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"I am Still Learning": Modeling LMS Critical Success Factors for Promoting Students' Experience and Satisfaction in a Blended Learning Environment

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ABSTRACT Blended learning has been growing in demand and popularity and has become a common phenomenon in modern higher education systems, especially with the implementation of learning management system (LMS). This paper examined the effects of critical success factors on students' experience and satisfaction with the LMS in a blended learning setting. Certain characteristics of students, instructors, system, classmates, course design, and organization were identified from the literature as the main indicators of the LMS success. A total of 174 university students (94 males and 80 females) responded to an online questionnaire. A partial least square (PLS) approach was used for data analysis. The result showed that certain factors were found to influence students' perceived ease of use and usefulness of LMS and consequently their satisfaction. Findings from this paper provide the necessary insights as to how universities can enhance students' experiences and satisfaction of LMS in order to support the blended learning approach.

INDEX TERMS Blended learning, LMS, classroom, satisfaction, higher education.

I. INTRODUCTION

The extensive use of Information and Communication Technology (ICT) in most developing countries is essential to ensure that modern teaching and learning are being properly used and applied [1]. The higher education sector in most developing countries has begun to revise their strategies in order to establish possible links between learners' achievement and use of technologies [2].

E-learning has the potential to promote self-directed learning by increasing students access to information [3], increasing interactivity between student and teacher [4], improving collaborative efforts [5], eliminating geographical barriers [6], and building self-confidence [7]. Yet, e-learning still suffers from some difficulties such as lack of face-to-face interaction with instructors and classmates [8], high initial costs for preparing online courses, substantial costs for system update and maintenance, and the need for flexible instructional support [9]–[11]. Furthermore, students in e-learning environments may experience feelings of isolation [12], arbitrariness [13], confusion and frustration [14] or reduced interest in the subject matter [15]. These can potentially increase both instructors' and students' dissatisfaction when interacting with the e-learning system, thus leading them to seek out alternative solutions to these challenges [16], [17].

Blended learning is a combination of traditional face-to-face learning and online learning delivery methods which aim to create a learning atmosphere that supports self-directed learning [18], [19]. From a blended learning perspective, an LMS is a software application used by educators to design, update, track, report, and maintain online courses on a university server [20]–[22]. It allows students to share information relevant to their learning goals and collaborate to solve a given task [23], [24]. This led public universities in most developing countries to consider revising its curricular by using LMS in a blended learning context. Although, the use of LMS makes the learning process much easier, it also induces some problems related to learners' previous knowledge and experience [25], [26]. As demands for higher education and e-learning continue to expand, it is important to determine the influential factors related to students' perceptions of LMS. This is because the success of an e-learning system relies on both its early adoption (satisfaction) and its sustained usage [27]. It is therefore important to understand the relevant

factors essential for promoting students' actual experience of the technology.

Our review of the existing literature revealed a noticeable lack of studies identifying the effects of different crucial factors on students' experience and satisfaction of LMS in a blended learning environment. The key factors that have been identified by past studies include instructors, students, infrastructure, management support, interaction, and LMS instruction [2], [28]–[30]. The existing review also showed that previous e-learning studies conducted in most developing countries were mainly concerned about the implementation or description of novel systems and their dissemination [31], acceptance and adoption of e-learning [32], [33], ICT readiness and acceptance [34], and descriptive usage of LMSs and other learning technologies [35], [36]. Despite these efforts, it appears that there are few studies that have evaluated the effect of different LMS success factors on students' experience and satisfaction in a blended setting. Previous studies showed that the level of the effect of these factors may differ for different user types and e-learning technology types [37]. Therefore, more evidence is needed to clearly show how certain individual, organizational, and technological related factors can contribute to the students' use of LMS in a blended learning setting.

This study was guided by two research questions: "What are the relationships between LMS critical success factors and students' learning experiences in a blended learning environment?" and "What are the relationships between students' learning experiences and their satisfaction with the LMS?". In response to these questions, this study identified and investigated the key factors influencing students' experiences and satisfaction of LMS use in a universities context.

The rest of this paper was organized in the following manner: Section 2 proposes the research model and hypothesis development. Section 3 gives the methodology of this study. Section 4 demonstrates results from Partial Least Square (PLS) analysis. Section 5 discusses the research findings. Section 6 introduces the study implications. Finally, Section 7 addresses limitations and possible future directions.

II. RESEARCH MODEL

In order to ensure a successful implementation of the e-learning system, several adoption, usage, success, acceptance, and satisfaction factors are needed to be taking into account [2], [38]. Assessing individual satisfaction is regarded as one of the most important measures of information system (IS) success, which may consist of several aspects including system quality, services offered, and users' perceptions [39]. In the LMS context, several researchers have examined a number of factors that may predict learner satisfaction according to capacity of use, culture, and technology capabilities.

This study proposed a research model by integrating variables obtained from the Information System (IS) success model [39], [40], and Technology Acceptance Model (TAM) [41], [42] to investigate how certain LMS success factors can drive students' experience and satisfaction of LMS usage. The proposed model (see Fig. 1) is considered an extension to these models based on the role of certain external variables in promoting individuals' experiences and satisfaction with LMS [43]–[45].

In the e-learning context, several studies found that the utilization of learning technologies in higher education might be influenced by several factors related to students, instructors, technology capabilities, course delivery, classmates, institutional support, and information technology infrastructure [28], [46]–[48]. The majority of empirical studies have pointed out that student characteristics are crucial for the success of e-learning initiatives [20], [49]–[51]. Liaw *et al*. [51] addressed the impact of instructors' characteristics and system characteristics on learners' experience in terms of the perceived usefulness of a learning system. They found that effective implementation and adoption of technology depends on instructors' positive attitude towards the technology. Lee [52] examined the effect of training and support in intra-organizational factors and extra-organizational factors (individual's access to hardware and software resources from inside or outside the organization) on the perceived ease of use and perceived usefulness of e-learning. Their result confirmed the original findings of TAM model that perceived ease of use and perceived usefulness are positively associated with the individual's behavioral expectation. They also stated that perceived resources, intra-organizational and extra-organizational may positively influence individuals' e-learning adoption.

Moreover, issues related to certain technological and organizational determinants were also reported to impose some influence on the acceptance and satisfaction of LMS. This is supported by other studies which have demonstrated how certain organizational factors, such as training [53] and technical support [54], can be related to the adoption of technology in higher education. In a theoretical study, Wan *et al*. [55] proposed that students and instructors, system quality, and course design may play a key role in shaping the learning process, and, consequently, learning outcomes. This motivated Selim [29] to examine factors related to learner, instructor, technology, and university support to predict LMS acceptance. Selim [29] found that instructor characteristics could significantly contribute to the e-learning success, followed by technological infrastructure and university support.

In principle, the review of the literature revealed that various studies examined the relationship between certain LMS critical success factors and the acceptance of students in different distance learning situations. Despite these observations, little is still known about how these factors may contribute to the students' learning experience for enhanced satisfaction. Hence, certain characteristics of students, instructors, system, classmates, course design, and organization were identified from the literature as the main

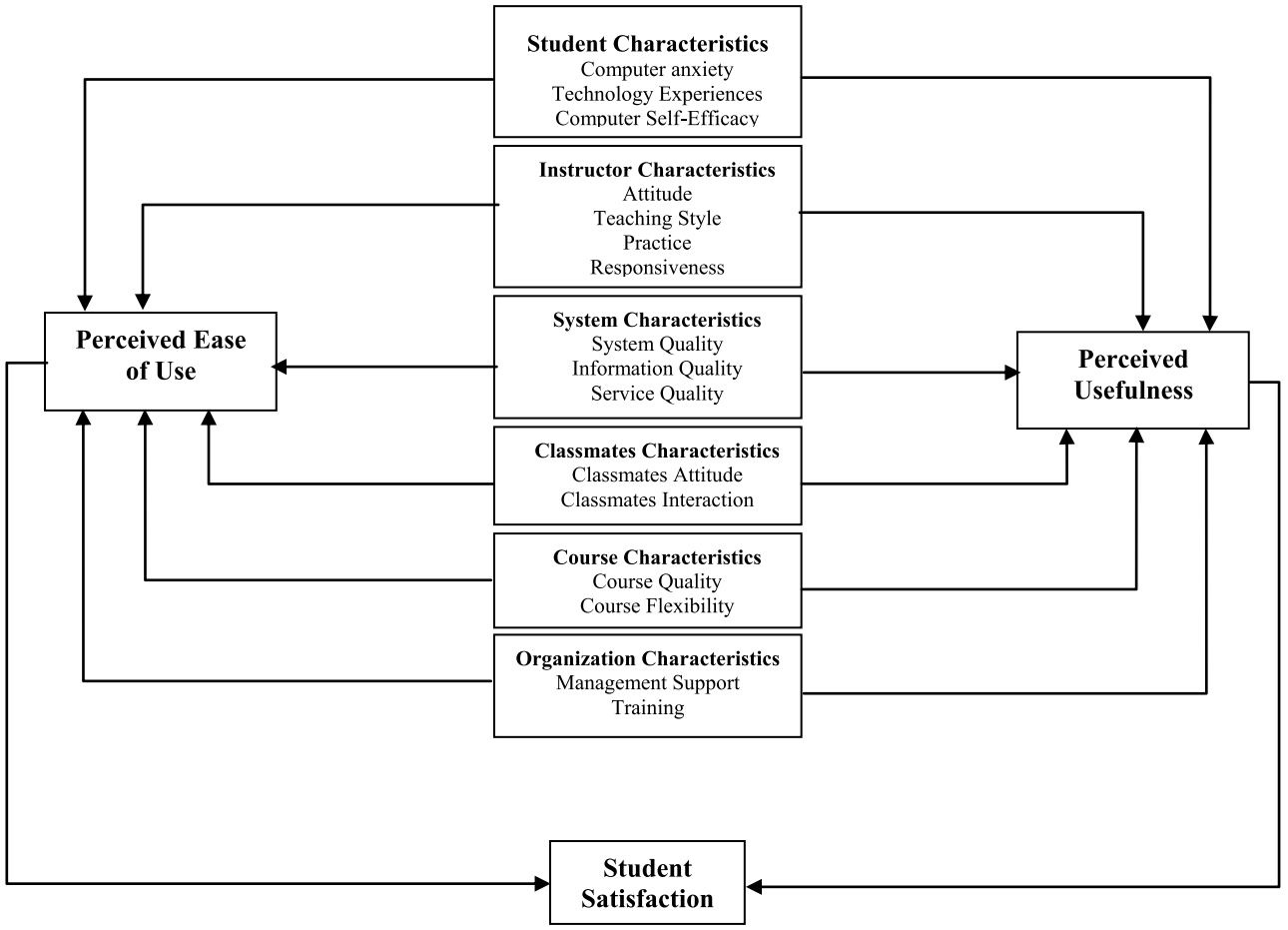

FIGURE 1. Research model.

