ORIGINAL RESEARCH

Critical e-learning quality factors affecting student satisfaction in a Korean medical school

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Purpose: This research investigated the critical factors that affect the e-learning quality. The student satisfaction model with the five factors such as content, system, learner, instructor and interaction was proposed and empirically examined. It also investigated the relationship between the interaction and other constructs.

Methods: This study used a cross sectional survey design, and convenience sampling. To examine the critical factors and their relationship, a survey of 28 items was developed based on previous studies and sent out through a learning management system to all the students (n=250) enrolled in the pre-med 1 to the medicine 3 in one medical school in Korea. The medical school delivered all the courses online due to the coronavirus disease 2019 pandemic. The collected data (n=209, 83.6%) were analyzed through structural equation modeling by using IBM AMOS ver. 26.0 and IBM SPSS ver. 26.0 (IBM Corp., Armonk, USA).

Results: The determinants of e-learning student satisfaction were system, learner, instructor, and interaction qualities, which together explained 72.6% of the variance of student satisfaction and the determinants of e-learning interaction quality were content and system qualities, which together explained 62.9% of the variance of interaction quality.

Conclusion: The results of this study presented practical guidelines to improve e-learning quality in terms of student satisfaction in medical education contexts. The results indicated that more efforts should be directed toward improving interaction features such as interactive teaching styles, collaborative activities, providing instructors and learners with proper training for e-learning prior to e-learning and a quality of contents, and upgrading e-learning system for better performance and service.

Key Words: E-learning, E-learning quality assessment, Student satisfaction model, Interaction, Medical education

Introduction

With the development of information technology, the adoption of e-learning has grown rapidly and e-learning has become a powerful medium for education [1,2]. Recently, e-learning has become more popular due to coronavirus disease 2019 (COVID-19) and has been adopted extensively in higher education worldwide, with many institutions across the globe investing in information technologies for seamless e-learning experiences [3]. Accordingly, its quality has received significant attention.

E-learning can be defined as making use of technology as a mediating tool for learning through electronic devices which enables learners to readily access information and interact with other learners [4], and the evaluation of e-learning quality is vital for the maximization of its effectiveness. Prior studies have attempted to identify the

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various factors which influence e-learning quality [1,5-8] as well as the factors related to technology; however, as technology has become increasingly reliable, recent studies have focused on both human (e.g., students or instructor) and non-human dimensions (e.g., system or content) [1,4,5].

One essential condition for successful e-learning is students' overall satisfaction with e-learning experiences [5,6], which can be defined as the individual's perception of the extent to which their learning needs, goals, and desires have been met [1,4]. Student satisfaction reflects a difference between students' expectation and the perceived performance of the e-learning system; therefore, it is considered one of the critical elements for the evaluation of e-learning quality [9]. Several researchers have adopted this student satisfaction model to assess e-learning quality and proposed critical determinants affecting student satisfaction [10-13]. Sun et al. [11] suggested a student satisfaction model and considered learners, instructors, course, technology, design, and the environment as critical factors affecting students' satisfaction with e-learning. Ozkan and Koseler [12] suggested a hexagonal model and critical determinants such as social determinants (supportive factors, learner perspective, instructor attitude) and technical determinants (system, information, and service quality) as affecting student satisfaction. Wu et al. [13] also suggested a satisfaction model, the constructs of which included computer self-efficacy, system functionality, content, interaction, performance expectations, and learning climate. These studies overall suggested system, content, learner, instructor, and interaction as critical factors affecting student satisfaction with e-learning.

