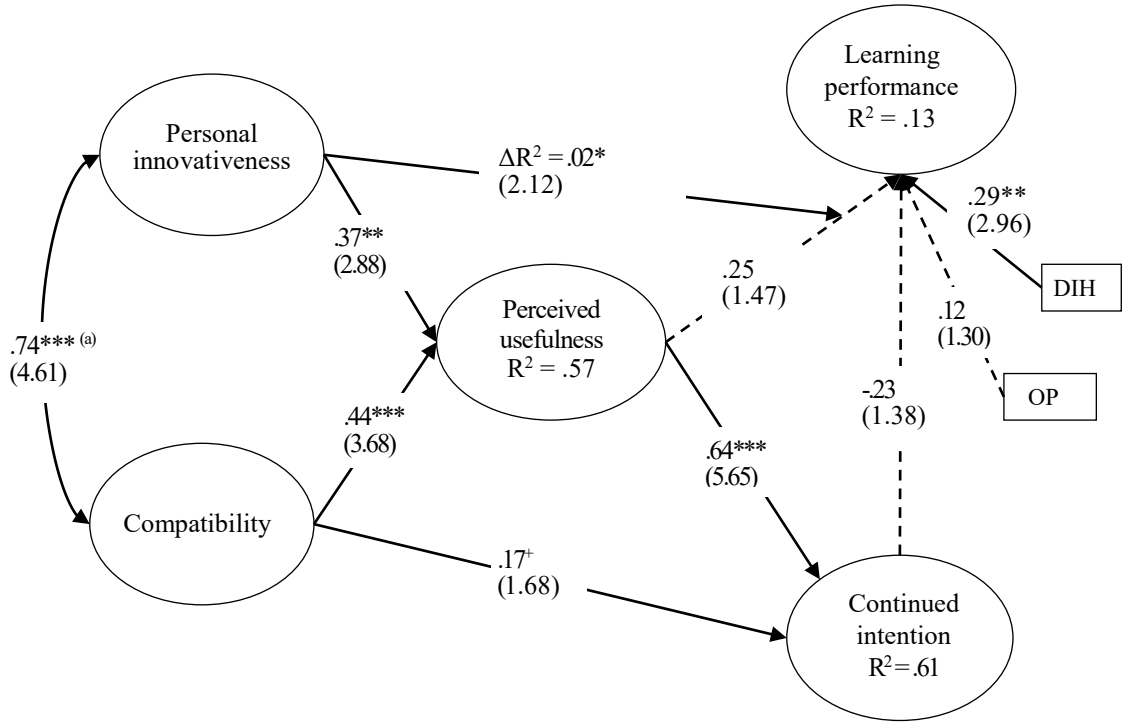
Table 3. Descriptive statistics, correlations, AVE, CR, and Cronbach's alpha

	1	2	3	4	5
1. Compatibility	**.86**				
2. Personal innovativeness	.65**	**.88**			
3. Perceived usefulness	.56**	.57**	**.81**		
4. Continued intention	.5**	.51**	.69**	**.92**	
5. Learning performance	.06	-.06	.09	-.05	**.79**
Mean	3.77	3.72	3.86	3.7	73.63
SD	.63	.66	.66	.74	15.93
Cronbach's alpha	.89	.85	.86	.94	.75
Composite reliability (CR)	.89	.91	.85	.94	.77

Note. $N = 151$, *SD* standard deviation. The square root of AVE is on the diagonal and the other matrix entries are the factor correlations.

