THE MEDIATING EFFECT OF STUDENT SATISFACTION ON THE RELATIONSHIPS AMONG ELEARNING SUCCESS FACTORS IN NURSING EDUCATION

Woan Ching Chang, International Medica University (IMU), Kuala Lumpur, Malaysia
Nooreiny Maarof, Segi University, Kota Damansara, Malaysia

ABSTRACT

Elearning provides enormous opportunities for working nurses to further their studies and to enhance their professional development. The purpose of this study was to identify the elearning success factors in elearning nursing undergraduate programs in Malaysia. The conceptual framework for this study is based on DeLone and McLean's Information Systems Success Model. This is a cross-sectional quantitative correlational study using a predictive design and multivariate analysis method. Stratified random sampling technique was applied to recruit 241 nursing students through an online survey. Self-administered questionnaires were adapted to measure the independent and dependent variables of the study. The variance-based Partial Least Squares Structural Equation Modeling (PLS-SEM) method was employed to analyze the possible effects on the relationships among the variables studied. The findings revealed statistically significant relationships among the factors of self-directed learning (SDL) abilities, elearning quality, student satisfaction, and elearning benefits. The study found a mediating effect of student satisfaction on elearning benefits through SDL abilities and elearning quality. The findings highlight the crucial role of learning environmental needs among online learners. A collaborative effort between universities, educators, and support personnel is essential to ensure successful elearning education for student nurses.

Keywords: *elearning quality, student satisfaction, elearning benefits, self-directed learning abilities, nursing education*

INTRODUCTION

The integration of technology in a flexible learning approach provides the opportunity for many nurse practitioners to fulfill their continuing higher educational needs. Such technological advances in education have not only helped to develop professionalism among nurses but have also enabled them to engage in lifelong learning. This is in line with the Strategic Plan 2020 developed by the Ministry of Higher Education Malaysia (2010), which aims to upgrade nurses' professionalism through higher education.

Elearning, a primary form of distance education, has become more diverse in its definition and application. The definitions of elearning include online learning, distance learning, blended learning, hybrid learning, and internet-based learning (Abuatiq et al., 2017). According to the Malaysian Qualification Agency's (2019) Standards, content delivery in elearning education consists of more than 60% online learning in both synchronous and asynchronous modes. In this study, we use the

term elearning to describe 70% of course content delivered online with 30% face-to-face classroom interaction.

The impact of technology since the beginning of the COVID-19 pandemic has profoundly affected individual lives, especially in the education sector. The school/university shutdown during the pandemic affected 1.37 billion students' educations worldwide (UNESCO, 2020). In Malaysia, approximately 1.2 million university students were affected during the lockdown/Movement Control Order period in 2020. Consequently, numerous initiatives have been taken by higher education institutions to transform face-to-face classes to online/elearning mode during the pandemic. Faculty members were striving to develop innovative ways to engage students in the virtual environment (Sharoff, 2019). Similarly, in nursing education, many nursing institutions adopted elearning platforms to provide continuous teaching and learning activities. These further substantiate the need for higher institutions to move forward in developing/improving elearning programs for working nurses.

LITERATURE REVIEW

The Ministry of Higher Education Malaysia (2017) reported that out of 354,673 students enrolled in both online and conventional programs, only 119,873 (33%) of the students had successfully graduated within the programs' duration. Delayed graduation and high attrition rates for online undergraduate programs pose a daunting challenge in many countries (Fraser et al., 2018). The literature on elearning situations in higher education institutions shows an alarming attrition rate and delayed graduation rate among nursing undergraduate students. However, there are few studies that address students' needs in an online learning context.

Various studies support positive relationships between student satisfaction and elearning benefits in elearning systems. Marjanovic et al. (2016) found a strong positive relationship between student satisfaction and elearning benefits. The researchers observed that as student satisfaction with the benefits of using the elearning system improved, their academic success likewise increased. Their findings are similar to that of Cidral et al. (2018) who found a strong positive effect of user satisfaction on individual academic performance. The findings showed the effect of satisfaction on elearning benefits as the most influential factor among factors such as system quality, service quality, and information quality for information systems success. Similarly, a recent study in a Malaysian public university reported a strong relationship between student satisfaction and academic achievement among undergraduate students in an elearning environment (Abuhassna et al., 2020).

Self-directed learning (SDL) is another element in nursing education that serves as a promising and effective pedagogical strategy in an elearning context (Lee et al., 2020). SDL requires learners to assume ownership in learning, that is, to be self-motivated, self-monitored, and self-managed in learning. However, didactic classroom teaching remains the dominant approach in nursing education in which teacher-centered methods are the main practice (Shin et al., 2017). A majority of working adults have been exposed to a didactic paradigm and may face problems in an elearning environment that requires self-independence and self-motivation. Past studies show that students trained in SDL skills outperformed their peers in traditional classes on competency skills. Similarly, Tohidi et al. (2019) found a significant difference in clinical competency among student nurses in the SDL intervention group. The recognition of SDL and quality factors in elearning as being important elements in online learning environments remains a focus of educational researchers. Thus, our study investigated the possible effects of SDL abilities and elearning quality on student satisfaction and elearning benefits among students in elearning nursing programs.