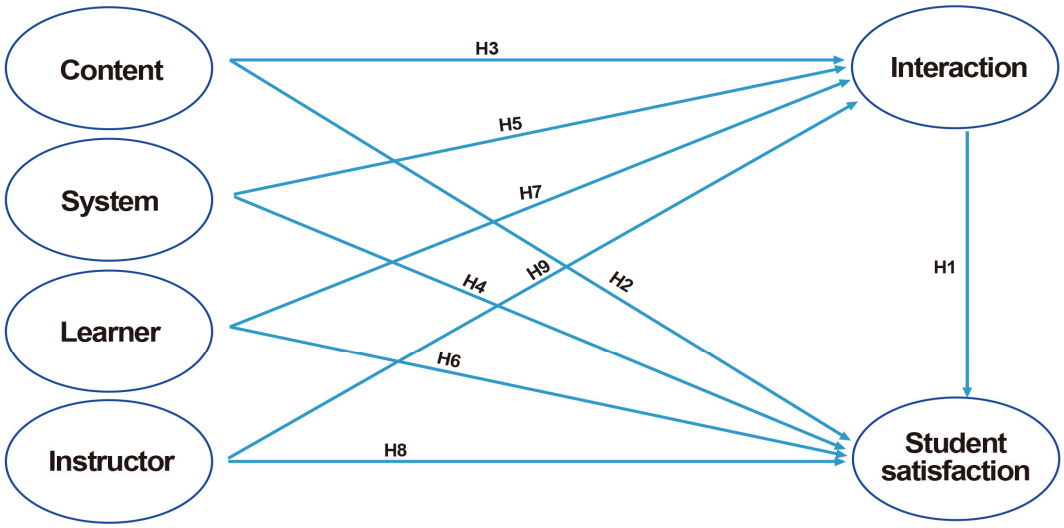
Assessing critical e-learning quality factors influencing student satisfaction enables us to detect areas for the development and improvement of e-learning, and guides us toward a better understanding of how student satisfaction can be increased and how the use of the e-learning system can be improved [7]. In addition, the factors affecting student satisfaction in e-learning contexts and their relationships may differ based on their relative importance according to the contexts [4]; for example, the study conducted by Kuo et al. [5] indicated the effect of learner-content interaction on student satisfaction differed according to the academic programs that students took. However, such research is scarce, particularly in medical education contexts. Little research has been conducted on e-learning quality factors based on a student satisfaction model in medical education fields. The current full-scale adoption of e-learning has made it important to probe vital determinants that will enhance student satisfaction in medical e-learning contexts.

Thus, this study aims to fill this void by investigating the critical factors that influence e-learning quality in terms of student satisfaction in medical education contexts. This study presents the student satisfaction model, which extends the core principles of the model of Sun et al. [11] and includes the content, system, learner, instructor, and interaction determinants. The fining of this study can contribute to the e-learning literature by providing guidelines for e-learning educators or system developers, and by better understanding students' perceptions of the primary factors associated with e-learning quality in medical education contexts.

1. Research model and hypotheses

The proposed student satisfaction model in this study is shown in Fig. 1, and Appendix 1 outlines the measures for each construct and the pertinent literature. Interaction is one of the critical determinants of e-learning quality [14-16], and defined as two or more objects' behavior of communicating with and affecting each other [14]. Despite its importance, few researchers have investigated the relationship between interaction quality as a stand-alone

Fig. 1. Research Model



construct and student satisfaction. In addition, integration in e-learning can be divided into learner-system, learner-instructor, learner-learner, and learner-content interactions [15] but extant studies have explained student satisfaction based on one or two types of interaction [9,10,17]. The inclusion of all four types of interaction into the explanation of e-learning quality may fully reflect interaction quality during e-learning. Thus, this study includes all four types of interaction as measures to investigate their influence on student satisfaction and hypothesizes that

H1. A higher level of interaction quality will lead to a higher level of learner satisfaction with e-learning.

Content is key in evaluating the quality of e-learning, due to its essential role in achieving learning goals [18]. Prior research has found a significant relationship between content quality and student satisfaction [12]. Sufficiency, conciseness, content design, diverse learning styles, and whether the content is up-to-date are the core determinants of content quality in e-learning environments [1,12,18-20]. Such content features can impact interaction quality as well. Learner-content interaction refers to a one-way process of accessing, elaborating, and reflecting on course contents [5], and a higher level of content quality may increase the quality of interaction. This study thus hypothesizes that

H2. A higher level of content quality will lead to a higher level of student satisfaction with e-learning.

H3. A higher level of content quality will lead to a higher level of interaction in e-learning.

System quality has a significant effect on the effectiveness of e-learning, and it can directly affect student satisfaction [1,18,20]. Prior research has found that ease of use, ease of learning, system features, and system reliability are important determinants of system quality [4,10,12,19,21]. Furthermore, they are expected to influence interaction quality [13]. Learner-system interaction can be defined as the degree to which learners perceive that they are in control of their learning experiences through the e-learning system [14], and a higher level of system quality allows students to have a higher level of control over their learning experiences. In addition, previous studies have shown that providing guidance and staff availability are significantly related to student satisfaction [10,12,18]. The authors of previous studies employed those measures as separate service quality factors, but this study includes them in the system quality construct, because learning management system

(LMS) include service components as well as technology components. Therefore, this study hypothesizes that

H4. A higher level of system quality will lead to a higher level of learner satisfaction with e-learning.