Structural model. We first examined the level of the GoF of our structural model by examining multiple GoF indices, as presented in Table 1 above, and the results indicated an adequate level of goodness-of-fit of our structural model according to the recommended threshold values (Hair et al., 2010). Additionally, the criterion validity of the structural model was ensured in two ways. We used the predictive relevance of the correlation between a measure developed based on a reflective perspective and the external criterion (i.e., dependent variable). R^2 was used to predict the accuracy of our structural model. The three levels of R^2 for endogenous constructs can be measured as follows: .75 for substantial, .5 for moderate, and .25 for weak (Hair, Ringle, & Sarstedt, 2011). The results show that the R^2 values of our three endogenous constructs, namely, perceived usefulness, learning performance, and continued intention, were equal to .57, .13, and .61, respectively. The findings indicate that our research model exhibited weak to moderate predictive accuracy. These results reveal that our proposed model had medium to large predictive relevance for the three endogenous constructs. Overall, the results of this study based on the examinations above support the criterion validity of the research model. Figure 2 shows that compatibility is positively and significantly related to perceived usefulness (H1a: $\beta = .44$, $p < .001$) and continued intention (H1b: $\beta = .17$, $p < .01$). Perceived usefulness is positively and significantly related to learning performance (H2a: $\beta = .25$, $p > .1$) and continued intention (H2b: $\beta = .64$, $p < .001$). Personal innovativeness is positively and significantly related to perceived usefulness (H3a: $\beta = .37$, $p < .01$) and has a positive and significant moderating effect on the relationship between perceived usefulness and learning performance (H3b: R^2 *changed* $= .02$, $t = 2.12$, $p < .05$). Additionally, the bias-corrected 95% confidence interval with 5000 bootstrapping tests confirmed that the moderation coefficient exactly excluded zero (.36-10.11), representing a significant moderating effect of personal innovativeness. Moreover, Figure 3 shows the

moderating effect's slope, which indicates that the level of personal innovativeness significantly increases the positive influence of perceived usefulness on learning performance. Continued intention is negatively but insignificantly related to learning performance (H4: β = -.23, p > .1). Therefore, all hypotheses are supported, except for H2a and H4.



***p< .001; **p< .01; *p< .05; +p< .1; T-values are in parentheses.
DIH daily internet/online learning hours, *OP* experience with other online learning platforms.
(a) Correlation parameter.

Figure 2. Hypotheses testing results of the proposed research model

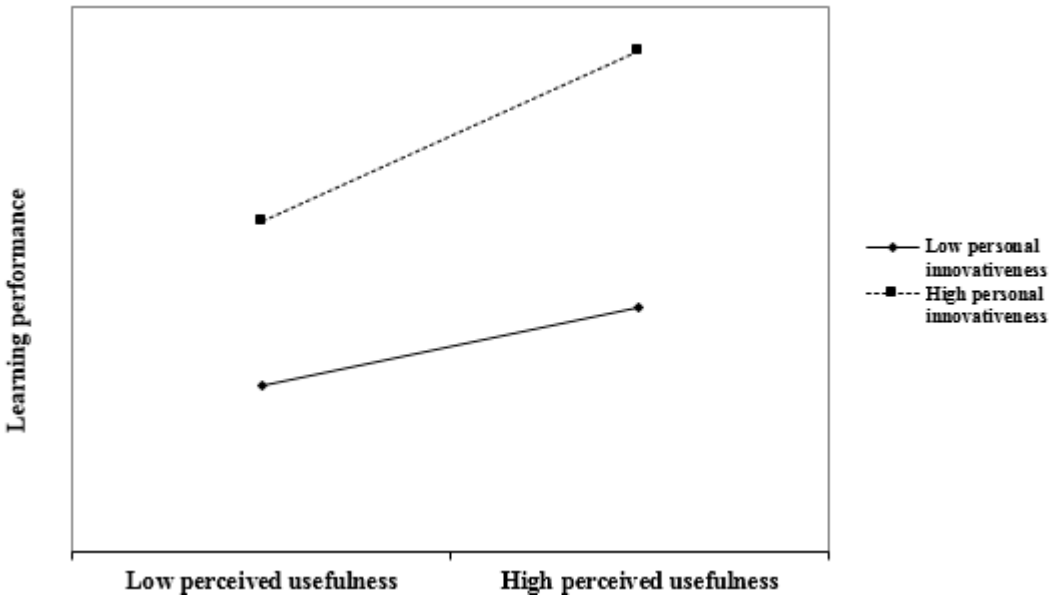


Figure 3. The moderating effect of personal innovativeness on the relationship between perceived usefulness and learning performance

6. Discussion

The findings of this study have confirmed that IDT is incorporated into the SCT model, which produces valuable insights as a framework to use for online healthcare courses. Personal innovativeness and compatibility enhance student beliefs by using OLSs and thus increase students' learning performance. The first path (person-belief-behavior) is supported by personal innovativeness → perceived usefulness → learning performance/continued intention. Simultaneously, the second path (environment-belief-behavior) is supported by compatibility → perceived usefulness → learning performance/continued intention. SCT is an influential theory that can help educators/instructors/students efficiently plan online teaching/learning modules.