indicators of LMS success. A more detailed explanation of the research hypotheses is presented in the following subsections.

A. STUDENT CHARACTERISTICS

Students' characteristics refers to their general attitudes and behaviours towards achieving certain learning goals [56], [57]. Many previous studies (e.g., [6], [42], [44], [50], [58]–[62]) have demonstrated several characteristics of students, including computer anxiety, technology experience, and computer self-efficacy.

1) COMPUTER ANXIETY

Anxiety is a type of cognitive response marked by self-doubt and feelings of inadequacy. In the technology acceptance field, computer anxiety refers to the individual's feeling of fear when using information system features to accomplish a certain task [63]. Individuals who are less anxious are more likely to react positively to the system than those who are more anxious [64]. In addition, students' lack of computer experience may trigger their anxiety in real time. Thus, it is assumed that anxiety to adopt or use a certain technology could potentially influence the acceptance of that technology.

In the context of e-learning acceptance, several studies (e.g., [65]–[67]) have argued that computer anxiety can be associated with the ease of use [68]–[71] and usefulness of the system [49], [65], [66]. Since computer anxiety can be associated with negative beliefs (perceived usefulness) about computers [72], it is suggested that students who feel comfortable in the LMS platform are more likely to accomplish desired outcomes. In contrast, if using the LMS makes students feel uncomfortable, then, their perceptions of the complexity of LMS can be increased [73]. Based on these observations, the following hypotheses were proposed:

H_{1a}: *Computer anxiety will negatively affect perceived ease of use of LMS.*

H_{1b}: *Computer anxiety will negatively affect perceived usefulness of LMS.*

2) TECHNOLOGY EXPERIENCE

Technology experience refers to the individual's exposure to the functionalities of the system, as well as the skills and abilities acquired by an individual from such exposure [62]. Previous studies have argued that the degree of computer experience can potentially encourage or discourage students from using and accepting technology [74]. As a result,

students' prior experience may influence their ability to learn how to use the LMS, presumably due to the need for them to absorb and reflect upon the learning process. Typically, when a system is flexible and credible, there is a high probability that students will be motivated or engaged [75]. According to Buabeng-Andoh [76], the more prior experience an individual has, the more likely is the positive outlook on LMS acceptance. Cheng [6] stated that an individual's experience with technology might be viewed as an indicator of their perception of its usefulness.

It has been suggested in the literature that students with more technological experience are likely to perceive the usefulness [49], [77], [78] and ease of use [66], [79] of the system. Moreover, students' prior computer experience is expected to serve as the basis for the student's judgment about the level of usefulness and easiness when using a new system [72]. Therefore, the study hypothesized the following:

H_{2a}: Technology experience will positively affect perceived ease use of LMS.

H_{2b}: Technology experience will positively affect perceived usefulness of LMS.

3) COMPUTER SELF-EFFICACY

Self-efficacy is an individual's belief that he or she can carry out a certain task or behavior [80]. In a computer work environment, Compeau and Higgins [81] defined computer self-efficacy as a self-assessment of one's ability to apply and use the computer to accomplish a task. Several prior studies have discussed the impact of self-efficacy on students' acceptance. For example, Hsia *et al*. [82] stated that students with higher computer self-efficacy are more willing to use learning systems routinely. Kanwal and Rehman [30] pointed out that users' perceived ease of use can be affected by the level of their self-efficacy towards computer technology. In addition, Cheng [6] showed how computer self-efficacy can be associated with individuals' perception of usefulness and ease of use to accomplish certain tasks. In addition to these, it can be anticipated that students with higher computer self-efficacy can easily handle difficult learning situations, thus perceiving the usefulness of the environment [12]. In contrast, individuals with lower confidence in their ability to complete a task may fail to achieve their learning goals due to the negative perception associated with the ease of use of the system [53], [68], [83]–[88]. Therefore, the following hypotheses were proposed:

H_{3a}: Computer self-efficacy will positively affect perceived ease of use of LMS.

H_{3b}: Computer self-efficacy will positively affect perceived usefulness of LMS.

B. INSTRUCTOR CHARACTERISTICS

Instructor characteristics refer to the antecedents of instructors' attitude, teaching style, and technology control in a blended learning environment [50], [89]–[91]. This study categorized instructors' characteristics into four categories: attitude, practice and control, teaching style, and response timeliness.

1) INSTRUCTOR ATTITUDE

According to Fishbein and Ajzen [92], attitude refers to an individual's positive or negative evaluative beliefs about performing a particular behavior. Mathew Myers and Halpin [93] described instructors' attitude as an important indicator of computer usage because it involves not only the knowledge, understanding, and value of technology, but also their ability to apply the theory-related concepts in their classrooms. Instructors who show a positive attitude toward the use of technology are more likely to perceive its value and subsequently adopt it in teaching [88]. In spite of the instructors' efforts to facilitate online learning, the misconception that blended learning is not as effective as traditional classroom may produce a negative attitude towards the use of LMS, thus influencing its acceptance [94]. This may also influence instructors' responsibilities towards teaching their courses in a way that may be more closely aligned to students' actual experiences (perceived usefulness and ease of use) [90]. Based on this, the following hypotheses were formed:

H_{4a}: Instructor attitude will positively affect perceived ease of use of LMS.

H_{4b}: Instructor attitude will positively affect perceived usefulness of LMS.

2) TEACHING STYLE

Teaching style refers to the pattern of teaching behaviors, attitudes, and beliefs demonstrated by instructors in the learning environment [95]. Many previous studies have addressed the role of an instructor's teaching style in driving students' learning experiences [96]–[98]. Instructors with an interactive teaching style may effectively contribute to students' involvement and participation, cognitive engagement and attitudes [55]. Thus, when students perceive the teaching style of their instructors to be interactive, their experience and satisfaction with the LMS will be enhanced. Wozney *et al*. [99] stated that instructors who apply more student-centered approaches in their courses tend to integrate and use computer technologies more often than others who use teacher-centered approaches. This, however, may limit students' exposure to various teaching styles (which often form a barrier to using technology for learning) [100], and can change students' perceptions of their learning experience and acceptance of the system [101]. This is supported by Cheng [86] who found that when instructors offer effective teaching styles to the students' particular needs, students will enthusiastically and actively immerse themselves in experiences, from which they may perceive the usefulness of the learning environment. Thus, this study hypothesized the following:

H_{5a}: Teaching style will positively affect perceived ease of use of LMS.

H_{5b}: Teaching style will positively affect perceived usefulness of LMS.

3) INSTRUCTOR PRACTICE

Instructor practice refers to the ability of instructors to control the progression of an online class and ensure that students are receiving appropriate learning opportunities [102]. This may include providing feedback on assignments promptly, identifying the suitable learning content, and stimulating learning activities and discussions. Gorsky and Caspi [103] stated that both facilitation skills and accessibility can serve as relevant variables of instructor characteristics. In addition, students who learn online are more likely to face various technical problems, which require instructors to be approachable and impartial [104]. When instructors exhibit the required skills to prepare, update, and organize the course content in the LMS, students would enthusiastically immerse themselves, resulting these students to be more likely to use the LMS in their learning process. Levy and Ramim [105] stated that when students face problems in their e-learning courses, providing the necessary instructor assistance and support in a timely manner can change the learning experience of students. Students become impatient when instructors are faced with technical problems that cannot be solved easily. For this reason, it is important to study the effects of instructor practices in the LMS and observe how such practices can improve the learning experience of students [27], [86], [90], [96]. The following hypotheses were proposed:

H_{6a}: *Instructor practice will positively affect perceived ease of use of LMS.*

H_{6a}: *Instructor practice will positively affect perceived usefulness of LMS.*

4) INSTRUCTOR ONLINE RESPONSIVENESS

Instructor online responsiveness refers to the students' perception of the instructor's prompt response to online problems and requests [50]. In many previous studies, instructor's feedback has been reported as a crucial factor in promoting positive learning experience. For instance, Costley and Lange [106] found that instructors' ability to respond immediately to students may potentially influence the overall learning experience and acceptance of the technology. This is because students' negative perception towards learning may take place when instructors fail to respond to students' questions or comment on students' posts [7], [107]. Furthermore, Thurmond *et al*. [108] opined that instructors' feedback may potentially influence students' perceived usefulness of the system, particularly through the development of students' individual practice and ability to solve complex problems [105]. In the LMS environment, students may often feel isolated in learning. To overcome this feeling, instructors should respond appropriately so that the students could perceive the system to be easy to use and useful [86]. It is believed that instructors' prompt online responsiveness in a blended learning environment would enable students to perceive LMS to be easy to use and useful for their learning. In the light of these observations, the following hypotheses were constructed:

H_{7a}: *Instructor online responsiveness will positively affect perceived ease of use of LMS.*

H_{7b}: *Instructor online responsiveness will positively affect perceived usefulness of LMS*

C. SYSTEM CHARACTERISTICS

Based on the updated DeLone and McLean IS success model, three types of quality factors, such as system quality, information quality, and service quality, can be considered when studying individuals' experiences and satisfaction with technology-enhanced learning [39]. This model was used in this study because it is considered the most appropriate for evaluating the success or effectiveness of virtual learning environments [109], [110].

