# DeLone and McLean Information Systems Success Model in a Blended-Learning Context

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# ABSTRACT

This study evaluates the success of the blended-learning mode in the context of a higher education institution in the Arabian Gulf region, utilizing the updated DeLone and McLean information systems success model. Students were surveyed about their perceptions of and feedback on the different characteristics of blended learning. Use of the blended-learning system and student satisfaction had a significant positive influence on net benefits. The service quality aspects of the blended-learning system—collaboration, support, and interaction between involved parties—provided strong support to both system use and student satisfaction. This study is one of only a few to evaluate blended learning in the Arabian Gulf region. The findings increase understanding of blended-learning system use in the entire region and shed light on its relation to student contentment. This would aid the curriculum design process, resource allocation, adoption, and customization of the blended-learning modality.

### **KEYWORDS**

D&M IS Framework, E-Learning, Learning Delivery, Service Quality, Student Satisfaction, System Quality

# INTRODUCTION

Recent advancements in computer and digital technology have led to the development of new models of teaching and learning that differ from traditional instruction. One such model is blended learning, a concept that dates to the advent of digital technology and is intended to individualize the learning process and bridge distance and time through correspondence courses (Bryan & Volchenkova, 2016). As such, this model offers students partial control over aspects of their learning and is associated with improved pedagogy and increased information access.

The term *blended learning* is context-dependent and has been defined differently by various scholars (Graham, 2006; Hew & Cheung, 2014; Krasnova, 2015; Oliver & Trigwell, 2005; Staker & Horn, 2012). There is agreement that blended learning is an integrated learning experience controlled and guided by instructors in the form of face-to-face communication or virtual presence. Lalima and Dangwal (2017) defined blended learning as embracing the advantages of both traditional classroom teaching and information and communication technology (ICT)–supported learning, with the potential for collaborative, constructive, and computer-assisted learning. According to Rovai and Jordan (2004), a blended course can lie anywhere between fully face-to-face and fully virtual e-learning (online) modalities.

Higher education institutions in the United Arab Emirates (UAE) have pioneered the integration of digital technology in education in the Gulf and the wider Arab region (Ahmed & Al Marzouqi, 2015; Alkaabi et al., 2016). Ahmed and Al Marzouqi (2015) found that blended teaching significantly

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enhanced learning and level of understanding among the United Arab Emirates University (UAEU) engineering students. Yet, their findings cannot be generalized because of the limited scope and sample coverage. AlMurshidi (2017) surveyed UAEU College of Education students engaged in a mobile learning project that was to subsequently transition to blended delivery. Students reported several positives, including bridging distance and time and eliminating the need for books. However, they also mentioned several drawbacks, including difficulty accessing the network and device limitations, such as battery life and memory capacity.

This study is driven by a need to assess the level of acceptance and usefulness of blended learning in higher education institutions in the Arabian Gulf Region, focusing on the UAEU. The UAEU is ranked among the top five Arab universities and is number 284 worldwide, according to the 2020 QS ranking system. The university is investing considerable resources to transform classrooms into collaborative, technology-based teaching environments. It is monitoring, through the UAEU Center for Excellence in Teaching & Learning, a transformation from traditional learning to a blended-learning approach. Several UAEU courses have transitioned to blended learning, yet few investigations have assessed student satisfaction (SS), information quality (IQ), service quality (SERQ), system use (SU), and overall system quality (SQ).

The main objective of this study is to use DeLone and McLean's information system success (D&M ISS) model and theory to evaluate the success of the blended-learning mode (DeLone & McLean, 1992, 2003), using UAEU data. To better account for the face-to-face factor of the blended modality, the SQ component of the original D&M ISS model has been updated to use measures of instruction quality, engagement, and interaction among instructors and peers. This reflects possible influence of the social bond in the success of the system. Originally, SERQ was used to measure the level of ICT support, information content, and delivery.