RESEARCH MODEL AND HYPOTHESES

Research Model

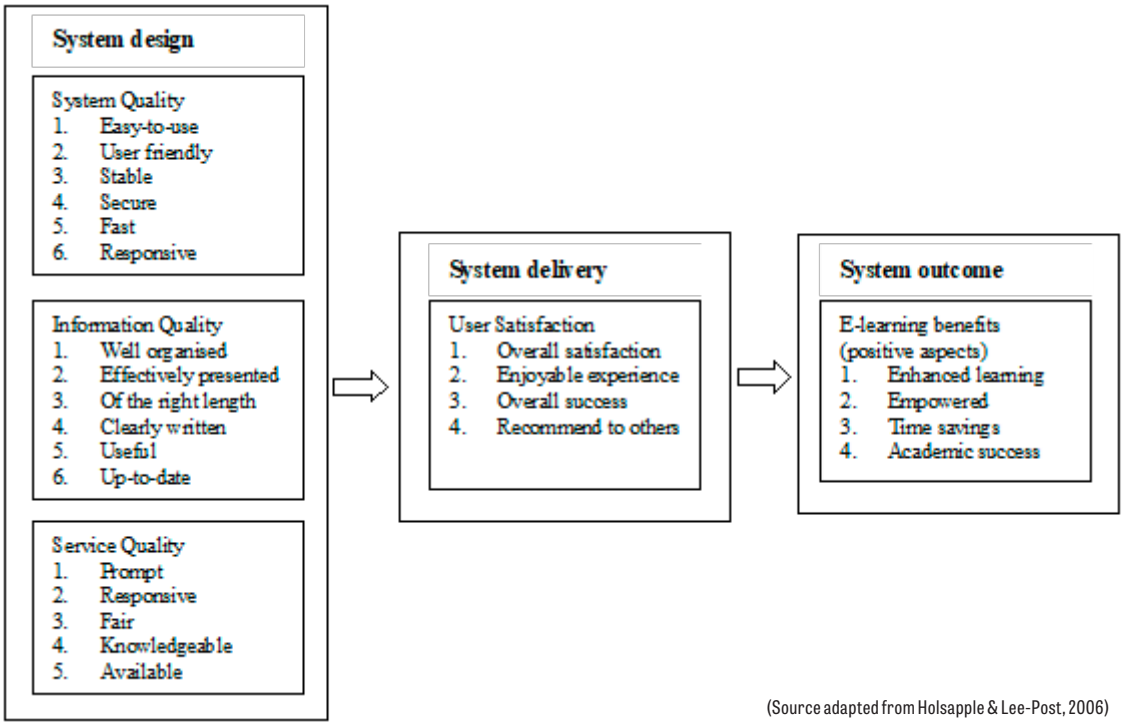
In this study, we based the predictive factors of elearning success on the five dimensions of DeLone and McLean's (2003) Information System (D&M IS) model: system quality, information quality, service quality, user satisfaction, and net benefits. We used three stages of elearning systems—design, delivery, and outcome—to evaluate the overall success of an elearning initiative (see Figure 1). First, we assessed the success of the system design through three quality dimensions, namely system quality, information quality, and service quality. Second, we assessed the success

of system delivery with user/student satisfaction dimension. Third, we assessed system outcome through net benefits (elearning benefits) dimension. Each dimension in system design is related to the other dimensions in system delivery, and user satisfaction is interrelated with net/elearning benefits in system outcome. We excluded the use dimension as a variable of study because the utilization of the elearning system is mandatory for all students enrolled in the elearning nursing programs. The overall success of the system design is essential to system delivery, which in turn will influence the success of system outcome for students. Also, the three stages of the elearning systems are in line with activity theory, which is incorporated with the interaction process among subject (system design), mediating tool (system delivery), and object (system outcome). These support the relevance use of the D&M IS Success model and the three stages of elearning systems in this study.

System quality refers to the desired characteristics of the elearning system at a technical level, which comprises the utility features of the system such as easy-to-use, user friendly, stable, secure, fast, and interactive. The second feature of elearning quality is information quality, which is defined as the desired characteristic outputs of an elearning system such as the systematic organization of course information and its effective presentation ensuring that it is the right length, clearly written, useful, and up to date. Third, service quality refers to the desirable characteristics of faculty support and student-faculty interactions such as promptness, responsiveness, fairness, knowledgeability, and faculty availability. The next feature, student satisfaction, consists of four items (overall satisfaction, enjoyable experience, overall success, and recommended to others) that relate to the level of satisfaction perceived by learners using the elearning system. Finally, the elearning benefits is the extent to which the elearning system benefits the learners in achieving a degree. The positive aspects of elearning benefits include Enhanced learning, Empowered, Time saving and Academic success.

With regards to the SDL dimension, learning motivation is defined as the inner drive of a learner to take responsibility for their own learning. Planning and implementing, on the other hand, is defined as the ability of a learner to set learning objectives and use appropriate learning resources and strategies to achieve elearning benefits. Self-monitoring is defined as the ability of a learner to

Figure 1. The Stages of Elearning Systems



(Source adapted from Holsapple & Lee-Post, 2006)

evaluate their own learning process and outcomes. Finally, interpersonal communication is defined as the ability of a learner to interact with others to promote effective learning.

The research model depicted in Figure 2 is an extension based on the D&M model. In this study, the relationship between the independent variables (elearning quality, SDL abilities) and the dependent variable (elearning benefits) is examined. In addition, student satisfaction (the mediating variable) among nursing undergraduates is examined to see if there is any relationship between the two independent variables (SDL abilities, elearning quality) and on the dependent variable (elearning benefits). The two independent variables are the exogenous variables because they are the possible causal factors of student satisfaction and elearning benefits in the model. On the other hand, student satisfaction and elearning benefits are identified as the endogenous variables since they may be influenced directly or indirectly by the exogenous variables.

