Evaluation of e-Learning System during the Covid-19 Pandemic in Morocco: A Partial Least Squares Modeling Approach

Abdelaziz Ouajdouni, Khalid Chafik, and Omar Boubker

***Abstract*—E-learning was a major study area during COVID-19 pandemic. Practically, public and private higher education institutions worldwide have switched from traditional face-to-face teaching to online learning solutions in order to deal with the spread of the coronavirus. Hence, the purpose of this study is to evaluate the effectiveness of the e-learning solution during COVID-19 crisis. The research data were gathered using a self-administered online survey from Moroccan public university students. Through using the structural equation modeling under the partial least squares (PLS-SEM), the findings reveal that instructor quality has a direct and significant influence on system use and learner satisfaction. Likewise, user satisfaction is positively associated with system quality. Moreover, the e-learning system success is driven by both system use and learner satisfaction. These results are useful for Moroccan University policymakers in order to develop best practices to ensure a successful e-learning implementation.**

***Index Terms*—E-learning system, COVID-19 pandemic, higher education, Morocco.**

I. Introduction

Even if some people have initially ridiculed the seriousness of the new coronavirus, considering it as a "flu like the others," it is clear that the pandemic has affected the daily life of most of us. From the simple gesture of disinfection to the stop of classes, passing by the state of sanitary emergency and the restriction of the circulation, arriving at the professional complications generated by the crisis, the COVID-19 has had negative consequences on all the plans including economy, health and education.

The Kingdom of Morocco has been severely affected by this pandemic crisis. According to WHO Africa, as of June 25, 2020, Morocco has reported 528,180 confirmed positive cases and 9,265 deaths. Referring to the various medical research made by infectious disease specialists, epidemiologists and public health officials; opinions are unanimous that the cessation of face-to-face classes reduces close interactions and consequently, the spread of the virus.

In today's digital age, the term information and communication technology (ICT) have broadened to embrace many areas of computing technology and is more widely recognized than ever before. Several reasons have contributed to the increased usage of ICTs in educational institutions. Using ICTs in the academic field, for example, will increase educational quality. It will increase the efficacy of executing educational policies by facilitating knowledge absorption and acquisition [1]. All academic institutions throughout the world have made significant investments in e-learning, and many of the conventional classroom-style courses have been transformed to E-Learning mode [2].

Certainly, the development of distance learning offers new learning alternatives and generates radical changes in educational practices [3]–[6], but the choice to implement e-learning devices is necessary if only to face these critical times of the "Covidian" crisis that has shaken the world including the community of higher education. In the current worldwide lockdown caused by the coronavirus disease 2019 (COVID-19) pandemic, e-learning has proven to be the sole option for continuing education [7]. Referring to [8], the impact of information technology on human existence is enormous, and its importance in education cannot be overstated. In the present COVID-19 pandemic scenario, the participation of information technology has gained traction owing to the closure of educational institutions, which creates obstacles for students' learning. Globally, educational institutions and students have adopted and valued the online learning platform. This acceptance is due to the simplicity of use, learning flexibility, and customizable environment. However, despite its numerous benefits, e-learning has a number of drawbacks, including social isolation, face-to-face connection between teacher and student, and connectivity concerns [9]. While research confirms that digital technologies are central to the learning process for learners, it also indicates that these technologies are not "revolutionizing" the nature of teaching and learning at the university [10]. According to the authors, instructors must eventually dampen their enthusiasm for what would be able to be achieved with technology-enhanced learning and expose an ultimate conception of the realities of student proactions with digital technology. Whitaker and New *et al*. [11] point out that students are able to learn with or without technology, asserting that the use of technology can have disruptive effects on them, leading to prejudicial attitudes.

In recent years, web-based learning systems have been widely used in educational and non-educational institutions. A report published by the Giga Information Group shows that the percentage of organizations using e-learning systems in training programs increased from 21% in 2002 to 75% in 2005, and nearly 75% of the 129 top U.S. universities used e-learning systems in 2007.

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In Morocco, the higher education sector, where the reflection on e-learning was already well underway as part of the strategic vision of the 2015-2030 Education Reform to solve the problem of overcrowding of education, has been forced to switch quickly to this new mode in conjunction with the suspension of classes and the closure of Moroccan schools and universities as of March 16, 2020, in order to ensure the continuity of learning provided to the student community.