1) SYSTEM QUALITY

System quality refers to the individual's perception of stability, responsiveness, and ease of use of an information system [39]. System quality is the main factor in the acceptance of technology use [111], [112]. The relationship between system quality and individual experiences has been highlighted by several previous studies [40], [113], [114]. In the e-learning context, the most commonly used measures of the system quality are system functionality [115], system interactivity [60], system response [86], system flexibility [27], and user-friendly design [116]. Lin *et al*. [117] argued that if an individual perceives a particular functionality of the system to be useful, so the same can be said for the acceptance. The ease of using different system functionalities can be expressed by the elements of flexibility and reliability [118]. Pituch and Lee [60] found that the quality of a system is related to its ability to offer students access to online lectures and other educational resources. Based on these observations, it can be said that students who perceive the LMS to offer them quality access to learning resources may positively relate to their perceptions of the LMS's usefulness and ease of use. The following hypotheses were constructed:

H_{8a}: *System quality will positively affect perceived ease of use of LMS.*

H_{8b}: *System quality will positively affect perceived usefulness of LMS.*

2) INFORMATION QUALITY

Information quality refers to the quality of content delivered through the information system to the target users, in terms of relevance, timeliness, accuracy, completeness, sufficiency, consistency, accessibility, understandability and format [39], [113], [114], [119]. Several previous studies have repeatedly demonstrated the relationship between information quality and perceptions of the system's ease of use and usefulness [20], [27], [86], [120], 121]. Gay [122] emphasized on the role of information quality in assessing the suitability of online learning environments, which is necessary to drive the acceptance of an individual. Cheng [86] proposed that if an e-learning system offers effective learning

to students, they would perceive such a system to be accurate, and thereby perceive the system as useful. Moreover, they pointed out that if the e-learning system offers students with convenient learning contents and well-designed courses, the e-learning system will be regarded as simple and easy. Thus, if the learning contents are interesting, challenging, and relevant, students' experience would be enriched. The following hypotheses were proposed:

H_{9a}: *Information quality will positively affect perceived ease of use of LMS.*

H_{9b}: *Information quality will positively affect perceived usefulness of LMS.*

3) SERVICE QUALITY

Service quality refers to the quality of supports provided to the system's end-users. Measures of service quality include effectiveness, reliability, responsiveness, assurance and availability of technical support [39]. In many empirical studies, the perception of technical guidance and support have been reported to play a role in shaping students' behavioral intention toward the acceptance of e-learning [86], [115], [123]–[125]. For instance, Ahn *et al*. [120] found that service quality indicates the availability of diverse communication technique to assist students, in a timely manner, in resolving problems emanating from the use of technology. Saeed *et al*. [126] stated that service quality can potentially influence individuals' perceived usefulness and perceived ease of use of an online system. Pai and Huang [127] found that a successful information system should offer professional, timely, and individually customized services, which may influence the quality of service and effect on users' perceptions of system's usefulness. Cheng [86] addressed the role of quality of service in identifying the acceptance of students to use e-learning based on their perceived ease of use and usefulness. In contrast, Xu and Du [128] pointed out that if the quality of service is low, students may need to do greater efforts to use it. Thus, their perception of usefulness and ease of use would be low. Therefore, the following hypotheses were proposed:

H_{10a}: *Service quality will positively affect perceived ease of use of LMS.*

H_{10b}: *Service quality will positively affect perceived usefulness of LMS.*

D. CLASSMATE CHARACTERISTICS

The effect of classmates' characteristics on students' acceptance and satisfaction of LMS is essential but rarely assessed. This study considered examining the role of classmates' characteristics (in terms of classmate attitude and classmate interaction in a blended learning environment) in promoting students' learning experience and satisfaction in LMS.

1) CLASSMATE ATTITUDE

Attitude is defined as a set of feelings (positive or negative) which effect on individuals' decision toward objects, people, or knowledge [129]. Classmates' attitude is defined as the students' impression of engagement and interaction in online activities [50]. The attitude that classmates show when dealing with e-learning is an important determinant of their learning experience [130]. Classmates who have positive attitudes toward information system usage (e.g., LMS) are more willing to deal with problems and changes in the environment [94]. Yang and Yoo [131] stated that if the classmates have a positive attitude toward the system, then they may encourage and motivate other students to use it. In contrast, it has been affirmed that when certain individual students find using the system to be complex and not easy to use, their beliefs about the computer inefficiency will increase, then they will convey a feeling of non-acceptance of the system to other students [59]. The literature showed that changes in classmates' attitude may influence students' participation, cognitive engagement with the technology [96]. Precisely, if the use of an innovation would enhance one's social status, then it will enhance the perceived usefulness and use of that innovation [20], [42]. This led us to pay careful attention to the role of classmates' attitude in changing students' experience and learning in LMS, and thus the formation of the following hypotheses:

H_{11a}: *Classmates' attitude will positively affect perceived ease of use of LMS.*

H_{11b}: *Classmates' attitude will positively affect perceived usefulness of LMS.*

2) CLASSMATE INTERACTION

Interaction refers to the social communication that occur during students-instructors, students-students, and students-materials [12], [132]. Anderson [133] found that significant learning may take place when at least one of these modes of interaction is provided. Ertmer *et al*. [134] noted that the use of feedback arising from the interaction between classmates in an e-learning environment offers several opportunities for students to deal with troubleshooting tools. A study by LaPointe and Gunawardena [135] found that classmates' interaction to impose a higher impact on students' acceptance and their learning outcomes. In addition, the lack of personal contact with classmates would influence students' perceptions of the system's ease of use and usefulness [136]. In a blended learning environment, classmates' interaction in terms of frequency, quality, and speed may influence students' overall learning experience [20], [137]. Hence, the interaction with classmates through the LMS may potentially enhance the student' perceived ease of use and usefulness of the learning environment [27], [52], [138]–[140]. Therefore, the following hypotheses were proposed:

H_{12a}: *Classmates' interaction will positively affect perceived ease of use of LMS.*

H_{12b}: *Classmates' interaction will positively affect perceived usefulness of LMS.*

E. COURSE CHARACTERISTICS

Course characteristics are essential for students' use of online learning systems. This study investigated the effect of course

characteristics in terms of course flexibility and course quality, as proposed by Sun *et al*. [50], on students' learning experience in LMS.

1) COURSE QUALITY

Review of the literature showed that to ensure the quality of a course, it must be designed to support online communication, collaboration, and sharing of materials. Specifically, it should offer students the opportunity to participate in online discussions, multimedia presentation, and management of learning processes [50], [59]. Well-designed learning materials and curriculum can help to facilitate students' learning experiences [141]. Several previous studies have addressed the significant effects of quality of the course on students' perceptions of the system's ease of use and usefulness. For instance, Shee and Wang [142] found that online courses should be designed to encourage students to keep on using the online system even after the completion of the current course. Sun *et al*. [50] found that a well-designed online course can potentially help students understand the content of the curriculum and solve technical difficulties, thus improving the overall learning experience. In addition, Paechter *et al*. [143] revealed that the quality of an online course can contribute to the success and acceptance of an e-learning system. If the online course contents are arranged and integrated with appropriate figures and examples, the content will be easy for students to use and understand. Few previous studies claimed that a well-designed course may have underlying effect on learners' use of the system [20], [86], [90], [144], which may potentially improve their learning experience and satisfaction. The following hypotheses were shaped:

H_{13a}: *Course Quality will positively affect perceived ease of use of LMS.*

H_{13b}: *Course Quality will positively affect perceived usefulness of LMS.*

2) COURSE FLEXIBILITY

Course flexibility refers to the student's perception of the efficiency and effectiveness of the system [50]. The flexibility of the course? in terms of time, location, and learning? was reported to impose a significant impact on the way students learn and use online resources [20]. It has been found that elimination of physical barriers would enable students to participate in a dynamic interaction that can be used in collaborative learning activities. With no restrictions on time and space in e-learning, students can communicate instantaneously, anytime and anywhere. If the online tools are easy to access, the learning experience of students can be enriched [50]. This flexibility gives students a sense of convenience and ease of use [86], [90], [116], and enables them to realize the benefits of LMS in supporting traditional classroom [20], [86], [116]. Thus, the following hypotheses were proposed:

H_{14a}: *Course flexibility will positively affect perceived ease of use of LMS.*

H_{14b}: *Course flexibility will positively affect perceived usefulness of LMS.*

F. ORGANIZATION CHARACTERISTICS

Organizational characteristics are an aspect of concern in relation to an individual's satisfaction with new technology. There are few limited theoretical and empirical studies that investigated the influence of organizational factors on students' experience with LMS. Here, it was proposed that management support and training in a blended learning environment are two important factors for students to effectively use the LMS.