Purpose of the Study

The study examined the relationships among self-directed learning (SDL) abilities, elearning quality, student satisfaction, and elearning benefits in the context of elearning nursing education in Malaysia. Also, this study examined whether student satisfaction is a possible mediator in the relationship between the exogeneous variables (SDL abilities, elearning quality) and the endogenous variable (elearning benefits) among the undergraduate students in the elearning nursing programs.

Research Hypotheses

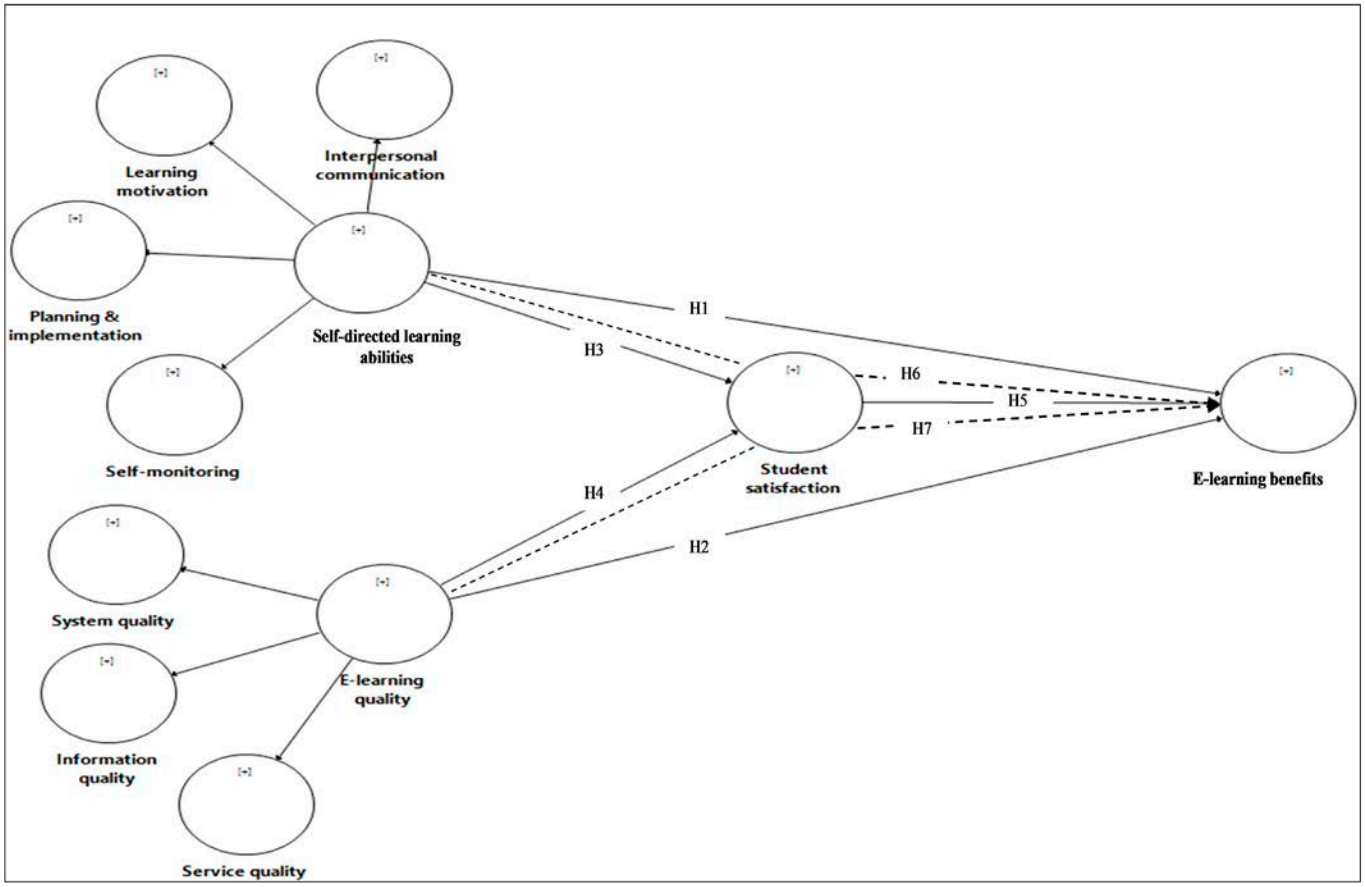
The following are the hypotheses posited for the study. The significance level was set at $p < .05$ for hypotheses H1 to H7.

H1: There is a statistically significant effect of self-directed learning abilities on elearning benefits.

H2: There is a statistically significant effect of elearning quality on elearning benefits.

H3: There is a statistically significant effect of

Figure 2. Research Model



self-directed learning abilities on student satisfaction.

H4: There is a statistically significant effect of elearning quality on student satisfaction.

H5: There is a statistically significant effect of student satisfaction on elearning benefits.

H6: Student satisfaction is a statistically significant mediator for the relationship between self-directed learning abilities and elearning benefits.

H7: Student satisfaction is a statistically significant mediator for the relationship between elearning quality and elearning benefits.

METHODOLOGY

We employed a cross-sectional quantitative correlational survey using predictive design and multivariate analysis method for this study. We used an online self-administered questionnaire to examine the relationships between SDL abilities, elearning quality, student satisfaction, and elearning benefits. The population of the study (N = 1100) comprised all adult working nurses enrolled in the elearning nursing program at private universities in Malaysia. A total sample of 241 student nurses participated in the study. Statistical tools (SPSS version 26 and PLS-SEM 3) were used for data analysis to test the hypotheses.