H5. A higher level of system quality will lead to a higher level of interaction in e-learning.

Several studies have shown that learner qualities such as attitude toward the e-learning system, self-efficacy, and previous e-learning experience, are significantly related to student satisfaction [1,11,12]. Self-efficacy is an individual's confidence in a certain task, based on an evaluation of the possibility for success [22]. A positive attitude toward e-learning, previous e-learning experience, and higher self-efficacy can increase students' learning interest and confidence, which will improve their satisfaction [11]. Their positive attitude and confidence can also increase the interaction quality between students and their classmates, instructor, or contents. Therefore, this study hypothesizes that

H6. A higher level of learner quality will lead to a higher level of student satisfaction with e-learning.

H7. A higher level of learner quality will lead to a higher level of interaction in e-learning.

Previous research has shown that instructor quality is an important determinant of e-learning quality [11,12] and that instructors' attitude toward e-learning, teaching styles, control over the e-class, and enthusiasm toward online teaching have a positive relationship with student satisfaction [1,11,12,23]. Such aspects are also likely to influence interaction quality. Learner-instructor interaction can be defined as the degree of interaction between instructor and learner via an e-learning system [14], and a higher level of instructor quality is expected to increase the level of interaction in e-learning. Therefore, this study hypothesizes that

H8. A higher level of instructor quality will lead to a higher level of learner satisfaction with e-learning.

H9. A higher level of instructor quality will lead to a higher level of interaction in e-learning.

Methods

1. Participants and procedures

This study was conducted in a private medical school in Korea, which held all the courses that are normally delivered face-to-face, in an online mode due to the COVID-19 pandemic. During the pandemic, courses were delivered both asynchronously, with recorded lectures through the LMS (https://eclass.donga.ac.kr) and synchronously, mostly through Zoom meeting (Zoom Video Communications Inc., San Jose, USA). However, the main delivery method was the recorded lectures through the LMS. All other learning resources were also uploaded onto the LMS. This semester was the third semester that the medical school delivered all the courses online except clinical rations and some laboratory courses.

This study has been approved by Dong-A Institutional Review Board (2-1040709-AB-N-01-202106-HR-042-04). This study used a cross sectional survey design, and the participants were drawn from convenience sampling. A survey of 28 items investigating the five dimensions affecting student satisfaction in e-learning, was adopted from previous research (Appendix 2) and presented as a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (strongly agree). The survey also collected background information (five items: gender, age, year, previous e-learning experience, and e-learning mode). It was distributed through the LMS to all the students (n=250) enrolled in the pre-medical program year 1 to the medical program year 3 at the end of the spring semester over 2 weeks (July 9th-July 23rd); among them, 209 students (83.6%) responded to the survey. Their background

Table 1. Participants' Background Information (N=209)

Characteristic	Frequency (%)
Gender	
Male	137 (65.6)
Female	72 (34.4)
Age (yr)	
20–25	182 (88.8)
26–29	21 (10.2)
30–37	2 (1.0)
Unidentified	4 (1.9)
Year	
Pre-med 1	51 (24.4)
Pre-med 2	42 (20.1)
Medicine 1	46 (22.0)
Medicine 2	33 (15.8)
Medicine 3	37 (17.7)
Previous e-learning experience	
Yes	27 (12.9)
No	182 (87.1)
E-learning mode	
Synchronous	3 (1.4)
Recoded lecture	2 (1.0)
Both	196 (93.8)
Unidentified	8 (3.8)

information is presented in Table 1.

2. Data analysis

This study used the structural equation modeling and followed the two-step approach recommended by Anderson and Gerbing [24]. In the first step, confirmatory factor analysis (CFA) was used to develop the measurement model. In the second step, the structural model was tested. Statistical analyses were conducted using IBM AMOS ver. 26.0 and IBM SPSS ver. 26.0 (IBM Corp., Armonk, USA).