1) MANAGEMENT SUPPORT

Management support refers to the practices for encouraging students' use of IS in learning [145]. In the context of this study, management support is defined as the perception of students of the extent to which the university understands the significance of LMS and allocate sufficient resources to help students achieve their learning goals [146]. Since students are always demanding continuous support from their university, particularly when it comes to the use of online tools, management support can be said to play a role in promoting the individual's acceptance of LMS technology [147, 148]. Past research has found that management support is positively associated with the individual's perception of the usefulness [65], [147], [149], [150] and ease of use [53], [148], [151], [152] of the technology. If there is no support given to the students in the blended learning environment, then they are likely to become frustrated with the LMS. Thus, the following hypotheses were formed:

H_{15a}: *Management support will positively affect perceived ease of use of LMS.*

H_{15b}: *Management support will positively affect perceived usefulness of LMS.*

2) TRAINING

Training is a process by which students gain the necessary skills to accomplish an activity or a task. It can be administrated in the form of online tutorials, seminars, workshops, and courses [145]. Training has been found to be an essential element in promoting the use and adoption of innovation [153]. Training is a continuous process of accommodation between users and their environments. Asiri [154] emphasized that lack of an effective training program may potentially influence students' learning experience and success of the system. Training programs, through the use of workshops and seminars, are the means for promoting students' use of technology. Furthermore, it is likely that when the organization provides students with the necessary training and expertise, they will perceive the technology as useful and easy to use. Thus, the following hypotheses were proposed:

H_{16a}: *Training will positively affect perceived ease of use of LMS.*

H_{16b}: *Training will positively affect perceived usefulness of LMS.*

G. SATISFACTION

Satisfaction is defined as the individual's perceptions of the extent to which the system meets their needs and expectations [155]. It has been found to be the main measure to the success of IS [156]. DeLone and McLean [39] claimed that system use is related to user satisfaction which sequentially results in a higher intention to use the system.

Up to now, many models have been used to explain users' acceptance/adoption of innovation. The Technology Acceptance Model (TAM), proposed by Davis [157], has been one of the most widely accepted and applied models in a variety of domains. It emphases on the importance of predicting individuals' tendency to accept technology [41], based on four important factors: perceived usefulness, ease of use, attitudes, and intention. The association between these variables is appropriate for predicting learners' acceptance of e-learning, as supported by several empirical studies [50], [158], [159]. Originally, the attitude factor was included in the TAM model to mediate the relationship between user perceptions (perceived ease of use and perceived usefulness) and behavioural intention to use a system [160]. However, recent studies have excluded the attitude component from the model, basically due to the weak relationship [161]–[163]. Precisely, Davis [41] found a weak relationship between perceived usefulness and attitude but a strong relationship between perceived usefulness and behavioural intention, and therefore excluding attitude from the original model. Liu [164] asserted that removing attitudes from the TAM model can provide a better understanding of the effects of perceived ease of use and perceived usefulness on the behavioural intention to use a system. As such, attitude was excluded from this study's model. In the mandatory context, where students are required to use IS provided by a university, intention to use may not sufficiently predict students' acceptance [165], [166]. Following this line of logic, satisfaction was chosen as a key factor of LMS usage in this study, which is similar to that discussed in the previous IS studies [40], [65], [167].

Basically, as in the TAM model, the perceived ease of use and perceived usefulness are the main factors representing cognitive beliefs of the system which influence the acceptance and adoption of it [41], [167]. According to Al-Samarraie *et al*. [168], the determinants of ease of use and usefulness may play a key role in predicting students' and instructors' continuous satisfaction with the system. If the e-learning system is perceived to be easy to use, students can effectively direct their attention toward learning the course materials instead of spending additional effort learning the system. Islam and Azad [169] reported positive associations between students' positive perceptions of the system's usefulness and their satisfaction to use it. It has been noted that students' perception of LMS can drive their progress in learning [27]. Based on these, it can be said that the more students perceive the system to be easy to use and useful, the more positive attitude they will develop towards the LMS, which may improve the learning experience and satisfaction of students in a blended learning context. The following hypotheses were shaped:

H_{17a}: *Perceived ease of use of LMS will positively affect satisfaction.*

H_{17b}: *Perceived usefulness of LMS will positively affect satisfaction.*

Finally, the proposed research model was formed based on the relationships between the above-mentioned hypotheses (see Fig. 1).

III. METHOD

A quantitative research approach was used in this study to investigate the effects of LMS success factors (see Fig. 1) on students' experience and satisfaction in a blended learning environment. A confirmatory research design was used in this study. This method provides results that are easily tabulated, summarized, analyzed and generalized. It also offers flexibility and freedom for those responding to the survey questions.

A. STUDY CONTEXT

This study was conducted in three key universities in Yemen. The selected universities were founded to provide education to all students who are not able to attend their studies on a full-time basis. These universities follow the same blended learning approach in their learning process (combination of traditional learning and e-learning). The blended learning-based courses in these universities consist of 30% class attendance rate, while 70% of the grade of course enrollees depend on their attendance in the virtual classes and participation in the online forum. These universities have adopted Moodle as the official LMS. Moodle is an open source platform that educators can use to create effective online learning sites. The training course on how to use Moodle has been provided to students during their study. The universities used in this study were using Moodle to manage, build, update, and maintain online courses. It has many characteristics such as delivering course contents, making the course announcements, giving assignments and grades, uploading lecture notes and documentation, communicating, and collaborating with instructors and peers, as well as establishing a learning community with unlimited accessibility. In addition, some functionalities, such as wiki, schedule management, an Arabic translator, certification, announcement, homework assignments, quizzes, grading, online chatting, discussion forum, email, and course evaluation, were commonly used to support learning and teaching.

The selected universities offer three undergraduate disciplines (social science, accounting, and communication) that lead to a bachelor's degree upon completion. All the courses were provided for a period of fourteen weeks. Each course includes a weekly face-to-face session, in which the instructor explains the course methods, objectives, and chapters. In the introductory session, students are provided with all the information they need to know about learning online. The learning resources, via the Moodle, in the three universities were

delivered through slide presentations, video tutorial, weekly virtual classroom sessions, and interactive books. In addition, the learning materials were presented to the students in the form of Acrobat PDF documents, PowerPoint slides, audio/video files, and MS Word to all the registered students which can be accessed at any time and from anywhere. Online synchronous sessions were scheduled for three hours at the end of each week, where the students had the opportunity to meet each other and their instructor. Furthermore, students and instructors commonly used the online forum to discuss certain learning topics, and to post instructions/queries for the upcoming discussion using the bulletin board feature. The role of instructors was to provide the necessary guide for students in their learning process. Students participate in weekly activities designed to help them understand the subject matter. Students could access the course and read the learning materials, download resources, and follow instructions at any point during the program. Prior to class, students were required to complete an individual assignment and submit them through the LMS platform for grading. Students were provided with technical and administrative support regarding their courses via email and Facebook. The evaluation of students' performance in LMS was based on their participation in the course and their performance in assignments and exams.

B. SAMPLE AND DATA COLLECTION METHOD

The target sample for this study was limited to students who registered in blended courses. The reason for selecting students from these courses was due to their familiarity and experience with the blended settings which can sufficiently explain their perceptions toward the learning environment. Participants who comprised the convenience sample were undergraduate students. The participants majored in one of three disciplines: social science, accounting, and communication. To achieve an adequate number of participants, students from three universities were asked to participate (a university in the central region, a university in the southern region, and a university in the northern region of Yemen). The initial enrolment per class taught in a blended way was approximately 30 to 38 students. Nine courses from the three universities, three courses each, were invited to participate in this study. Due to attrition, the mean number of students in each course dropped to 25-29 students by the end of the semester. A total of 250 students comprised the study sample (98 students from the central region, 63 from the northern region, and 86 from the southern region). Data were collected through a survey from these universities with the help of the instructors of the courses offered, over a period of one week. The total number of responses gathered was 174 resulting in approximately 71.2% response rate to the survey. This sample size satisfies the 1:10 ratio for PLS path modeling as recommended by Hair *et al*. [170].

C. INSTRUMENT

A questionnaire was constructed based on existing, tested, and verified instruments from previous studies. The questionnaire consisted of 72 items divided into two separate parts. The first part asked about demographic data consisted of four items (e.g., gender, age, number of online courses completed, and level of study). The second part asked about LMS critical success factors along with students' experience and satisfaction (see Table 1 for more information about the items) with LMS use.