Traditional learning methods were broadly accepted in developing nations prior to the emergence and proliferation of COVID-19. Nevertheless, the lockout of institutes and the need to fulfil the required syllabus in a specified time limit in accordance with the education system drove academic institutions to relinquish their worries and adopt emergency remote learning [12]. In this regard, this study aims to evaluate the e-learning system success.

- To identify e-learning system success determinants during the COVID-19 pandemic from the perspective of the Moroccan student as a final user.
- To assess the efficacy of the e-learning solution during the COVID-19 crisis.
- To identify all of the factors that must be considered for the effective implementation of an e-learning system in higher education institutions in Morocco.

In this regard, this study attempts to evaluate the e-learning system success from the point of view of the end-users, in this case the Moroccan students, since a result of their perceptions, educational institutions and policymakers will be able to develop better ways of e-learning in the aftermath of the COVID-19 crisis, as social separation may become the new rule. For this purpose, the present paper is organized as follows. Section 2 presents the literature review, the objectives and the proposed research model. Section 3 highlights the research methodology. Section 4 delineates detailed results and findings. The final section offers discussions and conclusions.

II. Literature Review and Research Model Development

A. Digital Technology in Higher Education

The use of digital technology in higher education is not new. The '90s marked the rapid growth of information technology with the first implementations of digital tools in higher education. The computer revolution was launched by the emergence of the concept of electronic classrooms in several disciplines such as engineering, management, science, languages [13], [14]. According to them, these electronic classrooms were equipped with computer-based tools where the teacher and/or student can use these facilities to record, manipulate or retrieve information/data during classroom presentations and analysis.

Since then, the use of digital technologies in higher education has begun to evolve, as it has been found that Internet technology can have a relevant impact on the learning industry. Higher education institutions opting for the traditional mode of learning such as those operating in the private sector have expanded and are using online training, but their effectiveness of the virtual learning environment has not been quantified compared to traditional face-to-face teaching [15].

Later in the literature, it was recommended that interactive instructional video be incorporated into e-learning systems given the performance and satisfaction level of learners via this mode of learning [16]. Ben Arbaugh *et al*. [17] go so far as to assert that online courses are at least comparable to face-to-face courses in achieving desired learning outcomes. Other researchers believe that the use of digital technologies in higher education has evolved due to their contribution and the teaching and learning opportunities they offer [11].

The interest in this issue of e-learning in higher education is notably directed by the assumption that ICTs allow for the enhancement of collaborative learning that is found in a constructivist pedagogy [18]. In this sense, it has been noted that the collaborative learning model should be the foundation upon which online courses are designed and delivered [19], [20]. However, every advantage has its disadvantages and vice versa, although research confirms that digital technologies are central to the learning process for learners, it also indicates that these technologies are not "revolutionizing" the nature of teaching and learning at the university [10]. According to the authors, teachers must eventually dampen their enthusiasm for what would be able to be achieved with technology-enhanced learning and expose an ultimate conception of the realities of student proactions with digital technology. Whitaker *et al*. [11] point out that students are able to learn with or without technology, asserting that the use of technology can have disruptive effects on them, leading to intrusive attitudes.

Another part of the evolution of digital technology involves social media, which continues to spread [21], [22]. Many researchers advocate for the purposeful integration of social media as an educational tool [23]. Despite students admitting MS into higher education, there is no consensus on its positive impact on students' academic scores and activity/experience in their academic courses [24]–[28]. Social media is increasingly apparent in higher education institutions due to instructors veering towards this type of technology to enhance their teaching as well as promote active learning for students. Nevertheless, the empirical evidence runs counter to this claim [28].

For many teachers, new educational technologies and facilities may cause discomfort or even feel unsettling due to their lack of suitability for effective pedagogical use and acculturation in teaching and learning [29].

In this regard, and in light of the different and sometimes inconsistent points of view, the presence of digital technology in the education sector cannot be overlooked at all, on the contrary, it has always been omnipresent at the center of the developments that the sector has undergone in time and space, to facilitate learning and improve performance, as defined by Januszewski and Molenda [30], who state that "educational technology is the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources".

B. E-Learning System Success

The Information System Success Model [31] is considered a very influential theoretical foundation for predicting and explaining information system usage, user satisfaction as well as information system success [32]–[34]. This model can be considered as a basis for evaluating the success of the e-learning system due to its strong theoretical basis and the numerous empirical studies conducted in this direction [32].