Results

1. Measurement model

The measurement model was assessed by examining

Table 2. Results of Factor Analysis, Reliability, and AVE

Factor	Factor loading		t-value	Cronbach's α	AVE	CR
	B	β				
System				0.918	0.65	0.80
S1	1.000	0.859				
S2	0.992	0.835	15.352***			
S4	0.980	0.885	16.997***			
S5	0.810	0.664	10.828***			
S6	0.960	0.823	14.965***			
S7	0.912	0.757	13.038***			
Instructor				0.905	0.74	0.82
I1	1.000	0.817				
I2	1.039	0.826	12.517***			
I3	1.230	0.884	15.550***			
I4	1.177	0.910	16.249***			
Learner				0.846	0.66	0.70
L1	1.000	0.877				
L2	0.891	0.804	15.400***			
L3	0.631	0.748	13.607***			
Content				0.938	0.75	0.88
C1	1.000	0.826				
C2	1.027	0.853	18.675***			
C3	1.042	0.878	15.965***			
C4	1.174	0.886	16.203***			
C5	1.138	0.873	15.818***			

(Continued on next page)

Table 2. (Continued)

Factor	Factor loading		t-value	Cronbach's α	AVE	CR
	B	β				
Interaction				0.926	0.69	0.84
IN1	1.000	0.812				
IN2	1.060	0.897	15.889***			
IN3	0.975	0.835	14.250***			
IN4	1.201	0.849	14.619***			
IN5	0.967	0.794	13.260***			
IN6	1.126	0.787	13.102***			
Student satisfaction				0.937	0.80	0.87
SS1	1.000	0.905				
SS2	1.150	0.944	23.422***			
SS3	1.242	0.938	23.926***			
SS4	0.951	0.777	15.089***			

AVE: Average variance extracted, CR: Composite reliability.
***p<0.001.

Table 3. Squared Correlations, AVE, and Discriminant Validity

	System	Instructor	Learner	Content	Interaction	Student satisfaction
System	0.65					
Instructor	0.45	0.74				
Learner	0.40	0.42	0.66			
Content	0.48	0.62	0.46	0.75		
Interaction	0.41	0.53	0.34	0.66	0.69	
Student satisfaction	0.42	0.49	0.59	0.59	0.52	0.80

AVE: Average variance extracted.

internal consistency reliability, indicator reliability, and convergent and discriminant validity. Cronbach's α and composite reliability were tested for internal consistency reliability, and their values were all above the recommended level of 0.70 [25], as shown in Table 2. Indicator reliability was also checked by CFA; as shown in Table 2, all factor loadings exceeded the recommended value of 0.70 [26] and were statistically significant. The average variance extracted (AVE) was tested for convergent validity, and all its values were greater than the recommended lower threshold of 0.50 [27]. Discriminant validity was also tested by the correlation matrix following the method of Fornell and Larcher [27]. The AVE of each construct should be higher than the squared correlation for each pair of constructs, indicating that each construct is distinct; as shown in Table 3, all diagonal values (AVE) are larger than the other values inside the one column. Finally, the overall fit indices of the measurement model were checked. The results of the CFA showed that χ^2 =774.69 ($p<0.001$), degrees of freedom (df)=333, Tucker-Lewis index (TLI)=0.92, comparative fit index (CFI)=0.93, and root mean square error of approximation (RMSEA) =0.80. The chi-square test is sensitive to the sample size, and it nearly always rejects the model when larger samples are used [27]; thus, other fit indices were considered. The TLI and the CFI yielded values greater than the suggested lower threshold of 0.90, and the RMSEA should be less than 0.08 [27]. Thus, as the indices were generally over their respective common acceptance levels, the measurement model is considered to fit the sample data.

2. Structural model

The structural model for the research model depicted in Fig. 2 was tested. The overall fit indices were as follows: χ^2=820.46 (p<0.000), df=335, TLI=0.91, CFI=0.92, and RMSEA=0.083. The value of RMSEA surpasses the recommended vale of <0.8 for an acceptable fit; thus, the research model was modified by connecting with the covariance path between the error variances, which exceeded the modified index value of 10 (between learner 3 and content 2 and between content 2 and content 3). The indices of the overall fit of the modified model were χ^2=751.74 (p<0.000), df=332, TLI=0.92, CFI=0.93, and RMSEA=0.078. The model fit improved, and the difference of the chi-square was 68.724 (df=3). This difference was statistically significant; therefore, these indices indicated that the modified research model fits the data well. The model explained 72.6% (R^2=0.726, adjusted R^2=0.719) of the variance in student satisfaction and 67.9% (R^2=0.679, adjusted R^2=0.673) of the variance in interaction quality, which are both considered substantial.