Partial Least Squares Structural Equation Modeling (PLS-SEM) is a structural equation model that employs a nonparametric and variance-based method in prediction-oriented research model (Hair et al., 2021; Ramayah et al., 2018). We used it to explain the variance of independent on the dependent variables. Particularly, it helped to identify the main factors that explain learning system, student satisfaction, and learning outcomes in the academic environment (Ghasemy et al., 2020). The reasons for selecting PLS-SEM for this study were to predict the relationships among constructs and to explore any mediating relationship between constructs based on the criteria recommended by Hair et al. (2019).

We adapted the elearning course evaluation survey from Holsapple and Lee-Post (2006) to measure the students' perceptions of elearning system success factors. Elearning success factors were represented by the five dimensions: system quality, information quality, service quality, student satisfaction, and elearning benefits. The 25-item survey questionnaire used a 5-point Likert scale that ranges from *Strongly Disagree* (1) to *Strongly Agree* (5). A mean score of the average ratings for each dimension was expressed in percentage form to indicate the highest perception of success rating possible for the dimensions.

Next, we adapted the Self-Directed Learning Instrument (SDLI) from Cheng et al. (2010) with permission to measure the SDL ability in elearning environment among students. The SDLI contains 20 items across four dimensions, namely learning motivation (6 items), planning and implementing (6 items), self-monitoring (4 items), and interpersonal communication (4 items). The 20-item questionnaire comprises a 5-point Likert scale ranging from *Strongly Disagree* (1) to *Strongly Agree* (5) with a minimum score of 20 to a maximum score of 100. High scores indicate a high level of SDL abilities among learners.

A panel of six content experts evaluated the item relevancy of the SDLI and the elearning course evaluation survey questionnaire using the Item-level Content Validity Index (I-CVI). The results of the I-CVI score ranged from 0.83 to 1.00 for each item, thus validating the relevancy of the tools for the study (Zamanzadeh et al., 2015). The internal consistency index obtained for the elearning course evaluation survey and SDLI was at Cronbach's Alpha of .942 and .80, respectively, which is considered a strong internal consistency coefficient for a survey questionnaire.

RESULTS

Background Information

As displayed in Table 1, the demographic data consisted of participants' age, gender, marital status, working experience, working position, current clinical area, experience in an online learning program, academic year, and current grade point average (CGPA). The mean age of participants was 32 years (SD = 6.269) and ranged between 25 and 57 years. A majority of the participants (54.3%, n = 131) were between 25 and 30 years old. Out of the 241 participants, the majority were female (93.4%, n = 255) and only 6.6% (n = 16) were male. In terms of marital status, 59.8% (n = 144) of the participants were single, 39.4% (n = 95) were married, and 0.8% (n = 2) were divorced or separated. The average working experience of the nurses was 9.5 years (SD = 5.684). A total of 83% (n = 200) of the participants held the position of staff nurse/charge nurse. Out of 241 nurses, 43.2% (n = 104)

Table 1. Background Information of Respondents (n = 241))

	Mean (M)	Standard deviation (SD)	Frequency (f)	Percentage (%)
Age (25-57 years)	31.8	6.269		
25-30 years			131	54.3
31-40 years			84	34.9
≥41 years			26	10.8
Gender				
Female			225	93.4
Male			16	6.6
Marital status				
Single			144	59.8
Married			95	39.4
Divorce/separated			2	.8
Years of working experience	9.5	5.684		
≤5 years			60	24.9
6-9 years			84	34.9
≥ 10 years			97	40.2
Working position				
Staff nurse/Charge nurse			200	83.0
Nurse educator/ Clinical instructor			13	5.4
Nurse manager/Sister			28	11.6
Current clinical area				
Medical/Surgical/Orthopedic			59	24.5
Critical care/ED/OT/RR/HD			104	43.2
Paediatric/Obstetric/Maternity			36	14.9
Others			42	17.4
Online learning experience				
Yes			165	68.5
No			76	31.5
Academic year				
Year 1			83	34.4
Year 2			91	37.8
Year 3			67	27.8
Current CGPA (2.5-4.0)	3.44	.385		
≤ 2.99			14	5.8
3.00-3.69			144	59.8
3.70-4.00			83	34.4

were assigned to critical care units (intensive care/ emergency/operation theater/recovery room/dialysis) and 56.8% (n = 137) were posted to other units.

A total of 165 nurses (68.5%) reported that they have attended other online learning prior to enrolling in the Bachelor of Nursing Science Post-Registration undergraduate program. The number of nurses enrolled in year 1 (34.4%) and year 2 (37.8%) was similar, but there was a decline in year 3 (27.8%) at the point of data collection. More than half of the nurses (59.8%, n = 144) had a moderate CGPA between 3.00 and 3.69 with a mean score of 3.44 (SD = 0.385).