DeLone and McLean identified six distinct variables of IS success: System quality, content quality, the use, users' satisfaction, individual impact, and organizational outcomes. Both quality and information quality of positively affect the level of use and the user satisfaction. Furthermore, IS level of use may affect user satisfaction either favorably or unfavorably. In turn, IS use and user satisfaction results in individual impact, which turns in enhancing the organizational impact [31].

Looking at the constructs of their actualized model and its interrelationships, it can be interpreted as follows: a system can be evaluated in terms of information, system, and service quality; these attributes affect subsequent use/intention to use and user satisfaction. Some benefits will be obtained by using the system. The net benefits will be able to (positively or negatively) influence user satisfaction and subsequent use of the IS [35]. The information system success model has been used as a cornerstone that enables the evaluation of several systems such as e-commerce, e-learning, e-health, e-justice, e-gov, and ERP systems [36]–[43]. In the context of e-learning, learning activities are done by students (end-users) through platforms often hosted on the web (information system).

Studies evaluating the success of IS related to academic context such as universities and colleges are scarce [44], particularly in the context of Arab countries [45], [46], which poses a problem in terms of proposing an evaluation criterion conducive to the educational organizations in this environment.

Multiple criteria and approaches were used to assess the performance of e-learning systems, owing to the different ways of defining e-learning [47], [48] . In the state of art, we found four such approaches: the Information System Success Model; the Technology Acceptance Model; models focusing on users' satisfaction and models focusing on e-learning quality.

C. Hypotheses and Research Model

E-learning system quality is fundamental to a successful e-learner experience [49]. Previous studies have reported that system quality directly affects system use and user satisfaction [32], [44], [50], [51]. For instance, Al-Fraihat, Joy, Masa'deh, & Sinclair [52] argued that the technical system quality is a key determinant of user satisfaction. Based on a comparison between males and females, Shahzad, Hassan, Aremu, Hussain, & Lodhi [53] found a positive and significant correlation between system quality and user satisfaction. Therefore, we can propose that:

H1: E-learning system quality has a significant influence on e-learning system use.

H2: E-learning system quality has a significant influence on user satisfaction.

The second most prominent and frequently used criterion for evaluating the quality of e-learning services is the instructor's quality [52].

Instructors' pedagogical competence in using educational technology is critical [54], as is sculpting good digital citizenship [55]–[58], because transformation does not occur eventually by putting instructors in contact with technology [59]. Undoubtedly, beginner instructors have been found to be more skilled at fast improvement and transformation than more qualified teachers [60], who really quote a scarcity of digital literacy as a disincentive to use more educational technology in classrooms, as well as structural issues such as accessibility and volume of work [61].

Studies in the field of e-learning have emphasized the role of the instructor in the e-learning success. For instance, Sun *et al*. [62] discovered a positive relationship between the instructor dimension and satisfaction. Also, Alam *et al*. [2] confirmed a direct relationship between instructor's quality and system use. In our study, we propose that IQ is likely to influence system use and user satisfaction. Hence, the following hypotheses are proposed:

H3: Instructor's quality has a significant influence on system use.

H4: Instructor's quality has a significant influence on e-learner satisfaction.

System use is a critical construct in determining system success [44], [63], [64]. When a system is perceived to be useful, it is more likely to be used; when it is perceived to be useless, it is less likely to be used [32]. If users perceive that the e-learning system helps to enhance their productivity, this system will be perceived as more effective [65]. Thereby, e-learning system use constitutes a key driver of students' benefits [52]. As a result, the following hypothesis is proposed:

H5: System use has a significant influence on system success.

User satisfaction has clearly demonstrated its validity and dependability as an essential measure of e-learning system's success [52], [66]. User satisfaction can be viewed as how well learners believe that e-learning system fits their needs [67]. In addition, universities regard e-learner satisfaction as an important predictor of e-learning quality [67]. Existing studies have revealed that system success depends on e-learner satisfaction [44], [53]. For instance, Cidral *et al*. [44] confirmed that user satisfaction positively and significantly affects the individual impact. Likewise, user satisfaction has been identified as an explanatory variable of e-learning portal success [53]. Hence, when e-learning system users are more satisfied, they are more likely to use the system and reap its benefits [65]. Accordingly, we propose that:

H6: User satisfaction has a significant influence on system success.

Based on the above-mentioned literature review and hypotheses, Fig. 1 depicts the proposed conceptual model and hypothesized relationships.

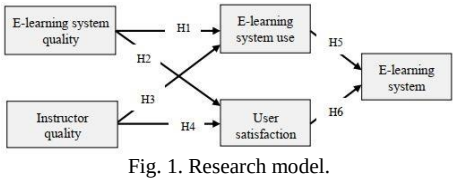

Fig. 1. Research model.