With regard to the environment-belief-behavior path, our findings show that compatibility is positively related to perceived usefulness (H1a) and continued intention (H1b), which is consistent with the findings of previous studies (e.g., Cheng, 2014; Raman et al., 2014). The result means that the usefulness of an OLS is determined by its ability to support students' self-directed learning, preferences, and peer interactions. This study suggests that students generally have a high level of compatibility in online educational settings, which results in higher loyalty to online learning and a positive attitude toward online courses.

Additionally, perceived usefulness is positively yet insignificantly related to learning performance (H2a), which is not consistent with the findings of previous studies (e.g., Davis, 1989; Findik-Coşkunçay et al., 2018; Han & Yi, 2019; Liaw & Huang, 2016). Thus, we used independent *t*-test analysis to compare students' perceptions of OLS usefulness based on groups with high learning performance and those with low learning performance. The results revealed an insignificant difference between both groups; however, a tendency was observed. It is thus reasonable to infer that groups of students with low learning performance certainly depend on OLSs to support their learning while those with high learning performance have high capabilities to cope with online courses and, thus, may not be impressed when using OLSs. Consequently, perceived usefulness is positively and significantly related to continued intention to use OLSs (H2b), which is in line with the findings of previous studies (e.g., Teo et al., 2019; Wang et al., 2014). The results show the significant role played by perceived usefulness. This finding provides novel insights to promote an OLS to improve the learning of healthcare students with implications for instructors and students in healthcare education.

With regard to the person-belief-behavior path, the result indicates that students' innovativeness is positively related to their perceived usefulness (H3a), which is in line with the findings of previous studies (Huang et al., 2019; Liu et al., 2010). Additionally, personal innovativeness has a significant moderating effect that increases the positive relationship between perceived usefulness and learning performance (H3b). This finding is first confirmed in this study. According to the personal factors of SCT, innovative students often have relevant knowledge and the ability to use OLSs to learn. Such a situation may motivate them to adopt a self-directed learning method according to their learning pace or to utilize other website learning resources to improve learning performance by supplementing online courses. This study suggests that instructors should foster students' innovativeness so they will be more willing to adopt new learning technologies and further strengthen their confidence to improve their learning performance.

Moreover, continued intention to use OLSs is insignificantly related to learning performance (H4), which is inconsistent with the findings of previous studies. There are possible explanations for this result. Online learning often emphasizes self-directed learning; thus, students must frequently interact and communicate with their peers/instructors and obtain accurate knowledge or information content compared to face-to-face courses. Simultaneously, instructors must provide timely feedback in response to students' questions, help students fill professional knowledge gaps, and encourage them to develop a more in-depth understanding of course content. In fact, in healthcare education, some issues have not been fully addressed, such as the flexibility of OLSs, students' adaptability, and their proficiency with OLSs (Smart et al., 2020). Based on the personal, environmental, and behavioral factors of SCT, we suggest that future research provide more insights into the external factors of learning performance, which may enrich the research on OLS adoption.

Figure 2 shows that the control variables, such as the students' other platform experiences and the number of hours students spend on online learning each day, are insignificantly and significantly related to learning performance, respectively. This implies that students' experiences of other platforms do not provide unique benefits to support their learning interaction or communications in healthcare courses.

6.1. Research and practical implications

The present findings have some implications for practice and future research. Few studies have specifically investigated the relationship between students' continued intentions and their learning performance in higher education settings. First, a useful OLS can enhance students' interaction with instructors, peers, and materials, promoting students' engagement and facilitating cognitive reasoning abilities and critical thinking skills. From the perspective of SCT, our findings support the proposition of social cognitive learning that is manifested by the relationships among the human, environmental, and behavioral factors proposed by the SCT. Therefore, instructors can actively offer some supporting teaching materials (e.g., case-based solutions) in online courses, encourage students to interact, participate, and discuss closely with peers, and give students appropriate guidance for learning critical knowledge that is important to healthcare professionals.