### Literature Review

Scholars have cited cost reduction as one of the benefits of blended learning. Other advantages include unlimited access to learning materials irrespective of geographic location, increased time efficiency, ease of communication and instructor–student interaction, better adherence to students' needs, and additional support in course content problem-solving (Owston et al., 2013; Szadziewska & Kujawski, 2017; Wu et al., 2010).

Several drawbacks to blended learning have also been noted. For example, successful implementation of the approach requires efficient network connections, accessibility of electronic devices, a suitable curriculum, and students' ability to use technology and to learn independently. Scholars have related the acceptance of blended learning to factors including gender, age, and cultural background (Alkaabi et al., 2016). Moreover, the lack of immediate response in asynchronous models, compared to the immediate feedback in face-to-face learning, results in a loss of the sense of community and group identity (Vonderwell, 2003). Further, students find it difficult to establish socio-emotional interactions, and instructors need the right ICT support to adapt to the changing nature of technology. Despite these challenges, the adoption of blended learning is increasing, as its benefits greatly exceed its drawbacks.

Sharpe et al. (2006) identified three models of blended learning. In the *transmissive pedagogical* model, delivery and learning mainly rely on traditional face-to-face lectures and seminars, in which the teacher fully controls knowledge delivery. Students receive extra support via online lecture notes available in the institution's virtual learning environments (VLEs). The *transformative* model involves extensive use of ICT tools beyond VLEs to enhance and alter students' modes of interaction, studying, and learning. It is underpinned by radical course redesign. Through dynamic interactions, learners are actively involved in constructing knowledge, not just receiving it. This mode of blended learning promotes intellectual activities that are dependent on the use of technology (Graham, 2006). Currently, the transformative model is widely adopted by higher education institutions, developed through a constructive alignment of assessment strategies with learning objectives (Biggs, 2011). The *holistic* 

model is characterized by situations in which most learners do not distinguish between learning with or without technology. The instructor facilitates learning by using students' own technology devices and platforms, including mobile phones, online communities, and instant messaging.

Bouilheres et al. (2020) surveyed students from business and science and technology schools at an Australian university, examining students' perceptions of blended learning and whether the blended environment increased engagement between students, instructors, and learning materials. The factor analysis results indicated positive student perception of blended learning.

Atmacasoy and Aksu (2018) synthesized research on the implementation of blended learning at teachers' education programs in Turkey and investigated its impact on learners' achievements and attitudes. They concluded that blended learning was more effective than face-to-face learning or purely online learning as it mainly relied on integrating the best of the two approaches. However, they stressed the importance of an appropriate ICT infrastructure and network, as well as reliable communications connectivity.

Yakubu and Dasuki (2018) used the D&M ISS model to examine factors contributing to the acceptance of the e-learning system in a private university in Nigeria. Their results supported positive relations between the quality of the system, students' intentions to use the system, and students' satisfaction. Similarly, information and SERQ were positively related to students' intentions to use the system and SS, which were in turn positively related to actual SU. No association was found between SERQ and SS, IQ and SS, SERQ and intention to use the system, and SS and intention to use the system. One clear limitation of the investigation was the absence of factors including instructor feedback and student interaction.

Chen and Jones (2007) investigated the perceptions of two groups of MBA students in the same accounting course. One group was engaged in a blended-learning mode and the other in a traditional-learning setting. The authors reported no differences in learning outcomes for the two groups. However, they indicated that the blended-learning group had developed improved analytical skills and better understanding of concepts in the field. Nevertheless, the blended-learning group found the course harder versus the traditional-learning group. Furthermore, the traditional-learning group expressed more satisfaction with the clarity of the instructions. Overall, both methods received positive feedback, and no differences were found in motivation or confidence in the ability to understand and apply the learning concepts.