- Items for measuring factors related to student characteristics were adopted from well-established sources: five items on computer anxiety were adopted from Loyd and Gressard [171] to assess the difficulty, discomfort, confusion, nervousness, and anxiety of students with technology; four items on technology experiences were adapted from Ball and Levy (2008) to measure the confidence in students to operator technology; and five items for measuring computer self-efficacy were adapted from Murphy *et al*. [172].
- Items for measuring factors related to instructor characteristics were also adopted and adapted from various studies: instructor attitudes were measured by three items adapted from Webster and Hackley [96]; teaching style was assessed by two items adapted from Webster and Hackley [96]; the instructor's practice was measured by three items (two items were based from Webster and Hackley [96] and one item was adapted from Biner *et al*. [173]); and two items were adopted from Sun *et al*. [50] to assess the instructor's immediate response to students' comments.
- To assess the system characteristics, a total of 14 items (adopted from DeLone and McLean [39]) in terms of accessibility, flexibility, interactivity, functionality, timeliness, availability, relevance, completeness, consistency, accuracy, assurances, responsiveness, reliability, and availability were used.
- The attitude of classmates in a course was measured by three items adapted from Webster and Hackley [96]. In addition, three items on classmates interaction were adopted from Sun *et al*. [50], Arbaugh [174], and Pituch and Lee [60] respectively to assess the interaction between students in the LMS environment.
- The quality and flexibility of the course were measured by seven items adopted from Arbaugh [174] in terms of course effectiveness, time saving and money, and arrange the schedule.
- To assess the organizational characteristics, a total of six items were adapted from Sumner and Hostetler [145] to capture students' perceptions about the management support (three items) and training programs (three items) provided by the university to them in terms of workshop, seminars and online manual on how to use e-learning tools.
- Students' experiences in LMS were measured by two sub-constructs (perceived ease of use and perceived usefulness) which were adopted from Venkatesh and Davis [42]. Meanwhile, students' satisfaction with the LMS was measured by five items

adopted from DeLone and McLean [39]. These items were mainly used to assess the adequacy, effectiveness, and interactivity of the system.

A five-point Likert scale (1 = strongly disagree; 2 = disagree; 3 = Not Sure; 4 = agree, and 5 = strongly agree) was used for measuring all the items in the survey questionnaire, except for the demographic data.

Since we have obtained most of the items from the literature, the validity of the instrument was reassessed in order to ensure its applicability. We invited two ICT lecturers from two different universities (research experience 8-12 years) to evaluate the face and content validity of the instrument using a card-sorting method by Moore and Benbasat [175]. The items for each construct were printed on 8 cm 6 cm index cards, which were shuffled randomly and then presented to the lecturers individually. The two lecturers were asked to place the items printed on cards into its own construct. Then, we measured the accuracy of the items placement between the two lecturers. The evaluation results were satisfactory, with an accuracy rate of 93%.

Meanwhile, to anchor the responses properly, the questionnaire provided working definitions of the study variables. The same two lecturers that participated in the face and content validation were again invited to examine the formatted survey to ensure that its layout and wording were appropriate to the LMS context.

Then, the instrument (in the pre-test phase) was administrated to 26 students in order to assess its reliability and construct validity. The pre-test result was satisfactory, as indicated by the obtained Cronbach's Alpha (all above 0.7) [176], as well as higher covariances among measurements for the same construct than for different constructs. Based on these measures, the instrument was assumed to meet the conditions required for acceptable reliability and construct validity.

IV. RESULTS

A. DESCRIPTIVE RESULTS

Frequencies and percentages of the demographic data are reported in Table 1. The sample consisted of 54.02% male and 45.98% female. The majority of students were between 18 and 25 years old (43.1%). 31.6% or 55 of the respondents were in their 4th year of study while 50 respondents (28.7%) were in their 3rd year, 38 of the respondents (21.8%) were in their 1st year, and the remaining 31 respondents (17.8%) were in their 2nd year.

TABLE 1. Demographics characteristics.

Measure	Category	Frequency	Percentage
Gender	Male	94	54.02%
	Female	80	45.98%
Age	Under 18	3	1.7%
	18 – 25	75	43.1%
	26 – 34	70	40.2%
	35 – 44	26	14.9%
	45 – 55	0	0%
Number of courses	Social science	60	30%
	Accounting	75	37.5%
	Communication	65	32.5%
Year of study	1st year	38	21.8%
	2nd year	31	17.8%
	3rd year	50	28.7%
	4th year	55	31.6%

B. STRUCTURAL EQUATION MODELING (SEM)

Structural equation modeling (SEM) was used to examine the hypothesized model. The software package SmartPLS, Version 3.0 was used to analyze the received data because it is considered a comprehensive statistical approach that allows for the simultaneous evaluation and modification of the conceptual model, including the relationships among the latent variables. In addition, PLS is appropriate for complex models that consist of a large set of relationships among constructs and sub-constructs [177]. The first stage is the assessment of the measurement model by investigating the reliability and the convergent and discriminant validity of the constructs. The second stage is related to the evaluation of the structural model by analyzing the paths of the structural model and by testing the significance of the relationships between the model constructs.

1) ASSESSMENT OF THE MEASUREMENT MODEL

To assess the measurement model, two types of validity were used: convergent validity, discriminant validity.

a: CONVERGENT VALIDITY

Fornell and Larcker [178] suggested three criteria to test the convergent validity: 1) Indicator loadings should be significant and greater than 0.70; 2) Internal consistency (Composite reliability and Cronbach's Alpha) should be greater than 0.70; and 3) average variance extracted (AVE) for each construct should be greater than 0.5. As shown in Table 2, all factor loadings for all items exceeded the recommended threshold of 0.70. The composite reliability (CR) values of the constructs (ranging from 0.891 to 0.934) exceeded the generally accepted threshold of 0.70. Furthermore, the AVE values (ranging from 0.653 to 0.849) exceeded the generally accepted threshold of 0.50. Hence, all three conditions for convergent validity were met. In addition, the internal consistency reliability needed to test unidimensionality was assessed by Cronbach's Alpha (α).

The resulting α values ranged from 0.758 to 0.912 and were therefore above the acceptable threshold of 0.70.

b: DISCRIMINANT VALIDITY

To evaluate the discriminant validity, Fornell and Larcker [178] suggested that the square root of each constructs' AVE should be greater than its highest correlation with any other constructs. Table 3 shows the square root of the AVE expressed on the diagonal. The results showed that the AVE value for each construct is greater than the correlation coefficient of that construct when compared with all the other constructs in the model.

TABLE 2. Constructs measures and loading.

	Construct Measures	Loading	Composite Reliability (CR)	Average Variance Extracted (AVE)	Cronbach's α
Student Characteristics	**Computer Anxiety (CA)**		0.910	0.671	0.876
	CA1	0.733			
	CA2	0.761			
	CA3	0.866			
	CA4	0.902			
	CA5	0.820			
	Technology Experiences (TE)		0.928	0.764	0.895
	TE1	0.927			
	TE2	0.923			
	TE3	0.872			
	TE4	0.764			
	Computer Self-Efficacy (CSE)		0.934	0.741	0.912
	CSE1	0.798			
	CSE2	0.894			
	CSE3	0.917			
	CSE4	0.878			
	CSE5	0.810			
Instructor Characteristics	**Instructor Attitude (IA)**		0.900	0.751	0.833
	IA1	0.783			
	IA2	0.908			
	IA3	0.902			
	Instructor Style (IS)		0.891	0.803	0.759
	IS1	0.866			
	IS2	0.925			
	Instructor Practice (IP)		0.899	0.749	0.831
	IP1	0.899			
	IP2	0.943			
	IP3	0.742			
	Instructor Online Responsiveness (IOR)		0.892	0.805	0.758
	IOR1	0.904			
	IOR2	0.891			
System Characteristics	**System Quality (SQ)**		0.904	0.653	0.867
	SQ1	0.821			
	SQ2	0.791			
	SQ3	0.833			
	SQ4	0.829			
	SQ5	0.764			
	Information Quality (IQ)		0.917	0.690	0.886
	IQ1	0.834			
	IQ2	0.890			
	IQ3	0.830			
	IQ4	0.871			
	IQ5	0.716			
	Service Quality (SVQ)		0.905	0.706	0.859
	SVQ1	0.788			
	SVQ2	0.879			
	SVQ3	0.913			
	SVQ4	0.772			
Classmate Characteristics	**Classmate Attitude (CMA)**		0.897	0.745	0.828
	CMA1	0.812			
	CMA2	0.887			
	CMA3	0.888			
	Classmate Interaction (CMI)		0.927	0.810	0.883
	CMI1	0.867			
	CMI2	0.932			
	CMI3	0.900			

TABLE 2. *(Continued.)* **Constructs measures and loading.**

Course Characteristics	**Course Quality (CQ)**		0.918	0.849	0.824
	CQ1	0.939			
	CQ2	0.904			
	Course Flexibility (CF)		0.906	0.661	0.871
	CF1	0.792			
	CF2	0.853			
	CF3	0.882			
	CF4	0.734			
	CF5	0.795			
Organization Characteristics	**Management support (MS)**		0.915	0.782	0.860
	MS1	0.865			
	MS2	0.943			
	MS3	0.842			
	Training (TR)		0.915	0.781	0.860
	TR1	0.858			
	TR2	0.896			
	TR3	0.896			
Experience	**Perceived Ease of Use (PEU)**		0.915	0.729	0.876
	PEU1	0.854			
	PEU2	0.845			
	PEU3	0.890			
	PEU4	0.826			
	Perceived Usefulness (PU)		0.921	0.796	0.872
	PU1	0.886			
	PU2	0.899			
	PU3	0.890			
Satisfaction	**Student Satisfaction (SS)**		0.916	0.733	0.878
	SS1	0.854			
	SS2	0.882			
	SS3	0.846			
	SS4	0.841			

c: COMMON METHOD BIAS (CMB)

For the PLS-SEM, common method bias (CMB) can be obtained through a full collinearity test [179]. Collinearity Statistics (VIF) values should be lower than the 3.3 threshold [179], [180]. As presented in Table 4, the VIF values for all the factors were lower than the threshold value of 3.3, this is indicative that the model is free from common method bias.