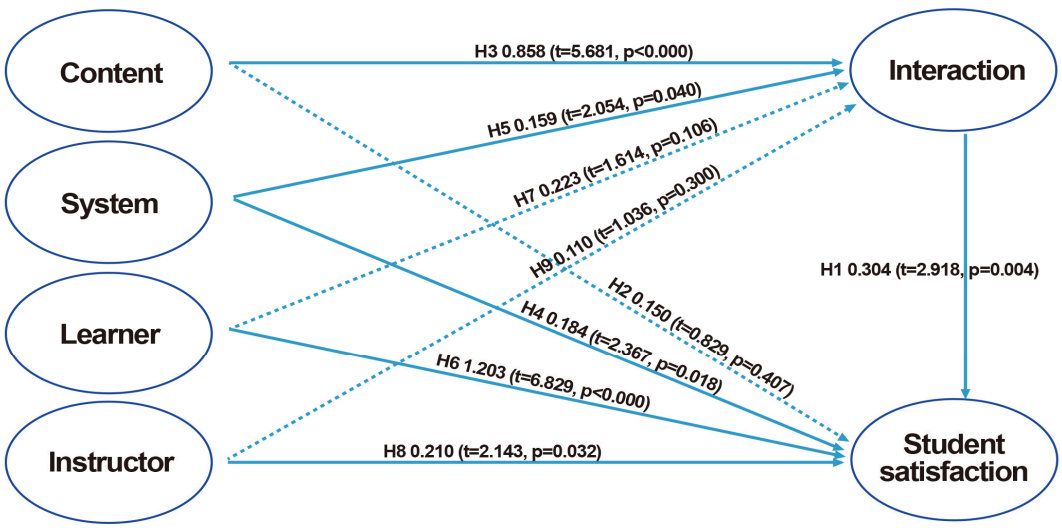
3. Hypothesis testing

Fig. 2 shows the hypothesized relationships between the constructs of the structural model with the standardized path coefficients, t-values, and their significance. The interaction, system, learner, and instructor qualities had significant effects on student satisfaction; hence, H1, H4, H6, and H8 were supported. The quality of content and system had significant effects on interaction quality; hence, only H3 and H5 were supported, while H2, H7, and H9 were rejected.

Discussion

Most of the hypothesized relationships were empirically verified. Hypothesis 1 was supported, which confirms that interaction is one of the most important factors in student satisfaction with e-learning contexts. The four types of interactions (learner-content, learner-system, learner-learner, learner-instructor) were important aspects and positively influenced student satisfaction. This finding supports the studies of Alqurashi [9], Cidral et al. [10], Kuo et al. [5], Regmi and Jones [7], Urbach et al. [21], and Wu et al. [13], which found a significant relationship between one or two types of interaction and student satisfaction. In addition, this study shows a similar result

Fig. 2. The Research Model Analysis Results



with the study of Eom and Ashill [28], which showed that student–student and instructor–student dialogues affected student satisfaction. The finding suggests that interaction features such as system interactivity or communication features (learner–system), instructors' timely responsiveness or communication skills (learner–instructor), interaction with other classmates (learner–learner), and easy access to course material (learner–content), make students feel more satisfied with e-learning experiences.

Although hypothesis 2 was rejected, hypothesis 3 gained empirical support. This result is different from the studies of Al-Fraihat et al. [1], Hassanzadeh et al. [29], Cidral et al. [10], Ozkan and Koseler [12], and Urbach et al. [21], which showed that content quality is a determinant of student satisfaction, while the study of Chen and Yao [30] showed an insignificant relationship. Instead, content quality affected interaction quality. Well-designed content in diverse modes will enhance learner–content interaction and ultimately improve student satisfaction. One possible explanation for the insignificant relationship between content quality and student satisfaction could be that the students depended on the system's quality to access the contents, and then, the content dimension became less important compared to the system dimension.

Hypotheses 4 and 5 were accepted. The aspects related to the system' s quality, such as ease of use, ease of learning, system features, and reliability, were important and contributed to student satisfaction. A similar significant relationship was found by Al-Fraihat et al. [1], Ozkan and Koseler [12], Holsapple and Lee-Post [19], Roca et al. [20], and Urbach et al. [21]. The finding also confirms that affording system services such as guidance and staff availability can increase the level of student satisfaction with e-learning [1,12,25]. Thus, it is critical to equip and maintain the quality of an e-learning system to generate students' positive feelings toward it. It can be deduced that such aspects have a significant impact on interaction quality, and the study's results confirmed this significant relationship.