Considering a personal factor, with regard to the study's findings, it can be reasonably inferred concerning personal innovativeness that traditional learning tools and pedagogical approaches may need to be changed to meet students' needs to actively seek new learning strategies, knowledge, or ideas through interaction. In such a case, students possess the capability to cope with a high level of uncertainty and accept new technology in the real world.

In considering environmental factors, the findings of compatibility and perceived usefulness show that the diffusion of technological innovation and the adoption of new technology have a high level of explanatory power and a complementary feature that is supported in this study. Our findings contribute to an understanding the element of compatibility with respect to students' capability of obtaining knowledge when they interact with an OLS in the online learning process.

Our findings also offer important practical implications. First, OLS developers must provide students with useful functions for enhancing intersystem connectivity and interpersonal communication (e.g., visual image retrieval from online databases and instant messaging functions) to satisfy healthcare students' learning needs. OLS developers can integrate several modules to develop new features based on user feedback and the results of the constant monitoring and evaluation of OLS performance. For example, OLSs can provide students with hyperlinks to access various online repositories or platforms to acquire critical information and quality tools to improve healthcare students' proficiency in acquiring professional skills.

Second, OLSs enable students to learn effectively in online courses at their own learning pace and based on their preferences. Therefore, course designers can design courses based on the context of healthcare training to enrich students' understanding of critical healthcare-related knowledge. Curriculum designers can use a variety of methods to embed a series of healthcare issues for each curriculum (e.g., medical humanities), allowing students to establish closer interactions and deeper discussion with lecturers and learning partners in online courses.

Finally, instructors must integrate relevant course materials (e.g., clinical films) and resources (e.g., sensitive medical records) into their online teaching. For example, instructors can combine previous clinical experience and basic scientific and medical principles into teaching content to increase students' interest in learning and enhance their reflection, creativity, and skill development. Additionally, instructors can encourage students to be open-minded and interact and share their expertise, experiences, or opinions with peers. These learning processes can help students improve their cognitive learning skills (Huang et al., 2019; Smith et al., 2009).

6.2. Limitations and future research

The limitations of this study are as follows. Concerning the generalizability of the findings, a cross-sectional analysis was performed based on questionnaires collected from 151 healthcare students from two medical and pharmacy universities. Future research could extend the proposed model to various OLSs or issues by collecting data from clinical training areas and using different sampling procedures. The results show that personal innovativeness and compatibility are critical antecedents that have significant positive direct or indirect relationships with students' continued intention and learning performance. However, the effects of other personal factors, including learning style, self-directed ability, and technology experience, could be considered in future research projects to enrich our understanding of students' learning performance in the context of OLS use.

7. Conclusion

Based on an integrated view, the relationships among the critical factors of three significant conceptual dimensions of SCT, namely, personal, environmental, and behavioral factors, were confirmed in this study. The findings of the study send a critical message to OLS developers, learning designers, and instructors. From the environmental and behavioral perspective, attracting and retaining healthcare students is of global concern for higher education institutions in OLSs. Universities can offer various lectures (e.g., blended or purely online) to respond to all students' needs while referring to the valuable findings of this study for their decision-making in the allocation of resources or educational strategies. From the personal and behavioral perspective, the development of OLSs should not stop here. Learning designers should be concerned with the requirements of innovative students' perceived usefulness and the compatibility of an OLS, improving course design to provide more efficient learning methods and content. In online healthcare courses, three interrelated core concepts (i.e., material, interaction, and embodiment) are bound together as priorities. From a holistic view of OLSs, instructors should eliminate the myth of traditional lectures and rethink the three factors of SCT to adjust teaching strategies in their online courses.

Acknowledgement

We want to thank the editor and two anonymous reviewers for their comments and suggestions. We also gratefully acknowledge Professor Hong-Long Chen and all people who provided valuable insights and information to this paper. This research was funded by the Ministry of Science and Technology of Taiwan (grant number: MOST 107-2511-H-006-005-MY2).