Results of the Measurement Model

The indicator reliability, internal consistency reliability, convergent validity, and discriminant validity were assessed using PLS-SEM. Based on the indicator loadings, the indicators that met the

Table 2. Construct Validity and Reliability of the Measurement Model of the Study

Construct	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Elearning quality	0.895	0.896	0.918	0.615
Student satisfaction	0.874	0.874	0.941	0.888
Elearning benefits	0.870	0.871	0.939	0.885
Self-directed learning abilities	0.894	0.895	0.922	0.703

standardized indicator loadings of ≥ 0.708 were retained for further analysis. One indicator from the variable service quality and another from planning and implementation were removed in the initial stage. Hair et al. (2019) stressed that it is important to retain the composite reliability values of less than 0.95 to avoid undesirably inflated correlations between the indicators. In the subsequent analysis, subcomponents of interpersonal communication and self-monitoring were removed as their internal reliability and convergent validity values did not meet the recommended criteria. In Table 2, the results show that the remaining indicators for Cronbach's Alpha were between 0.7-0.9, for rho_A between 0.8-0.9, for composite reliability between 0.8-0.95, and for Average Variance Extracted (AVE) more than 0.5. These findings suggest that all retained indicators and constructs met internal reliability and convergent validity requirements at this stage. Hair et al. (2021) explained that indicators in a reflective measurement model are interchangeable, and that any single indicator can generally be removed without changing the meaning of the construct.

Our next step was to determine discriminant validity using Heterotrait-Monotrait (HTMT) ratio of correlations. The purpose was to assess the extent to which a construct was truly distinct from other constructs. Based on the recommended quality criteria, HTMT values should be smaller than 0.90 (Franke & Sarstedt, 2019). During the analysis stage, we removed subdimensions of interpersonal communication and self-monitoring as its HTMT values exceeded 0.9. As can be seen in Table 3, the results of the three constructs based on $HTMT_{0.90}$ criteria confirmed discriminant validity between constructs. This indicated that all the retained indicators in this study reflect its respective construct sufficiently.

Table 3. Discriminant Validity (HTMT) Criterion

Construct	Elearning quality	Elearning benefits	Self-directed learning abilities
Elearning benefits	0.789		
Self-directed learning abilities	0.718	0.703	
Student satisfaction	0.868	0.845	0.747

Results of the Structural Model

The research model in Figure 2 was further evaluated using structural model analysis for collinearity assessment (VIF), significance and relevance of path coefficients (Bootstrapping), in-sample predictive power assessment (R^2), and out-of-sample predictive power assessment. Table 4 presents the outcome of lateral collinearity test conducted for the study. A VIF value of less than 5 indicates that each variable that is causally related is not measuring the same construct in the research model.

Table 4. Lateral Collinearity Assessment of Inner VIF

Construct	Elearning benefits	Student satisfaction
Elearning quality	2.675	1.722
Self-directed learning abilities	1.939	1.722
Elearning benefits	2.760	

In this study, all paths *t*-statistics were generated using bootstrapping with 10,000 subsamples to test the significance level of each hypothesis. As shown in Table 5, all the five direct hypotheses are statistically significant at *t*-value of ≥ 1.96, and *p* values of < 0.05. Therefore, H1, H2, H3, H4, and H5 were supported. The predictors of SDL abilities ($\beta = 0.178$, $p < 0.01$), elearning quality ($\beta = 0.261$, $p < 0.01$), and student satisfaction ($\beta = 0.418$, $p < 0.01$) were positively related to elearning benefits. This positive relationship explained 63.8% and 60.2%

Table 5. Hypotheses Testing Using Bootstrapping

Hypothesis	Relationship	Original Sample (O)	Sample Mean (M)	T values	P Values	Confidence interval (BC)	
						LL	UL
H1	Self-directed learning abilities -> Elearning benefits	0.178	0.181	2.780	0.006**	0.058	0.310
H2	Elearning quality -> Elearning benefits	0.261	0.263	3.340	0.001**	0.113	0.422
H3	Self-directed learning abilities -> Student satisfaction	0.281	0.282	5.664	0.000**	0.186	0.383
H4	elearning quality -> Student satisfaction	0.588	0.587	11.328	0.000**	0.482	0.685
H5	Student satisfaction -> Elearning benefits	0.418	0.414	4.462	0.000**	0.224	0.591

Note: * $p<0.05$, ** $p=0.01$, BC=Bias-Corrected, LL=Lower Level (2.5%), UL=Upper Level (97.5%)

of variances in student satisfaction and elearning benefits, respectively. The R^2 value of 0.602 for elearning benefits, and 0.638 for student satisfaction, are considered close to large in producing a substantial model for in-sample population of the study (Hair et al., 2019).

Next, the indirect effects at 95% Boot Confidence Interval with Bias-Corrected levels (LL = 0.186, UL = 0.383) for H3, (LL = 0.482, UL = 0.685) for H4, and (LL = 0.224, UL = 0.591) for H5, did not include a zero in between indicating a significant mediation effect (Carrión et al., 2017). This implies that the mediation effect of student satisfaction for the relationship between exogenous variables (SDL abilities, elearning quality) and endogenous variable (elearning benefits) was significant ($p < 0.05$). These findings supported H6 and H7 of the study.

In comparing the liner regression model (LM) and predictive error, the values of the root mean squared error (RMSE) and mean absolute error (MAE) in predictive error were found to be higher (or positive) than those values in LM. These positive results indicate that the model lacks predictive power for the out-of-sample study population (Hair et al., 2019). In this study, the predictive relevance (Q^2), effect size (f^2), and goodness-of-fit of path models were not measured since they were redundant and did not provide highly interpretable findings (Hair et al., 2021; Ramayah et al., 2018).