Statistical results showed a positive relationship between learner quality and student satisfaction (H6), matching those of previous studies by Al-Fraihat et al. [1], Ozkan and Koseler [12], Sun et al. [11], and Venkatesh et al [8]. The finding confirms that learners who have positive attitudes toward e-learning, previous e-learning experience, and confidence to perform tasks in e-learning contexts are more satisfied with e-learning. However, hypothesis 7 was rejected. Such learner qualities were expected to affect interaction quality in e-learning, but they did not. Considering that lecture-oriented courses in the medical school mostly changed just mode from face-to-face to online, one possible explanation for this result may reside in course design. Arbaugh and Benbunan-Fich [17] showed that a higher level of learner–learner interaction was associated with collaborative environments; thus, in e-learning contexts where the course does not require interaction between students, learner quality has less influence on interaction quality.

Hypotheses 8 gained empirical support, but hypothesis 9 was rejected. The aspects related to instructor quality, such as instructor enthusiasm, instructor attitude, teaching skills, and control over the e-class, are important, and contribute to student satisfaction. The results support the studies by Al-Fraihat et al. [1], Eom and Ashill [23], Ozkan and Koseler [12], and Sun et al. [11], which reported that student satisfaction with e-learning was positively influenced by instructor quality, but instructor quality did not significantly affect interaction quality. In the current COVID-19 situation, e-learning systems have become the only channel for interaction between instructors and students, and the instructors' prompt response and regular communication are quasi-mandatory, regardless of their attitude or enthusiasm toward e-learning, which may inflate the influence of instructor quality on interaction

quality.

These findings shed light on practical implications that should be considered, to increase student satisfaction with e-learning in medical education contexts. First, this study provided evidence of the importance of interaction for e-learning quality in terms of student satisfaction. Effective interaction takes place only if e-learning is designed and implemented well [7,9,16]; thus, providing and improving interaction features should be considered when implementing e-learning, to enhance student satisfaction. The e-learning developer should install more interactive functionalities. Instructors should develop interactive teaching styles, and they are encouraged to employ strategies that enhance learner-content and learner-learner interaction. Collaborative activities such as group discussions, group projects, and content sharing are recommended for a higher level of interaction.

Second, this study revealed that instructor and learner qualities have significant effects on student satisfaction with e-learning contexts. Proper training for e-learning instructors and learners before they experience e-learning is necessary; this will aid instructors and learners in gaining confidence and a positive attitude toward using e-learning, and it will improve their awareness of the features of the e-learning system, which will enhance student satisfaction with it.

Third, the findings of this study revealed that providing quality content is key for interaction in e-learning contexts, which ultimately increases student satisfaction. Thus, universities should make an effort to supply sufficient, concise, up-to-date content with proper design, in diverse modes. A variety of delivery tools can also extend opportunities for learner-content interaction [5]. Fourth, this study indicated that the system's quality is an important factor, affecting interaction quality and student satisfaction. Thus, e-learning systems should be upgraded for better performance and service, such as by becoming more user-friendly [7] and more reliable, providing proper guidance, and having various communication features.

This research investigated the factors that affect e-learning quality in terms of student satisfaction in medical education contexts. It proposed a student satisfaction model and empirically examined it with the five dimensions of content, system, learner, instructor, and interaction. In addition, it investigated the relationship between interaction and other constructs. The results indicated that in general, these constructs are all important and contribute to student satisfaction and more efforts should be directed toward improving interaction features, providing instructors and learners with proper training for e-learning and a quality of contents, and upgrading e-learning system for better performance and service. The research about factors influencing on e-learning quality in terms of student satisfaction is scare particularly in medical education contexts. More research is necessary to enhance our understanding of vital factors affecting e-learning satisfaction in medical education fields.

This study has several limitations. Although a substantial number of students participated in it, it was conducted in one university of one country. To increase the results' validity and reliability, future studies which comprise a larger group of students from diverse backgrounds is necessary. It also needs to explore the unsupported hypothesized relationships in this study with a larger group of students. Longitudinal research to examine how the relationship among the constructs suggested in this study changes over time, could contribute to a better understanding of the student satisfaction model in e-learning contexts as well.