Alkaabi et al. (2016) highlighted universal and UAE-specific factors that affected achievement in a blended-learning environment. They discussed three factors: academic caring, self-efficacy, and social interaction. *Academic caring* entails frequent instructor–student interactions and support for student well-being. According to Wentzel (2009), from the student perspective, the willingness of the instructors to be available and to mindfully attend to their academic needs are elements of academic caring. *Self-efficacy* is the belief in one's capabilities to execute the actions required to produce given attainments (Bandura, 1986). *Social interaction* refers to the level of online interaction between students, their peers, and course instructors (Alkaabi et al., 2016). According to Alkaabi et al. (2016), several scholars have raised concerns that blended learning is being used as an information source rather than a medium of interaction with content and social interaction.

# Background

The updated DeLone and McLean (2003) model is an information systems (IS) theory that defines IS success by identifying, describing, and explaining the relationships among six of the most critical dimensions of success along which an IS might be evaluated (Figure 1).

Source: DeLone and McLean (2003)

In this context, an IS is defined as a set of coordinated network components that act together to produce, distribute, or process information (Boell & Cecez-Kecmanovic, 2015). What matters in the IS is the application of technology that meets the needs of the different users and their specific objectives and practices. According to DeLone and McLean (2003), an IS can be evaluated based

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on the information, system, and SERQ it provides. These three qualities directly influence the use or intention to use the system and user satisfaction. The model also postulates that certain benefits can be achieved by using the system. Further, SU, together with user satisfaction, will be influenced positively or negatively by net benefits (NB).

Several scholars have evaluated the e-learning teaching approach using the D&M ISS model (Lee-Post, 2009; Ramayah et al., 2010; Yakubu & Dasuki, 2018). In contrast to the blended-learning approach, e-learning occurs entirely online. Thus, to assess the success of the blended-learning modality utilizing the D&M IS framework, the face-to-face component of the blended-learning mode should be accounted for as an important dimension of success. Such a dimension has a clear manifestation in the SERQ, through instructors, peer contributions, and social interactions.

Thus, within the blended-learning delivery context, the D&M ISS model offers an understanding of interrelationships between blended-learning quality factors, SU, and user satisfaction when assessing the end user NB. Based on a literature review, Urbach and Müller (2012) produced lists of validated measures that can be used to operationalize success dimensions of the D&M ISS model. The lists are meant to serve as a starting point in the search for context-driven measures.

# System Quality

The SQ dimension stresses desirable IS characteristics, focusing on measures of usability and performance. Common measures in this dimension are perceived ease of use, system accessibility, accuracy, reliability, and interactivity (Table 1). In the current study, however, SQ is evaluated in the context of a blended-learning delivery system and the additional elements of success needed to measure this dimension. These include reliability, clarity of information, overall performance of the learning management portal used, and the effective use of multimedia to promote interactivity among involved parties (Wu et al., 2010).

# Information Quality

The IQ dimension is concerned with content issues and desirable characteristics of the IS output. It focuses on measures of quality and usefulness of the information produced by the system. Urbach and Müller (2012) noted that IQ is the key criterion for user satisfaction. In their review of measures used to operationalize this construct, they listed several items (Table 1) that are consistent with the IQ needed for blended learning, including information organization, precision, relevancy, and currency.

# Service Quality

The SERQ dimension describes the level of support received by the IS user. This support includes training provision, hotline services, or helpdesk availability. Urbach and Müller (2012) listed possible proxies to the IS SERQ (see Table 1). In the blended delivery context, SERQ implies the existence of a stable ICT system and the efficient utilization of a learning management portal.

In addition to using instructor support, the current study follows Holsapple and Lee-Post's (2006) suggestion of using student-instructor interaction to assess SERQ. Instructor support has several manifestations, including instructor availability, fairness, and knowledge of blended-learning technology; clear and prompt communication of class activities and tasks; and encouragement of student participation in course activities. Peers can further contribute to the provision of high-quality service by maintaining appropriate on- and offline interactions and feedback that encourage other students to explore and learn.