DISCUSSION AND IMPLICATIONS

The statistically significant findings of the relationships among SDL abilities, student satisfaction, and elearning benefits indicate that success in an elearning course is influenced by level of SDL abilities of learners. The findings of this study are similar to that of studies conducted by Firat et al. (2016) and Yeoh et al. (2017), whereby SDL abilities seem to be a major influential factor in elearning. The high mean scores for learning motivation and self-monitoring among the students in this study help to facilitate the achievement of their learning goals. Tohidi et al. (2019) assert that nurses who can initiate their own learning would be able to function independently in a complex healthcare setting. Therefore, in relation to the findings above, the role of a teacher as facilitator is critical in helping students to become highly motivated, self-directed learners.

In addition, the findings of the study indicate a positive correlation between elearning quality

(system quality, information quality, service quality), elearning benefits, and student satisfaction. This is consistent with previous studies that support the effect of system quality (Zhao, 2016), information quality (Albelbisi & Yusop, 2019), and service quality (Yakubu & Dasuki, 2018) on learning experience and academic achievement. Their findings show that elearning quality strongly influences student satisfaction. Similarly, a majority of the students in our study considered quality of the elearning system as highly favorable.

An efficient elearning system that is able to provide interactive features between user and system assists students' learning. In this study, the nursing students found elearning valuable in developing their knowledge and skills with the availability of good system support, ease of access, flexibility, portability of the system, and improved student-teacher interactions. As shown in this study, the students are familiar and comfortable with the elearning system because it is a popular instructional method offered in many higher education institutions in Malaysia, particularly during the COVID-19 pandemic. Other than the availability of a good elearning system, pedagogical materials used in the elearning context need to be relevant and easily available to help users realize the elearning benefits. For instance, a positive learning experience whereby students are satisfied with the quality and relevance of the information provided will further influence student's acceptance of an elearning program. Another possible explanation for the findings might be that most of the participants in the study were experienced in other online systems before they enrolled in the elearning nursing program. The prior online systems may have similar features as the existing elearning systems, and thus, students might not have been challenged in navigating the contents, materials, activities, and assessments during their studies.

Another important factor of successful elearning systems is effective service quality. A good elearning program needs to have efficient and reliable faculty and facilitator support. Timely response and prompt feedback from facilitators regarding assignments are essential to the students in the learning process. Students who experience deeper engagement with facilitators tend to put in more effort to achieve their desired academic goals (Hodge et al., 2018). It is thus important for facilitators to constantly interact actively with students through communication tools such as elearning platforms, social media, and emails correspondence. Nonetheless, social isolation was one of the main concerns among students during the pandemic lockdown. Social presence through active interactions is an essential ingredient for the success of elearning. Past studies support that the social interactions with peers, teachers, and resource person enhanced progressive learning in an online environment (Iradel et al., 2021; Lasfeto & Ulfa, 2020). We attest that positive social presence forms a conducive learning environment that allows active interactions and communication while reducing learners' anxiety in online studies. Although direct human experiences cannot be replaced, they can be compensated with social presence and quality service. Faculty and facilitators involved in elearning courses should consider enhancing or improving the design of online courses and developing teaching and learning strategies that could further enhance social presence within an online learning environment.

Student satisfaction is a significant mediator in the relationship between SDL abilities and elearning benefits in our study. Tan et al. (2017) assert that SDL and elearning benefits are affected by level of student satisfaction with the elearning system. Students who exhibit a strong sense of satisfaction constantly have a high level of self-motivation. Also, encouraging students to self-regulate their own learning with good time management could assist them to accomplish their goals in learning (Lynch, R., & Dembo, 2020). As a result, they will put more effort into planning and implementing learning, evaluating their own learning processes, and collaborating in active learning activities with others. Student satisfaction can lead to a positive individual achievement, which in turn can influence student likelihood to complete a course.

The mediation effect of student satisfaction in the relationship between elearning quality and elearning benefits as found in this study is consistent with the findings of studies by Selvaraj (2019) and Shahzad et al. (2021). A common finding in these studies is that elearning systems show a positive effect on the depth of learning of students, student productivity, and learning pace when students' satisfaction increases. An implication of the role of student satisfaction in effective elearning

programs is the critical contribution of elearning quality such as facilitator support, their responsiveness to student needs, expertise in content, and prompt academic services to students. Student satisfaction is an influential factor in the relationship between SDL abilities and elearning quality, and in the resulting perceived benefits of an elearning education experience.

The findings of our study have significant implications for all stakeholders involved in higher education institutions. For educators, we offer insights into what pedagogical and elearning success strategies are more likely to positively affect student satisfaction and individual elearning benefits. The model derived from this study enables educators to better understand and put into practice the important concepts of SDL in higher education. The extended D&M IS success model, which is based on activity theory, was applied as a substantial model for the population of this study. The model helped us understand more deeply the key success dimensions and their interrelationships in elearning nursing context. Online learning will continue to stay in the education system worldwide, either in a blended mode approach or a fully online distance learning mode. It is important to what extent and how the SDL approach and elearning success measures are incorporated or integrated in the elearning undergraduate programs.

The findings of our study will also be useful to policy makers, administrators, and elearning designers (IT support members, elearning support members, academics) in the program development. In this study, the perceived level of elearning systems quality among nurses is reported to be relatively high. It is therefore essential for universities to maintain the quality features of the elearning systems to ensure they are meeting the needs of students in online learning. The model of this study indicates that student satisfaction is a significant mediator. Institution can consider how to improve the mediation effect of student satisfaction while increasing the quality of the elearning systems and the level of SDL abilities of nursing students. Also, educators may design interactive teaching materials such as iLecture using Articulate 360, and Storyline or Storyboard applications that could engage active learning and participation among students. At present, many higher education institutions in the world are still striving to implement online teaching and learning activities in response to the COVID-19 pandemic. Creating a 5G-enabled environment will be a major move forward for all learning institutions (Chung et al., 2020). It is therefore recommended for administrators and policy makers of all higher learning institutions to invest in high-speed internet, appropriate Information Communications Technology (ICT) devices, sustainable online platforms, and a strong ICT team for an effective implementation of elearning programs.