References

Acosta, M. L., Sisley, A., Ross, J., Brailsford, I., Bhargava, A., Jacobs, R., & Anstice, N. (2018). Student acceptance of e-learning methods in the laboratory class in Optometry. *PloS One*, *13*(12), e0209004.

Agarwal, R., & Prasad, J. (1998). The Antecedents and consequents of user perceptions in information technology adoption. *Decision Support Systems*, *22*(1), 15-29.

Al-Azawei, A., Parslow, P., & Lundqvist, K. (2017). The Effect of universal design for learning (UDL) application on e-learning acceptance: A Structural equation model. *The International Review of Research in Open and Distributed Learning*, *18*(6), 1-21.

Ali, S., Uppal, M. A., & Gulliver, S. (2018). A Conceptual framework highlighting e-learning implementation barriers. *Information Technology & People*, *31*(1), 156-180.

Byrne, B. M. (2006). *Structural equation modeling with AMOS: Basic concepts, applications, and programming*. London, UK: Lawrence Erlbaum Associates.

Cheng, M., & Yuen, A. H. (2019). Cultural divides in acceptance and continuance of learning management system use: A Longitudinal study of teenagers. *Educational Technology Research and Development*, *67*(6), 1613-1637.

Cheng, Y. M. (2014). Exploring the intention to use mobile learning: The Moderating role of personal innovativeness. *Journal of Systems and Information Technology*, *16*(1), 40-61.

Damnjanovic, V., Jednak, S., & Mijatovic, I. (2015). Factors affecting the effectiveness and use of Moodle: Students' perception. *Interactive Learning Environments*, *23*(4), 496-514.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, *13*(3), 319-340.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A Comparison of two theoretical models. *Management Science*, *35*(8), 982-1003.

Duan, Y., He, Q., Feng, W., Li, D., & Fu, Z. (2010). A study on e-learning take-up intention from an innovation adoption perspective: A Case in China. *Computers & Education*, *55*(1), 237-246.

Findik-Coşkunçay, D., Alkiş, N., & Özkan-Yildirim, S. (2018). A Structural model for students' adoption of learning management systems: An Empirical investigation in the higher education context. *Educational Technology & Society*, *21*(2), 13-27.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis* (7th ed.). Upper Saddle River, NJ: Pearson Education.

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice*, *19*(2), 139-152.

Han, S., & Yi, Y. J. (2019). How does the smartphone usage of college students affect academic performance? *Journal of Computer Assisted Learning*, *35*(1), 13-22.

Hansen, S. E. (2018). Improving educational and financial effectiveness through innovation: A Case study of Southern New Hampshire University's College for America. *International Journal of Educational Development*, *58*, 149-158.

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A Regression-based approach*. New York, NY: Guilford Press.

Hill, T., Chidambaram, L., & Summers, J. D. (2017). Playing "catch up" with blended learning: Performance impacts of augmenting classroom instruction with online learning. *Behaviour & Information Technology*, *36*(1), 54-62.

Hsu, J. Y., Chen, C. C., & Ting, P. F. (2018). Understanding MOOC continuance: An Empirical examination of social support theory. *Interactive Learning Environments*, 1-19.

Hu, L. T., & Bentler, P. M. (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.

Huang, R. T., Yu, C. L., Tang, T. W., & Chang, S. C. (2019). A Study of the use of mobile learning technology in Taiwan for language learning. *Innovations in Education and Teaching International*, 1-13.

Ifinedo, P. (2017). Examining students' intention to continue using blogs for learning: Perspectives from technology acceptance, motivational, and social-cognitive frameworks. *Computers in Human Behavior*, *72*, 189-199.

Iqbal, S., & Bhatti, Z. A. (2017). What drives m-learning? An Empirical investigation of university student perceptions in Pakistan. *Higher Education Research & Development*, *36*(4), 730-746.

Johnson, R. D., Hornik, S., & Salas, E. (2008). An Empirical examination of factors contributing to the creation of successful e-learning environments. *International Journal of Human-Computer Studies*, *66*(5), 356-369.