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Appendix 1. Construct Measures and Pertinent Literature

Construct	Item	Measure	Pertinent literature
Content	C1	Sufficiency	DeLone & McLean [18] (2003)
	C2	Conciseness	Al-Fraihat et al. [1] (2020)
	C3	Up-to-date content	Ozkan & Koseler [12] (2009)
	C4	Content design	Roca et al. [20] (2006)
	C5	Meeting diverse learning style	Holsapple & Lee-Post [19] (2006)
			Mohammadi [4] (2015)
			Cidral et al. [10] (2018)
System	S1	Ease of use	Al-Fraihat et al. [1] (2020)
	S2	Ease of learning	Holsapple & Lee-Post [19] (2006)
	S3	System features	Ozkan & Koseler [12] (2009)
	S4	System reliability	Sun et al. [11] (2008)
	S5	Providing guidance	Roca et al. [20] (2006)
	S6	Staff availability	Mohammadi [4] (2015)
			Cidral et al. [10] (2018)
Learner	L1	Learner attitude	Al-Fraihat et al. [1] (2020)
	L2	Previous e-learning experience	Sun et al. [11] (2008)
	L3	Self-efficiency	Ozkan & Koseler [12] (2009)
			Kuo et al. [5] (2014)
			Navimipour & Zareie [31] (2015)
Instructor	I1	Instructor enthusiasm	Al-Fraihat et al. [1] (2020)
	I2	Instructor attitude	Sun et al. [11] (2008)
	I3	Teaching skills	Ozkan & Koseler [12] (2009)
	I4	Control over the e-class	Eom & Ashill [23] (2018)
Interaction	IN1	Learner-system interaction	Wu et al. [13] (2010)
	IN2	Learner-system interaction	Kuo et al. [5] (2014)
	IN3	Learner-instructor interaction	Alqurashi [9] (2019)
	IN4	Learner-instructor interaction	Cheng [14] (2013)
	IN5	Learner-learner interaction	Eom & Ashill [23] (2018)
	IN6	Learner-content interaction	Urbach and Ahlemann [25] (2010)
Satisfaction	SA1	Satisfaction with overall performance	Al-Fraihat et al. [1] (2020)
	SA2	Meeting educational needs	Cidral et al. [10] (2018)
	SA3	Satisfaction with learning experience	Ozkan & Koseler [12] (2009)
	SA4	Effective learning tool and improve learning process	Holsapple & Lee-Post [19] (2006)
			Sun et al. [11] (2008)

Appendix 2. Indicators for Each Construct

Construct	Item	Indicator
Content	C1	The course content is covered to an appropriate degree of breath.
	C2	Information from the e-class is concise and clear.
	C3	The content of the e-class is up-to-date.
	C4	The design of the content (fonts, style, color, image, video) is good and meets the quality standard.
	C5	The contents provide me with different learning styles (e.g., flash animation, video, audio, text, simulation, etc.) and they are interesting and appropriate to my study.
System	S1	The e-class is easy to use.
	S2	The e-class is easy to navigate.
	S3	The e-class includes the necessary features and functions that I need.
	S4	The e-class does not crash frequently.
	S5	There are enough and clear instructions about how to use e-class.
	S6	The responsible service personnel are available and cooperative when facing an error in the e-class.
Learner	L1	I have a positive attitude toward using the e-class.
	L2	My previous experience with the e-learning helped me to use the e-class.
	L3	I am able to perform the tasks in the e-class successfully.
Instructor	I1	The instructor is enthusiastic about teaching the class online.
	I2	Generally, my instructors have positive attitude to the utilization of the e-class.
	I3	The instructors' style of presentation holds me interest.
	I4	The instructor handles the e-learning class effectively.
Interaction	IN1	The e-class provides interactivity and communication facilities such as chat, forums, and announcements.
	IN2	The e-class supports an effective and efficient sharing of information with my classmates
	IN3	The instructor promptly responds to questions and concerns via the e-class.
	IN4	The instructor is good at communication with the students via the e-class.
	IN5	I communicated with other students about the course contents through diverse communication tools in e-class.
	IN6	I did not face problems accessing the online course materials.
Student satisfaction	SS1	I am satisfied with the performance of the e-class.
	SS2	The e-class satisfies my educational need.
	SS3	Overall, I am pleased with the experience of using the e-class
	SS4	The e-class is a very effective educational tool and has helped me to improve my learning process.