2) ASSESSMENT OF THE STRUCTURAL MODEL

The structural model was used to test the independent relationships among the variables proposed in this study. The path coefficients (β) were calculated in order to estimate the effects between constructs along with their degree of significance. A bootstrapping procedure of 5000 samples was used to assess the level of significance of the paths (t-value). The goodness of fit (GoF) index of the hypothesized model was examined in this study based on the recommendations of Tenenhaus *et al*. [181]. The GoF measure uses the geometric mean of the AVE and the average R^2 (for endogenous constructs). The calculation formula of GoF is as follows:

$$\text{GoF} = \sqrt{\overline{(R^2} \times \overline{AVE)}}$$

For the model used in this study, a GoF value of 0.678 was calculated. According to the Wetzels *et al*. [182], the GoF, of this study, was 0.678 which is considered large.

Table 5 illustrates the results of the hypothesized relationships. Overall, 14 out of 16 hypotheses were supported by the data. The results showed that individuals' characteristics in terms of computer anxiety ($\beta = 0.130$, t = 1.894, $p < 0.10$) and technology experiences ($\beta = 0.346$, t = 3.714, $p < 0.01$) had a significant relationship with students' perceived ease of use. Results also showed that both computer anxiety ($\beta = 0, 161$, t = 2.916, $p < 0.01$) and computer self-efficacy ($\beta = 0.199$, t = 2.554, $p < 0.05$) had a positive relationship with students' perceived usefulness. In contrast, students' perception of technology experience had no significant relationship with their perceived usefulness of LMS ($\beta = -0.021$, t=0.352, p = 0.725). Instructor characteristics in terms of responsiveness ($\beta = -0.174$, t=1.956, $p < 0.10$) was found to impose a significant negative relationship on students' perceived ease of use of LMS, but not on perceived usefulness ($\beta = 0.046$, t=0.591, p = 0.555). The other three sub-constructors of instructors' characteristics such as attitude, style, and practice had no relationship with students' perceived ease of use and usefulness of LMS.

The effects of system characteristics on students' perceived ease of use ($\beta = 0.249$, t=1.966, $p < 0.05$) and usefulness ($\beta = 0.233$, t=1.739, $p < 0.10$) were positive, except for the information quality which had no relationship with students' perceived ease of use and usefulness ($\beta = 0.090$, t=0.700,

TABLE 3. Constructs correlations and discriminant validity.

	CMA	CMI	CA	CSF	CF	CQ	IQ	IA	IP	IOR	IS	MS	PEU	PU	SQ	SS	SVQ	TE	TR
CMA	**0.863**																		
CMI	0.483	**0.900**																	
CA	0.103	0.097	**0.819**																
CSF	0.283	0.359	0.270	**0.861**															
CF	0.436	0.590	0.248	0.451	**0.813**														
CQ	0.349	0.496	0.176	0.352	0.688	**0.921**													
IQ	0.395	0.467	0.097	0.322	0.492	0.504	**0.830**												
IA	0.403	0.487	0.116	0.504	0.526	0.402	0.562	**0.866**											
IP	0.296	0.451	-0.020	0.268	0.379	0.320	0.479	0.650	**0.866**										
IOR	0.376	0.431	-0.004	0.226	0.369	0.376	0.499	0.542	0.625	**0.897**									
IS	0.308	0.348	0.045	0.329	0.287	0.323	0.321	0.556	0.616	0.448	**0.896**								
MS	0.186	0.260	0.056	0.262	0.406	0.302	0.359	0.445	0.317	0.388	0.233	**0.884**							
PEU	0.366	0.369	0.316	0.350	0.547	0.377	0.467	0.478	0.329	0.301	0.307	0.425	**0.854**						
PU	0.489	0.591	0.309	0.508	0.612	0.623	0.539	0.585	0.508	0.500	0.489	0.408	0.602	**0.892**					
SQ	0.272	0.402	0.105	0.388	0.387	0.314	0.614	0.405	0.306	0.394	0.253	0.360	0.461	0.353	**0.840**				
SS	0.452	0.553	0.161	0.418	0.658	0.660	0.517	0.597	0.536	0.458	0.482	0.475	0.550	0.749	0.323	**0.856**			
SVQ	0.344	0.466	0.215	0.307	0.635	0.709	0.601	0.511	0.477	0.520	0.499	0.326	0.551	0.649	0.502	0.692	**0.808**		
TE	0.198	0.135	0.260	0.383	0.378	0.421	0.248	0.345	0.328	0.246	0.308	0.084	0.485	0.362	0.221	0.331	0.456	**0.874**	
TR	0.239	0.285	0.069	0.339	0.359	0.255	0.452	0.407	0.297	0.464	0.250	0.620	0.436	0.372	0.592	0.392	0.359	0.073	**0.884**

Bold Numbers in the diagonal represent the SQRT(AVE) of the construct; to achieve the discriminant validity of the construct, the SQRT (AVE) of each construct should exceed the correlations shared between the construct and other constructs in the model

TABLE 4. Collinearity (VIF) statistics.

	Perceived Ease of Use	Perceived Usefulness	Student Satisfaction
Classmate Attitude	1.498	1.498	
Classmate Interaction	2.130	2.130	
Computer Anxiety	1.195	1.195	
Computer self-Efficacy	1.800	1.800	
Course Flexibility	2.940	2.940	
Course Quality	2.828	2.828	
Information Quality	2.471	2.471	
Instructor Attitude	2.801	2.801	
Instructor Practice	2.714	2.714	
Instructor Responsiveness	2.193	2.193	
Instructor Style	2.053	2.053	
Management Support	1.870	1.870	
Perceived Ease of Use			1.568
Perceived Usefulness			1.568
Service Quality	2.333	2.333	
Student Satisfaction			
System Quality	3.288	3.288	
Technology Experiences	1.662	1.662	
Training	2.390	2.390	

$p = 0.484$; $\beta = 0.091$, t=1.231, $p = 0.219$), respectively. Furthermore, the results revealed that service quality to be significantly related to students' perceived usefulness of LMS ($\beta = -0.171$, $t = 2.317$, $p < 0.05$), but not to their perceived ease of use ($\beta = 0.056$, t=0.520, $p = 0.603$). It can be said that providing appropriate learning services and support would help students to understand the online course and solve problems related to their learning topic. This would likely promote students' positive perception about the usefulness of LMS for their study. Classmates' attitude had a significant relationship with students' perceived usefulness ($\beta = 0.130$, t=1.910, $p < 0.10$), but not with their perceived ease of use ($\beta = 0.112$, t=1.489, p=0.137). As well, the interaction between classmates in the LMS environment was positively related to students' perceived usefulness of LMS ($\beta = 0.184$, t=2.410, $p < 0.05$), but not to perceived ease of use.

The examination of the effect of LMS quality was found to be significantly related to students' perceived ease of use and usefulness ($\beta = -0.256$, t=2.435, $p < 0.05$; $\beta = 0.157$, t=1.692, $p < 0.10$), respectively. It is assumed that providing students with a well-designed course helped them to improve their perceived ease of use and perceived usefulness of the environment. Surprisingly, students' perception of the efficiency and effectiveness of LMS had no relationship with students' perceived ease of use ($\beta = 0.182$, t=1.268, $p = 0.206$; $\beta = -0.034$, t=0.405, $p = 0.685$). Moreover, it can be assumed that the role of administrative support played a key role in shaping students' perception of LMS experience which imposed a significant relationship on both students' perceived ease of use ($\beta = 0.179$, t=1.915,

TABLE 5. Significance testing results of the structural model path coefficients.

Path	Path Coefficients (β)	t-value	p-value	Result
H_{1a}: Computer Anxiety -> Perceived Ease of Use	-0.130	1.894*	0.059	Supported
H_{1b}: Computer Anxiety -> Perceived Usefulness	-0.161	2.916***	0.004	Supported
H_{2a}: Technology Experiences -> Perceived Ease of Use	0.346	3.714***	0.000	Supported
H_{2b}: Technology Experiences -> Perceived Usefulness	-0.021	0.352	0.725	Not supported
H_{3a}: Computer self-Efficacy -> Perceived Ease of Use	-0.097	1.082	0.280	Not supported
H_{3b}: Computer self-Efficacy -> Perceived Usefulness	0.199	2.554***	0.011	Supported
H_{4a}: Instructor Attitude -> Perceived Ease of Use	0.092	0.718	0.473	Not supported
H_{4b}: Instructor Attitude -> Perceived Usefulness	0.007	0.078	0.938	Not supported
H_{5a}: Instructor Style -> Perceived Ease of Use	0.001	0.004	0.996	Not supported
H_{5b}: Instructor Style -> Perceived Usefulness	0.067	0.955	0.340	Not supported
H_{6a}: Instructor Practice -> Perceived Ease of Use	-0.053	0.432	0.666	Not supported
H_{6b}: Instructor Practice -> Perceived Usefulness	0.089	0.989	0.323	Not supported
H_{7a}: Instructor Responsiveness -> Perceived Ease of Use	-0.174	1.956*	0.051	Supported
H_{7b}: Instructor Responsiveness -> Perceived Usefulness	0.046	0.591	0.555	Not supported
H_{8a}: System Quality -> Perceived Ease of Use	0.249	1.966**	0.050	Supported
H_{8b}: System Quality -> Perceived Usefulness	0.223	1.739*	0.083	Supported
H_{9a}: Information Quality -> Perceived Ease of Use	0.090	0.700	0.484	Not supported
H_{9b}: Information Quality -> Perceived Usefulness	0.091	1.231	0.219	Not supported
H_{10a}: Service Quality -> Perceived Ease of Use	0.056	0.520	0.603	Not supported
H_{10b}: Service Quality -> Perceived Usefulness	-0.171	2.317**	0.021	Supported
H_{11a}: Classmate Attitude -> Perceived Ease of Use	0.112	1.489	0.137	Not supported
H_{11b}: Classmate Attitude -> Perceived Usefulness	0.130	1.910*	0.057	Supported
H_{12a}: Classmate Interaction -> Perceived Ease of Use	0.089	0.876	0.382	Not supported
H_{12b}: Classmate Interaction -> Perceived Usefulness	0.184	2.410**	0.016	Supported
H_{13a}: Course Quality -> Perceived Ease of Use	-0.256	2.435**	0.015	Supported
H_{13b}: Course Quality -> Perceived Usefulness	0.157	1.692*	0.091	Supported
H_{14a}: Course Flexibility -> Perceived Ease of Use	0.182	1.268	0.206	Not supported
H_{14b}: Course Flexibility -> Perceived Usefulness	-0.034	0.405	0.685	Not supported
H_{15a}: Management Support -> Perceived Ease of Use	0.179	1.915*	0.056	Supported
H_{15b}: Management Support -> Perceived Usefulness	0.121	1.811*	0.071	Supported
H_{16a}: Training -> Perceived Ease of Use	0.167	1.945*	0.052	Supported
H_{16b}: Training -> Perceived Usefulness	0.021	0.242	0.809	Not supported
H_{17a}: Perceived Ease of Use -> Student Satisfaction	0.156	1.588	0.113	Not supported
H_{17b}: Perceived Usefulness -> Student Satisfaction	0.655	8.137***	0.000	Supported