# Intention to Use/Actual Use

The dimension of intention to use/actual use reflects the degree and manner of utilization of the IS. The Technology Acceptance Model (TAM) (Davis, 1989) offers a comprehensive approach to measure this dimension using variables such as perceived ease of use and perceived usefulness, both of which contribute to attitude toward use, intention to use, and actual use. Urbach and Müller (2012) noted that, due to difðculties in interpreting the use dimension, DeLone and McLean suggested intention to use as an alternative measure for use in some contexts. Table 1 summarizes the variables Urbach and Müller (2012) employed to measure use or intention to use the IS. In this study, however, measures of actual SU were adopted, rather than intention to use.

# **User Satisfaction**

The user satisfaction dimension is measured when the IS system is utilized. Several authors (e.g., Doll et al., 2004; Ives et al., 1983) have listed measures of user satisfaction. These instruments also include items of SQ, IQ, and SERQ (Table 1). In the online and blended-learning context, researchers have utilized different methods to define and assess student satisfaction, including final grades, students' attitudes toward online classes, and students' self-report of satisfaction (Park & Choi, 2009; Patterson & McFadden, 2009).

# **Net Benefits**

NB are a measure of the contribution of the IS to the success of the different stakeholders. Measures of NB are combined into one dimension, mainly including individual and organizational impacts, together with work group and societal impacts (Table 1). As argued by many researchers, NB constitute a context-driven dimension that largely depends on the specific research problem, purpose of the study, and level of analysis. Despite the association and dependency between NB, measures of user satisfaction, and SU, researchers have alluded to measuring it directly. In financial and market-based studies, investigators have attempted to quantify NB through numerical measures such as profitability, cost, market share, or productivity.

Table 1 highlights measures utilized by researchers to operationalize IS NB on both an individual and organizational basis. This study employs measures that operationalize this dimension in the context of a student's NB from the blended-learning system. Thus, NB can be measured via improvement in learning productivity, tasks accomplishment, and enhanced effectiveness of activities.

# **Study Hypotheses**

The study intends to use D&M ISS model and theory to evaluate the success of the blended-learning mode in UAEU. It makes several assumptions regarding the success of the blended-learning system. According to the updated DeLone and McLean (2003) theoretical framework, six dimensions contribute to the success of the blended-learning system (Figure 1). Theoretically, the blended-learning SQ, IQ, and SERQ are expected to have a positive influence on SS and SU. This, in turn, will influence NB. SU is further assumed to be influenced by SS. The following nine research hypotheses are formulated:

	m quality Information Service Intension to Use/		The State Contract	Net Benefit (Impact)				
System quality	Quality	Quality	Use	User Satisfaction	Individual	Organizational		
Access	Accuracy	Assurance	Actual use	Adequacy	Awareness/ Recall	Business process change		
Convenience	Availability	Empathy	Daily use	Effectiveness	Decision effectiveness	Competitive advantages		
Customization	Conciseness	Flexibility	Frequency of use	Efficiency	Individual productivity	Cost reduction		
Data accuracy	Format	Interpersonal quality	Intention to (re) use	Enjoyment	Job effectiveness	Enhancement of communication and coordination		
Data currency	Relevance	Intrinsic quality	Nature of use	Information satisfaction	Job performance	Enhancement of internal operations		
Ease of learning	Reliability	IS training	Navigation patterns	Overall satisfaction	Job simplification	Enhancement of reputation		
Ease of use	Timelines	Reliability	Number of site visits	System satisfaction	Learning	Improved outcomes/ outputs		
Efficiency	Understand- ability	Responsive- ness	Number of transactions		Productivity	Improved decision making		
Flexibility	Usability	Tangibles			Task performance	Increased capacity		
Integration	Usefulness				Usefulness	Overall productivity		
Interactivity					Task innovation	Overall success		
Navigation						Quality improvement		
Reliability						Customer satisfaction		
Response time						Management control		
Sophistication								
System accuracy								
System features								
Turnaround time								

#### Table 1.Constructs and Measures of the Updated D&M ISS Model, Based on Urbach and Müller's (2012) Review

H<sub>1</sub>: SQ will have a positive influence on SS in blended learning.