III. Material and Methods

A. Constructs Operationalization

The measurements employed in this research were derived from earlier literature. Hence, the e-learning system quality was measured with 3 items selected from [68]. Referring to Roca and Gagn é[69], and Sun *et al*. [62], we chose 5 items to measure instructor quality. To measure system use, we mobilize the [70] scale with 6 items. According to previous studies, user satisfaction was measured with 6 items [68], [71]–[73]. Finally, system success was measured with 6 items [74], [75]. A five-point Likert-type scale was used to measure questions associated with each variable (See Appendix I).

B. Sampling and Method of Data Collection

The research questionnaire survey was carried out among Moroccan university students. We used a convenience sampling method due to the lack of a sample frame. Throughout two months (May and June 2020), the questionnaire was self-administered by using the Google

Forms tool. During this time, a number of 264 student responses were gathered, with 187 females (70.80%) and 77 males (29.20 %). Approximately half of those who replied to our survey were undergraduate students (46.2%). Students from 31 Moroccan educational institutions affiliated to 13 universities provided responses. 25.67% of students say they do not use any video conferencing software. Teachers, on the other hand, use WhatsApp groups to interact with students, while YouTube videos are used to share knowledge. In addition, the most widely used video conference tools in the Moroccan universities are Zoom Cloud Meetings and Google Meet.

C. Data Analysis Method

In terms of the data analysis method adopted in our research, we opted for a quantitative approach using the Partial Least Squares Structural Equation Modeling technique [76] and SmartPLS software.

IV. Findings

A. Measurement Model Assessment

The results of convergent validity of outer models assessment can be found in Fig. 2 except three items (SU1, SU3, IQ4), all item loading values are above 0.7.

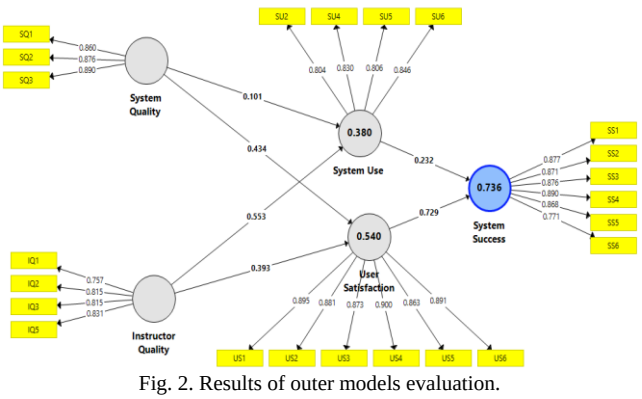

Fig. 2. Results of outer models evaluation.

The values of Cronbach's alpha and composite reliability are all above 0.7. In addition, all average variance extracted values are above 0.5 (Table I).

TABLE I: Results of Convergent Validity

Construct	Alpha	CR	AVE
Instructor Quality	0.82	0.88	0.65
System Quality	0.85	0.91	0.77
System Success	0.93	0.94	0.74
System Use	0.84	0.89	0.68
User Satisfaction	0.94	0.96	0.78

The discriminant validity of outer models is verified using Fornell-Larcker criterion (Table II) and the Heterotrait-Monotrait Ratio Index (Table III), and the cross-loading criterion (Table IV).

TABLE II: Discriminant Validity: Fornell-Larcker Criterion

Construct	IQ	SQ	SS	SU	US
Instructor quality	0.81				
System quality	0.58	0.88			
System success	0.67	0.67	0.86		
System use	0.61	0.42	0.56	0.82	
User satisfaction	0.64	0.66	0.83	0.44	0.88

As shown in Table below the highest value of HTMT was 0.884, which aligns with the suggestions of Henseler *et al*. [77].