Note: *p<0.10 **p<0.05 ***p<0.01

$p < 0.10$) and perceived usefulness ($\beta = 0.121$, t=1.811, $p < 0.10$). In addition, the type of training support provided by the university to promote students' learning in a blended learning environment had a positive relationship with their perceived ease of use ($\beta = 0.167$, t=1.945, $p < 0.10$), but not on their perceived usefulness.

Lastly, students' perceived usefulness of LMS was found to impose a significant relationship on their satisfaction ($\beta = 0.655$, t=8.137 $p < 0.01$). However, this was not true for the effect of students' perceived ease of use on their satisfaction, which was found to be insignificant.

The coefficient of determination (R^2 value) was used to confirm the hypotheses model based on the model's predictive accuracy between a specific endogenous construct's actual and predicted values. In general, R^2 values of 0.75, 0.50, or 0.25 for the endogenous constructs can be described as respectively substantial, moderate, and weak [180]. The result shown in Fig. 2 led us to claim that the proposed model accounted for 58% of the variance which explained students' perceived ease of use of LMS, and 68.9% of the variance explained students' perceived usefulness, and 57.6% of the variance explained students' satisfaction with LMS use. These results are considered substantial [180].

V. DISCUSSION

The success of LMS in academic institutions may be initiated by instructors' acceptance, but its survival can be attributed to students' experience and satisfaction. This study examined the critical factors influencing students' experience and satisfaction of LMS use in a blended learning environment.

The results showed significant relationships between computer anxiety and students' perceived ease of use and usefulness of LMS. These relationships are consistent with the work of Chang *et al.* [49], Abdullah and Ward [183], Pituch and Lee [60], and Venkatesh and Davis [42] who linked computer anxiety to the development of individuals'

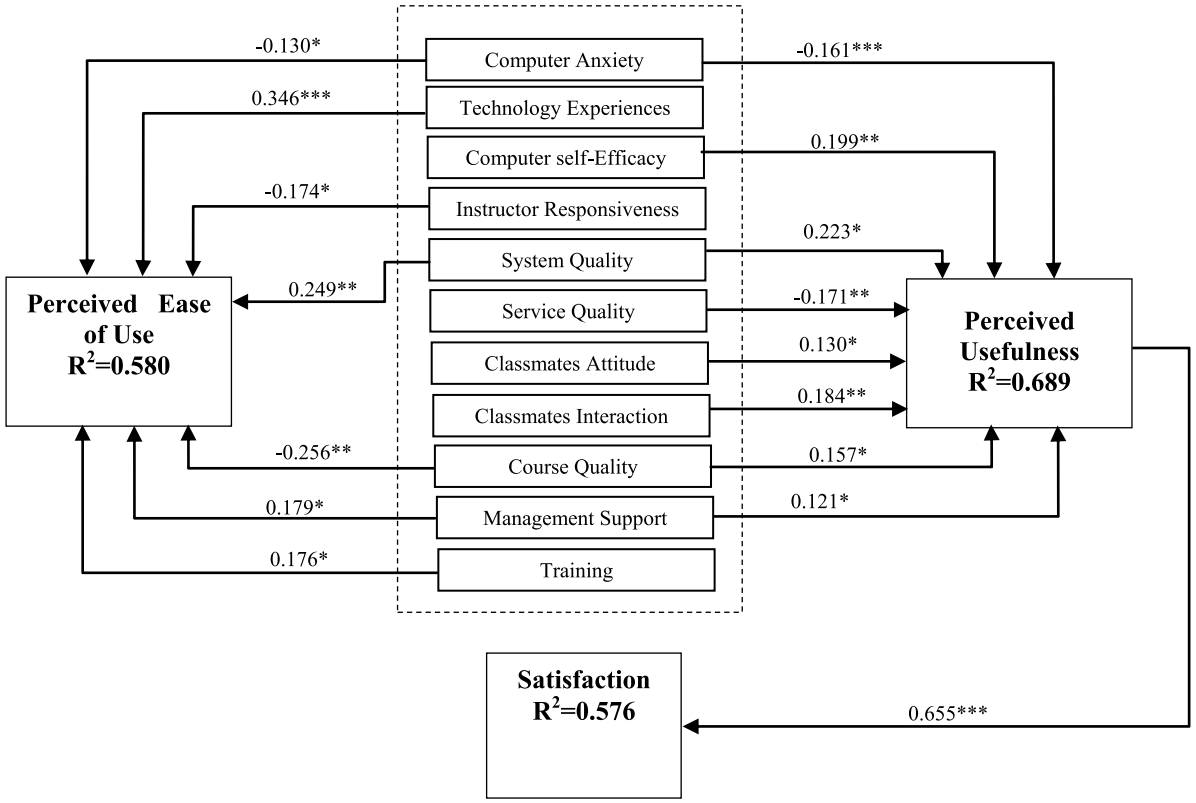

FIGURE 2. Tested model.

perceptions about technology. This study assumes that continuing to promote students' usage of LMS will enable them to develop a more positive attitude that can reduce their anxiety.

Moreover, the study found computer self-efficacy to be associated with students' perception of LMS usefulness, which may contribute to their level of confidence in LMS by offering them with the technology-related knowledge and skills relevant to their learning. Given that the respondents in this study are less likely to have an advanced knowledge about statistics to observe the e-learning system limitations, a significant and positive relationship between self-efficacy and perceived usefulness seems to be reasonable. This is in line with the finding of Hsu *et al*. [184] who found a significant effect of self-efficacy on users' perceived usefulness of the system. In contrast, the results showed that the relationship between students' self-efficacy and their perceived ease of use of LMS was not significant. This non-significant relationship can be due to the educational level of the participants, which may have resulted in a higher awareness, and as a result make ease of use less important. The study also found that the higher the level of computer skills among students, the more they become able to use the system. This assumption is supported by Fathema *et al*. [185] who found that students' confidence of their skills (i.e. operating basic features) will enable them to perceive the system to be useful. The relationship between students' technology experiences and perceived ease of use was insignificant in this study, which is consistent with some previous studies [161], [186]. This result can be acceptable because, when we look at it from the perspective of e-learning designers, we can notice that the perceived usefulness of a well-designed system may not require previous experience.

With respect to instructor characteristics, the finding indicated that only instructor online responsiveness had a significant relationship with students' perceived ease of use. It can be said that the constant help and timely online responses received by students have greatly contributed to their perception of the LMS effectiveness. In addition, the results showed that instructor attitude, style, and practice had no significant relationship with students' perceived ease of use or usefulness. These findings are not in line with other previous studies (e.g., [27], [86], [90], [187]) that mostly reported a positive relationship between these factors and students' usage of a system. One possible explanation for these results is the role of the instructor in a blended learning environment in which students perceived it to be limited to uploading learning materials with minimal communication.

The results also showed a significant relationship between system quality and students' perceived usefulness and ease of use of the LMS. It is common to assume that users may accept to use technology when the quality is within their expectations. The finding also revealed that a well-designed and user-friendly interface is considered as one of the most

important factors in determining the students' perceived ease of use and usefulness when using the LMS. These findings support the conclusion made by Lwoga [27], and other previous ones (e.g., [65], [86]) on how the system quality may exhibit stronger effects on the use of a system more than other quality-related factors.

As for the relationship between information quality and students' perceived ease of use and usefulness, the result showed no effect. This finding is supported by Berner and Maisiak [188] in which it is possible to assume that the limited support provided by the instructors on the task might have led to stronger associations between the other measures of task characteristics and students' experience in the LMS, which this study did not cover. The relationship between the quality of information and students' experience is more complex. Usefulness is a multifaceted construct. The LMS can be useful not only by meeting students' learning needs but also broadening their way of thinking by providing more relevant resources for solving complex problems. It is also possible that the usefulness and ease of use of LMS (promoting students' learning needs) operate differently when the task complexity exceeds the capacity of learners. This interpretation could offer an explanation for the relationship between information quality and students' experience (perceived ease of use and usefulness).

Moreover, the finding indicated no relationship of classmates' attitude and interaction to students' perceived ease of use. It is assumed that the limited influence of classmates can be due to various individual differences or learning style preferences, which is supported by [189]. Student-teacher interaction, students-materials interaction, and student-student interaction were found to be important for promoting perceived usefulness of the LMS among students. This finding supports the work of [20] who found a significant relationship between classmates' interaction and perceived usefulness, but not with perceived ease of use, possibly due to instructor related characteristics.