CONCLUSION

This study extends the work of previous studies based on DeLone and McLean's Information System (D&M IS) Success model. The findings of the study reveal that SDL abilities, elearning quality, and student satisfaction are accurate predictors for the model in elearning nursing education. Further analysis of the predictive investigations discovers that student satisfaction is a significant mediator and the strongest predictor in the study model. The findings of this study highlight the important concept of SDL pedagogy in elearning nursing programs in addition to quality indicators in the Malaysian education system.

Meeting the elearning environmental needs of the students and their level of satisfaction are the upmost important aspects that cannot be emphasized enough. The quality of the programs, academics, and support systems must be ensured in order to promote elearning success for students. Future studies are recommended to further extend the conceptual model of this study, and to identify other potential factors that will further contribute to the elearning education.

ACKNOWLEDGEMENTS

The study is a PhD project at Asia-e university in Malaysia. We thank the institutions and participants for their cooperation in supporting the study.

DECLARATION OF INTEREST STATEMENT

We declare that there is no conflict of interest that may have inappropriately influenced us in writing this paper.

References

Abuatiq, A., Fike, G., Davis, C., Boren, D., & Menke, R. (2017). E-learning in nursing: Literature review. International Journal of Nursing Education, 9(2), 81. https://doi.org/10.5958/0974-9357.2017.00041.1

Abuhassna, H., Al-Rahmi, W. M., Yahya, N., Zakaria, M. A., Mohd Kosnin, A., & Darwish, M. (2020). Development of a new model on utilizing online learning platforms to improve students' academic achievements and satisfaction. International Journal of Educational Technology in Higher Education, 17, 38. https://doi.org/10.1186/s41239-020-00216-z

Albelbisi, N. A, & Yusop, F. D. (2019). Factors influencing learners' self-regulated learning skills in a massive open online course (MOOC) environment. Turkish Online Journal of Distance Education, 20(3), 1–7. https://doi.org/10.17718/tojde.598191

Carrión, G. C., Nitzl, C., & Roldán, J. L. (2017). Mediation analyses in partial least squares structural equation modelling: Guidelines and empirical examples. In H. Latan & R. Noonan (Eds.), Partial least squares structural equation modeling: Basic concepts, methodological issues and applications (pp. 173–195). Springer. https://doi.org/10.1007/978-3-319-64069-3_8

Cheng, S. F., Kuo, C. L., Lin, K. C., & Lee-Hsieh, J. (2010). Development and preliminary testing of a self-rating instrument to measure self-directed learning abilities of nursing students. International Journal of Nursing Studies, 47(9), 1152–1158. https://doi.org/10.1016/j.ijnurstu.2010.02.002

Chung, E., Subramaniam, G., & Christ Dass, L. (2020). Online learning readiness among university students in Malaysia amidst Covid-19. Asian Journal of University Education, 16(2), 45–58. https://doi.org/10.24191/ajue.v16i2.10294

Cidral, W. A., Oliveira, T., Di Felice, M., & Aparicio, M. (2018). E-learning success determinants: Brazilian empirical study. Computers and Education, 122, 273–290. https://doi.org/10.1016/j.compedu.2017.12.001

DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information system success: A ten-year update. Journal of Management Information Systems, 19(4), 9–30. https://doi.org/10.1080/07421222.2003.11045748

Firat, M., Sakar, N., & Kabakci Yurdakul, I. (2016). Web interface design principles for adult's self-directed learning. Turkish Online Journal of Distance Education, 17(4), 31–46.

Franke, G., & Sarstedt, M. (2019). Heuristics versus statistics in discriminant validity testing: A comparison of four procedures. Internet Research, 29(3), 430–447. https://doi.org/10.1108/IntR-12-2017-0515

Fraser, J., Fahlman, D. W., Arscott, J., & Guillot, I. (2018). Pilot testing for feasibility in a study of student retention and attrition in online undergraduate programs. International Review of Research in Open and Distributed Learning, 19(1), 260–278. https://doi.org/10.19173/irrodl.v19i1.3326

Ghasemy, M., Teeroovengadum, V., Becker, J-M., & Ringle, C. M. (2020). This fast car can move faster: A review of PLS-SEM application in higher education research. Higher Education, 80, 1121–1152. https://doi.org/10.1007/s10734-020-00534-1

Hair, J. F., Hult, T. M., Ringle, C. M., & Sarstedt, M. (2021). A premier on Partial Least Square Structural Equation Modelling (PLS-SEM) (3rd ed.). Sage Publication.

Hair, J. F., Risher, J. J., Sarstedt, M, & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. European Business Review, 31(1), 2–24. https://doi.org/10.1108/ebr-11-2018-0203

Hodge, B., Wright, B., & Bennett, P. (2018). The role of grit in determining engagement and academic outcomes for university students. Research in Higher Education, 59(4), 448–460. https://doi.org/10.1007/s11162-017-9474-y

Holsapple, C. W., & Lee-Post, A. (2006). Defining, assessing, and promoting e-learning success: An information systems perspective. Decision Sciences Journal of Innovative Education, 4, 67–85. https://doi.org/10.1111/j.1540-4609.2006.00102.x

Iradel, C. M., Cadosales, M. N. Q., & Perez, N. (2021). Lived experience of teaching interns during the COVID-19 Pandemic. Journal of Research, Policy & Practice of Teachers and Teacher Education,11(2), 74–87.