TABLE III: Discriminant Validity Using HTMT Index

Construct	IQ	SQ	SS	SU	US
Instructor quality					
System quality	0.69				
System success	0.77	0.76			
System use	0.73	0.49	0.63		
User satisfaction	0.73	0.74	0.88	0.49	

TABLE IV: Discriminant Validity Using the Cross-Loading Criterion

	Sat	Use	SQual	Succ	IQual
Sat1	0.895	0.370	0.620	0.721	0.528
Sat2	0.881	0.412	0.561	0.738	0.534
Sat3	0.873	0.440	0.585	0.752	0.605
Sat4	0.900	0.411	0.612	0.762	0.635
Sat5	0.863	0.319	0.537	0.691	0.471
Sat6	0.891	0.398	0.583	0.745	0.624
Use2	0.369	0.804	0.411	0.461	0.499
Use4	0.423	0.830	0.355	0.466	0.573
Use5	0.248	0.806	0.199	0.395	0.410
Use6	0.397	0.846	0.385	0.497	0.507
SQual1	0.532	0.358	0.860	0.547	0.466
SQual2	0.559	0.378	0.876	0.593	0.489
SQual3	0.638	0.364	0.890	0.618	0.552
Succ1	0.794	0.431	0.535	0.877	0.568
Succ2	0.727	0.469	0.647	0.871	0.574
Succ3	0.772	0.452	0.641	0.876	0.594
Succ4	0.707	0.489	0.547	0.890	0.594
Succ5	0.698	0.520	0.510	0.868	0.583
Succ6	0.576	0.529	0.588	0.771	0.532
IQual1	0.398	0.551	0.481	0.461	0.757
IQual2	0.527	0.474	0.435	0.595	0.815
IQual3	0.581	0.470	0.468	0.523	0.815
IQual5	0.557	0.479	0.472	0.568	0.831

As shown in Table below the highest value of HTMT was 0.884, which aligns with the suggestions of Henseler *et al*. [77].

B. Inner Model Evaluation

The findings show that R square values for the endogenous variables including system success, user satisfaction, and

system use are 0.736, 0.540 and 0.380, respectively, which indicate an acceptable level of determination of these variables.

Likewise, the results indicate a moderate effect size of instructor quality on e-learner satisfaction (f^2=0.22), and e-learning system use (f^2=0.33). In addition, the f^2 of the system quality on user satisfaction is 0.28, which means that this effect size is moderate. While, there is no effect size of system quality on system use. Finally, the effect size of user satisfaction and systems use on system success are strong (0.976) and weak (0.164). For the predictive relevance, all Q-square values for the endogenous variables, including, user satisfaction, system use, and system Success are 0.41, 0.24, and 0.54, respectively (Table V).

TABLE V: RESULTS OF PREDICTIVE RELEVANCE

Construct	SSO	SSE	Q ²(=1-SSE/SSO)
E-Learner Satisfaction	1584.000	928.137	0.414
ES Use	1056.000	797.523	0.245
ES Quality	792.000	792.000	
ES Success	1584.000	731.487	0.538
Instructor Quality	1056.000	1056.000	

The structural model evaluation results indicate that most hypotheses were supported except the relationship between system quality and system use, which was rejected (H1. β = 0.101, t = 1.749; p = 0.079). These results also reveal that system quality positively affects user satisfaction (H2. β = 0.434, t = 7.793; p = 0.000). Likewise, instructor quality significantly influence on system use (H3. β = 0.553, t = 10.254; p = 0.000), and user satisfaction (H4. β = 0.393, t = 8.001; p = 0.000). Finally, the findings show that system use (H5. β = 0.232, t = 6.397; p = 0.000), and user satisfaction (H6. β = 0.729, t = 22.692; p = 0.000), were found to have a positive effect on system success (Fig. 3).

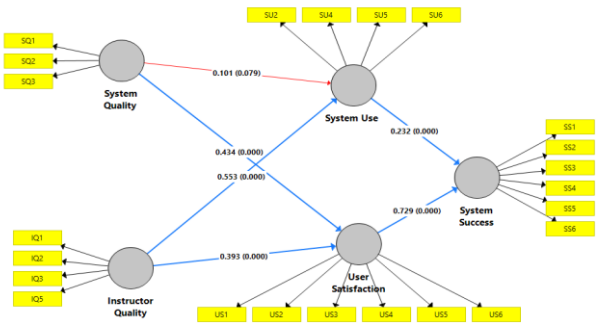

Fig. 3. Results of PLS analysis.

V. DISCUSSIONS AND CONCLUSION

The main objective of the current study was to identify the key factor that affects e-learning system success in the case of the Moroccan universities. The results highlight that e-learning system quality and instructor quality provide a basis for enhancing the level of e-learning use in the Moroccan context. These results are consistent with the previous studies, which suggest that e-learning system quality and also e-learner quality play a significant place in order to encourage students to use technology in learning [2], [78].