Jonker, H., März, V., & Voogt, J. (2020). Curriculum flexibility in a blended curriculum. *Australasian Journal of Educational Technology*, *36*(1), 68-84.

Kuo, F. R., & Hwang, G. J. (2015). A Structural equation model to analyse the antecedents to students' web-based problem-solving performance. *Australasian Journal of Educational Technology*, *31*(4), 400-420.

Liaw, S. S., & Huang, H. M. (2016). Investigating learner attitudes toward e-books as learning tools: Based on the activity theory approach. *Interactive Learning Environments*, *24*(3), 625-643.

Liu, Y., Li, H., & Carlsson, C. (2010). Factors driving the adoption of m-learning: An Empirical study. *Computers & Education*, *55*(3), 1211-1219.

Lu, J., Yao, J. E., & Yu, C. S. (2005). Personal innovativeness, social influences and adoption of wireless Internet services via mobile technology. *The Journal of Strategic Information Systems*, *14*(3), 245-268.

Ma, L., & Lee, C. S. (2019). Investigating the adoption of MOOCs: A Technology-user environment perspective. *Journal of Computer Assisted Learning*, *35*, 89-98.

McKimm, J., Jollie, C., & Cantillon, P. (2003). ABC of learning and teaching web based learning. *BMJ: British Medical Journal*, *326*, 870-873.

Novotny, N. L., Stapleton, S. J., & Hardy, E. C. (2016). Enhancing critical thinking in graduate nursing online asynchronous discussions. *Journal of Nursing Education*, *55*(9), 514-521.

Panigrahi, R., Srivastava, P. R., & Sharma, D. (2018). Online learning: Adoption, continuance, and learning outcome - A Review of literature. *International Journal of Information Management*, *43*, 1-14.

Park, S. Y. (2009). An Analysis of the technology acceptance model in understanding university students' behavioral intention to use e-learning. *Journal of Educational Technology & Society*, *12*(3), 150-162.

Raman, R., Achuthan, K., Nedungadi, P., Diwakar, S., & Bose, R. (2014). The VLAB OER experience: Modeling potential-adopter student acceptance. *IEEE Transactions on Education*, *57*(4), 235-241.

Risner, M., & Kumar, S. (2016). Graduate student perceptions of a globally networked course. *Journal of Applied Research in Higher Education*, *8*(3), 287-301.

Rogers, E. M. (1995). Lessons for guidelines from the diffusion of innovations. *Joint Commission Journal on Quality and Patient Safety*, *21*(7), 324-328.

Rogers, E. M. (2003). *Diffusion of innovations* (5th Ed.). New York, NY: Free Press.

Shaw, N., & Sergueeva, K. (2019). The Mon-monetary benefits of mobile commerce: Extending UTAUT2 with perceived value. *International Journal of Information Management*, *45*, 44-55.

Smart, D., Ross, K., Carollo, S., & Williams-Gilbert, W. (2020). Contextualizing instructional technology to the demands of nursing education. *CIN: Computers, Informatics*, *Nursing*, *38*(1), 18-27.

Smith, G. G., Passmore, D., & Faught, T. (2009). The Challenges of online nursing education. *The Internet and Higher Education*, *12*(2), 98-103.

Song, L., Singleton, E. S., Hill, J. R., & Koh, M. H. (2004). Improving online learning: Student perceptions of useful and challenging characteristics. *The Internet and Higher Education*, *7*(1), 59-70.

Teo, T., Zhou, M., Fan, A. C. W., & Huang, F. (2019). Factors that influence university students' intention to use Moodle: A Study in Macau. *Educational Technology Research and Development*, *67*(3), 749-766.

Wang, T., Jung, C. H., Kang, M. H., & Chung, Y. S. (2014). Exploring determinants of adoption intentions towards Enterprise 2.0 applications: An empirical study. *Behaviour & Information Technology*, *33*(10), 1048-1064.

Zayim, N., & Ozel, D. (2015). Factors affecting nursing students' readiness and perceptions toward the use of mobile technologies for learning. *CIN: Computers, Informatics, Nursing*, *33*(10), 456-464.