Lasfeto, D. B., & Ulfa, S. (2020). The relationship between self-directed learning and students' social interaction in the online learning environment. Journal of e-Learning and Knowledge Society, 16(2), 34–41. https://doi.org/10.20368/1971-8829/1135078

Lee, S., Kim, D. H., & Chae, S-M. (2020). Self-directed learning and professional values of nursing students. Nurse Education in Practice, 42, 102647. https://doi.org/10.1016/j.nepr.2019.102647

Lynch, R., & Dembo, M. (2020). The relationship between self-regulation and online learning in a blended learning context. International Review of Research in Open and Distributed Learning, 5(2), 1-16.

Malaysian Qualifications Agency. (2019). Code of Practice for Programme Accreditation: Open and Distance learning [COPPA: ODL](2nd ed.). https://www2.mqa.gov.my/qad/garispanduan/COPIA/2019/Final%20COPPA-ODL%202nd%20edition%204.12.19.pdf

Marjanovic, U., Delić, M., & Lalic, B. (2016). Developing a model to assess the success of e-learning systems: Evidence from a

manufacturing company in transitional economy. Information Systems and e-Business Management, 14, 253–272. https://doi.org/10.1007/s10257-015-0282-7

Ministry of Higher Education Malaysia. (2010). Development of Nursing Education in Malaysia: Towards the year 2020. https://www.moe.gov.my/images/Terbitan/Rujukan-Akademik/Development%20of%20Nursing%20Education%20in%20Malaysia%20Towards%20the%20Year%202020.pdf

Ministry of Higher Education Malaysia. (2017). Private higher education institutions: Malaysian students. University Publication Centre (UPENA). https://www.moe.gov.my/menumedia/media-cetak/penerbitan/rujukan-akademik/1418-development-of-nursing-education-in-malaysia-towards-the-year-2020/file

Ramayah, T., Cheah, J., Chuah, F., Ting, H., & Menon, M.A. (2018). Partial least square structural modeling (PLS-SEM) using SmartPLS 3.0: An updated and practical guide to statistical analysis (2nd ed.). Pearson.

Selvaraj, C. (2019). Success of e-learning systems in management education in Chennai city-using user's satisfaction approach. The Online Journal of Distance Education and E-learning, 7(2), 124.

Shahzad, A., Hassan, R., Aremu, A. Y., Hussain, A., & Lodhi, R. N. (2021). Effects of COVID-19 in e-learning on higher education institution students: The group comparison between male and female. Quality & Quantity, 55, 805–826. https://doi.org/10.1007/s11135-020-01028-z

Sharoff, L. (2019). Creative and innovative online teaching strategies: Facilitation for active participation. Journal of Educators Online, 16(2). https://doi.org/10.9743/JEO.2019.16.2.9

Shin, Y. H., Choi, J., Storey, M. J., & Lee, S. G. (2017). Effectiveness of self-directed learning on competency in physical assessment, academic self-confidence and learning satisfaction of nursing students. Journal of Korean Academy of Fundamentals of Nursing, 24(3), 181–188. https://doi.org/10.7739/jkafn.2017.24.3.181

Tan, S., Chuah, F., & Ting, H. (2017). Students' satisfaction towards online learning systems: assessing its internal and external factors. In G. B. Teh & S. C. Choy (Eds.), Empowering 21st century learners through holistic and enterprising learning (pp. 3–10). Springer Nature. https://doi.org/10.1007/978-981-10-4241-6_1

Tohidi, S., KarimiMoonaghi, H., Shayan, A., & Ahmadinia, H. (2019). The effect of self-learning module on nursing students' clinical competency: A pilot study. Iranian Journal of Nursing and Midwifery Research, 24(2), 91–95. https://doi.org/10.4103/ijnmr.IJNMR_46_17

UNESCO (2020, March 24). 1.37 billion students now home as COVID-19 school closures expand, ministers scale up multimedia approaches to ensure learning continuity. https://en.unesco.org/news/137-billion-students-now-home-covid-19-school-closures-expand-ministers-scale-multimedia

Yakubu, M. N., & Dasuki, S. I. (2018). Assessing elearning systems success in Nigeria: An application of the DeLone and McLean information systems success model. Journal of Information Technology Education: Research, 17, 183–203. https://doi.org/10.28945/4077

Yeoh, M. P., Cazan, A.-M., Ierardi, E., & Jacić, L. A. (2017). Facilitating self-directed learning (SDL) and satisfaction with SDL among pre-university students. Educational Studies, 43(5), 584–599. https://doi.org/10.1080/03055698.2017.1343711

Zhao, H. (2016). Factors influencing self-regulation in e-learning 2.0: Confirmatory factor model [Facteurs qui influencent la maîtrise de soi en cyberapprentissage 2.0: modèle de facteur confirmative]. Canadian Journal of Learning and Technology, 42(2), 1–20. https://doi.org/10.21432/T2C33K

Zamanzadeh, V., Ghahramanian, A., Rassouli, M., Abbaszadeh, A., Alavi-Majd, H., & Nikanfar, A-R. (2015). Design and implementation content validity study: Development of an instrument for measuring patient-centered communication. Journal of Caring Sciences, 4(2), 165–178. https://doi.org/10.15171/jcs.2015.017