This study also confirms the significant influence of instructor quality on e-learner satisfaction. As suggested by prior research in management information systems, a significant relationship between instructor quality and student satisfaction with e-learning system has been reported by prior studies [44], [62]. Finally, e-learning system use and e-learner satisfaction play a central role in enhancing the e-learning system success. The use of e-learning technology and the e-learner satisfaction can help students to enhance their performance on class work, to increase their knowledge, and to increase their self-reliance.

This study adds to the current body of knowledge by highlighting the key features of students and instructors, as well as technological adoption and students' acceptance of e-learning during the COVID-19 pandemic. This study consists on proposing a model specifically dedicated to the e-learning system success in the university context, particularly in Morocco, allowing us to better understand the key factors that contribute in enhancing the level of e-learning success, which was considered as critical in [79] previous study. The study gives crucial insights on the bigger starring role of instructor quality in e-learning while students are physically absent from the classroom throughout the pandemic, which was not considered as critical in [80] recent study. The current conclusion supports earlier findings [52], [79] that the instructor is one of the most critical variables in the effective adoption and deployment of e-learning systems in academic institutions. e-learning system quality and instructor quality has been proven to be particularly vital for enhancing the level of e-learning use in the Moroccan context [79], and this study verifies the instructor's role as an interaction starter in the class, which Ouajdouni *et al.* confirm (2021). The results of the study are consistent with the previous studies, which suggest that e-learning system quality and also e-learner quality play a significant place in order to encourage students to use technology in learning [2], [78]. Also, the current finding confirms the previous findings [2], [44], [52], [79], [81], [82] which state that the system quality does not have a greater influence on use of e-learning system. As a consequence, the findings of this study provide important recommendations for policymakers, academics, administrators, and researchers, allowing them to understand how the e-learning system use in the university context contribute to the learning success. Hence, the study findings may be useful in trying to guide Moroccan university administrators and decision makers especially in higher education in revising practices to improve system use, user satisfaction, and system success.

APPENDIX

APPENDIX I: QUESTIONNAIRE

Gender	:	□ Male		□ Female	
University	:				
Educational institution	:				
Level of studies	:				
Video conferencing system during COVID-19	:	□Big blue button	□Zoom	□Google Meet	□Cisco Webex

[Strongly disagree .1] - [.2] - [.3] - [.4] - [5. Strongly agree]	1	2	3	4	5
System Quality					
1. The e-learning system is easy to navigate.	□	□	□	□	□
2. The e-learning system allows me to easily find the information I am looking for.	□	□	□	□	□
3. The e-learning system is easy to use	□	□	□	□	□
Instructor Quality					
1. I use e-learning system as recommended by my instructors	□	□	□	□	□
2. I think an instructor's enthusiasm about using e-learning stimulates my desire to learn	□	□	□	□	□
3. I receive a prompt response to questions and concerns from my instructors in e-learning	□	□	□	□	□
4. I think communicating and interacting with instructors are important and valuable in e-learning	□	□	□	□	□
5. Generally, my instructors have a positive attitude to the utilization of e-learning	□	□	□	□	□
System Use					
1. Retrieve information.	□	□	□	□	□
2. Publish information.	□	□	□	□	□
3. Communicate with colleagues and teachers.	□	□	□	□	□
4. Store and share documents.	□	□	□	□	□
5. Execute course work	□	□	□	□	□
6. I currently use e-learning systems *(1). Not at all (2); about once a week; (3). Four or six times a week; (4). About once a day; (5). Several times a day*	□	□	□	□	□
User Satisfaction					
1. E-learning is enjoyable	□	□	□	□	□
2. E-learning give me self-confidence	□	□	□	□	□
3. E-learning satisfies my educational needs	□	□	□	□	□
4. I am satisfied with performance of system	□	□	□	□	□
5. E-learning is pleasant to me	□	□	□	□	□
6. I am pleased enough with e-learning system	□	□	□	□	□
System Success					
1. The system has a positive impact on my learning	□	□	□	□	□
2. Overall, the performance of the system is good	□	□	□	□	□
3. Overall, the system is successful	□	□	□	□	□
4. The system is an important and valuable aid to me in the performance of my class work.	□	□	□	□	□
5. Increased knowledge	□	□	□	□	□
6. Self-reliance	□	□	□	□	□

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

AO contributed to the study conception, wrote original draft and software, conducted formal analysis, investigation, analyzed data, and methodology; KC contributed to the study conception, wrote original draft, supervised and administered the project; OB contributed to analysis and manuscript preparation. All authors had approved the final version.

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