In contrast, course quality showed a significant relationship with students' perceived ease of use and usefulness. This can be reasoned to that students might perceive the learning content to be sufficient for their learning [144]. Such a finding is consistent with those found in previous studies [50], [86], [116] demonstrating the importance of online courses quality in shaping individuals' perception of system usefulness.

In addition, the finding indicated that the management support had a significant relationship with students' perceived ease of use and perceived usefulness. Of course, senior managers' support is important for students to be satisfied with LMS use. They should clearly determine the goal of LMS for the university curriculum to support and encourage their students to use the system. This finding is supported by findings in [52] and [153], where it was reported that the needs for universities to constantly focus on providing effective support and training to students. In parallel with [52], [86], [190], supportive staffs are an essential part of a blended learning module. Both organization and technical resources must be identified and committed to the learning schedule when developing a blended module [191]. Thus, it can be anticipated that providing the necessary technical support to the students is essential for enhancing service quality that can further aid students' use of the system, thus enhancing their satisfaction with it.

The results revealed that perceived ease of use had no significant relationship with students' satisfaction of LMS. This could be due to the participants' characteristics, when compared with other groups in the community, in which university students are used to leveraging existing technologies to advance their learning. This conclusion seems quite reasonable and consistent with the results of previous studies [192], [193]. In contrast, the finding on the relationship between perceived usefulness and satisfaction is beyond our expectation. In other words, it was found that students' perceived usefulness had a significant relationship with their LMS satisfaction. Indications are that perceived benefits such as increased productivity, effectiveness, and greater control over learning can thereby increase user satisfaction with the e-learning system. This is consistent with previous research findings which reported that perceived usefulness may impose a more significant and stronger role than perceived ease of use [27], [119], [121], [194]–[196].

VI. IMPLICATIONS

This study found that certain characteristics of students, instructors, systems, courses, classmates, and organization are important for increasing satisfaction with e-learning systems in higher education. The findings from this study offer some practical implications for researchers, policy makers and practitioners.

First, the study suggests the importance of providing the required supports for students to develop positive experiences that will help them to learn effectively. The management support at the universities should regularly conduct professional development programs or workshops for students to expand their knowledge and capabilities. These practices may help instructors build their capacity about the design and delivery of online courses, which should be tailored to meet the particular needs of students in order to facilitate their usage of the LMS environment. Furthermore, it is important for students to become aware of how to best utilize the service and how they can take control over much of their learning.

Second, the results showed that ensuring the quality of the learning system and service can potentially contribute to students' positive experience in their learning. It is suggested that the quality of learning services need to be managed with modern applications, which may contribute to the development of students' computer self-efficacy, thus shaping a positive perception about the usefulness of LMS.

Third, in addition to studying regularly, classmates' attitude and interaction were significant in shaping students' perceptions of LMS usefulness. Therefore, considering pedagogies for instructors to rethink their role and the role of their

students in the learning process is essential for developing a positive role model that can inspire students to effectively participate and interact in the LMS peer response activity.

VII. LIMITATIONS AND FUTURE WORKS IMPLICATIONS

Although this study used a strict research procedure, still there are some limitations that may impact the overall generalizability and interpretation of the findings of this preliminary investigation. For example, the design of the courses' content was not taken into consideration in this study, and further, students had varying background in online contexts; it can be assumed that these differences would influence student perceptions of the learning environment. Second, this study is cross-sectional which measures students' perceptions and satisfaction at a single point in time. Third, it is possible that the type of learning activities in which the students participated in may require certain skills to achieve the learning outcomes being sought, thus changing their perceptions of the environment. As indicated in Table 1, many students who participated in the study were enrolled in different LMS courses, which may result in students having multiple course experiences. For example, it would be possible that the process of responding to a collaborative discussion would have a greater influence on students than the process of reading.

Based on these limitations, future research designs may consider examining how different types of courses and activities can influence students' perception of the LMS environment. Future studies may also consider conducting a longitudinal study to increase the ability of making causal inferences related to the students' use of LMS. In addition, more attention can be given to the relationship between students' experiences in multiple courses and their performance in the LMS.

VIII. CONCLUSION

In this study, we examined an integrated model of IS success and TAM to investigate students' experience and satisfaction of LMS in a blended learning setting. Specifically, the influence of factors related to instructor, student, and system characteristics, along with the effects of perceived usefulness and ease of use on students' satisfaction was analyzed. The outcomes provide invaluable information on the students' patterns of behavior during their learning in the LMS. The study is expected to provide some new insights into the current state of students' satisfaction with LMS. Our results showed that student' characteristics (computer anxiety, technology experience, and computer self-efficiency), classmates' characteristics (attitude and interaction), and course characteristics (quality and flexibility) were vital elements for maintaining positive usage experience and satisfaction with LMS. Outcomes from this study can be used to guide higher education institutions in developing countries to initiate effective discussions and debates that can shape discourse on blended learning sustainability. In addition, the findings provided in this study can be used to design policies, practices, and a culture that supports continuance satisfaction of e-learning systems among both students and instructors. This can be achieved by increasing resources for education and re-prioritizing funds allocation for faculty development of new online courses and curriculum in developing countries.

APPENDIX

Questionnaire

TABLE 6. Questionnaire.

Construct	Measures
Student Characteristics	**Computer Anxiety (CA)**
	1. I believe that working with computers is very difficult.
	2. Computers make me feel uncomfortable.
	3. I get a sinking feeling when I think of trying to use a computer
	4. Working with a computer would make me very nervous
	5. Computers make me feel uneasy and confused
	Technology Experiences (TE)
	1. I feel confident using the e-learning system.
	2. I feel confident downloading necessary materials from the e-learning system.
	3. I feel confident uploading necessary materials to the e-learning system.
	4. I feel confident using online communication tools.
	Computer Self-Efficacy (CSE)
	1. I feel confident working on a personal computer (microcomputer)
	2. I feel confident using the user's guide when help is needed
	3. I feel confident learning to use a variety of programmes (software)
	4. I feel confident using the computer to organize information
	5. I feel confident troubleshooting computer problems
	Instructor Attitude (IA)
	1. The instructor shows a positive attitude toward the e-learning system.
	2. The instructor considers the e-learning system as useful.
	3. The instructor supports the use of e-learning system.

TABLE 6. *(Continued.)* **Questionnaire.**

Instructor Characteristics	**Instructor Style (IS)**	1. The instructor exhibits an interactive teaching style 2. The instructor encourages students' interactions.
	Instructor Practice (IP)	1. The instructor exhibits a good control over the e-learning system. 2. The instructor handles the e-learning system effectively. 3.The instructor frequently updates lecture notes for learners on the e-learning system
	Instructor Online Responsiveness (IOR)	1. The instructor responds to online inquiries and discussions on timely manner 2. I receive the instructor's comments on online assignments or tests on time
System Characteristics	**System Quality (SQ)**	1. The system offers flexibility in learning as to time and place. 2. The course content in the system is available in multimedia form (audio, video, graphic, and text). 3. The system is reliable. 4. The system enables interactive communication.
	Information Quality (IQ)	1. The information content in the system is very good. 2. The information from the system is current. 3. The information provided by the system is complete. 4. The information provided by the system is important and helpful for my learning. 5. The information provided by the system appears readable, clear and well formatted
	Service Quality (SVQ)	1. The system support service is reliable. 2. The system support service is accessible. 3. The system support service is easy to communicate with. 4. A specific person (or group) is available for assistance with system difficulties
Classmate Characteristics	**Classmate Attitude (CMA)**	1. The classmates show a positive attitude toward the e-learning system. 2. The classmates support the use of e-learning system 3. The classmates consider the use of e-learning system as useful
	Classmate Interaction (CMI)	1. Student-to-student interactions were easier in this course than other courses. 2. The system makes it easy for me to share ideas with my classmates. 3. Interacting with other students and the instructor using E-learning system became
Course Characteristics	**Course Quality (CQ)**	1. The use of e-learning system in this program has helped to improve its quality. 2. I feel the quality of the courses I took was largely affected as it is offered in the elearning
	Course Flexibility (CF)	1. Taking this course with e-learning system allows me to finish my study more effectively. 2. Taking this course with e-learning system saves me a lot of time commuting to class. 3. Taking this course with e-learning system allows me to arrange my work for the class more effectively. 4. The advantages of taking this course with e-learning system outweigh any disadvantages
Organization Characteristics	**Management support (MS)**	1. My university highlights the importance of e-learning system on my curriculum. 2. Senior administrators clearly identify the importance of e-learning tools to the university curriculum.
	Training (TR)	1. The training workshops on how to use e-learning tools provided by the university is useful. 2. The seminar on the use of e-learning tools provided by the university is useful
Experience	**Perceived Ease of Use (PEU)**	1. I find the e-learning system easy to use. 2. I seldom make errors when I am using the e-learning system. 3. E-learning tools are clear and understandable to me. 4. I find the e-learning system to be flexible to interact with
	Perceived Usefulness (PU)	1. Using e-learning system enables me to accomplish tasks more quickly. 2. Using e-learning system increases my productivity. 3. Using e-learning system enhances my learning effectiveness
Satisfaction	**Student Satisfaction (SS)**	1. I am satisfied with the effectiveness of the e-learning system 2. I am pleased with my experience of using the e-learning system. 3. I am satisfied with the quality of interaction between all involved parties. 4. I am satisfied with my participation in the class.

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