**H**<sub>2</sub>: SQ will have a positive influence on SU of blended learning.

**H**<sub>3</sub>: IQ will have a positive influence on SS in blended learning.

**H**<sub>4</sub>: IQ will have a positive influence on SU of blended learning.

H<sub>5</sub>: SERQ will have a positive influence on SS in blended learning.

H<sub>6</sub>: SERQ will have a positive influence on SU of blended learning.

H<sub>2</sub>: SS will have a positive influence on the NB of blended learning.

H<sub>s</sub>: SU of blended learning will have a positive influence on the NB of blended learning.

 $\mathbf{H}_{o}$ : SS will have a positive influence on SU of blended learning.

# METHODOLOGY

# Participants

This study covered all undergraduate students enrolled in all six blended courses offered by the UAEU in fall 2020. A total of 191 students completed the blended-learning survey, amounting to slightly over 72% of the total population of the 262 enrolled students (see Table 2). The 15-minute survey questionnaire was distributed to students on paper on the last day of the course, after the final exam.

Over three quarters of participants were female, which aligns with the 4:1 enrollment ratio of female to male, as indicated in UAEU student enrollment statistics of 2018/2019. UAE national students are the majority group at the university, representing over 80% of all enrolled students.

# **Blended Courses**

Table 2 provides a list of the six blended courses with the students enrolled. All courses belonged to the humanities and social sciences disciplines. Three of the courses were lower 100-level courses, two were intermediate 200-level, and one course was a junior 300-level course. These were populated, respectively, by 45%, 35%, and 20% of the surveyed students. The courses had percentages of online modality that ranged from 25% to 75%, as per the UAEU Center for Excellence in Teaching & Learning guidelines.

C 4'41-	Enroll	ed Students	Dementer
Course the	Female	Male	Department
Educational Technology	28	0	Curriculum & Instruction
Commercial Arbitration Law	28	25	Private Law
Public Relations & Advertising Principles	35	0	Mass Communication
Social & Cultural Change	56	0	Sociology
Critical Thinking	9	22	Philosophy
Arts and Society I	44	18	English Literature
Total	200	65	265

#### Table 2. Course Title, Department, and Number of Students by Gender

The delivery of almost all UAEU blended courses, including those listed in Table 2, utilizes the Blackboard management system, which is the university's mandatory platform for the delivery of learning and the integration of information and e-learning resources.

# **Questionnaire Design**

The questionnaire benefited from the existing research on a validated list of measures used to evaluate the blended-learning approach and validate the D&M ISS model. Urbach and Müller's (2012) review was the main source of the measures adapted for use in this study. Additional measures of instructor–student interaction and peer interactions among students appear in the work of Wu et al. (2010). Pituch and Lee (2006) and Wu et al. (2010) suggested a direct effect of social interaction on the use of e-learning systems. They added that interactions among students, interactions between faculty and students, and learning collaboration are key to learning process effectiveness. Similar remarks were also given by Bouilheres et al. (2020) and Alkaabi et al. (2016). Poelmans and Wessa (2015) proposed instructor support and peer input as proxies for SERQ.

Students enrolled in blended-learning courses at UAEU were surveyed about the different quality aspects and effectiveness of the blended-learning system and their overall level of satisfaction. The first part of the questionnaire asked about students' basic demographic profile, English reading and writing skills, and ICT literacy needed to access course materials. The second part asked for their opinions on different dimensions and constructs related to blended-learning success. The students rated their agreement with each of the 22 items on a 5-point scale from 1 *strongly disagree* to 5 *strongly agree*. A statement that received a score of less than 3 was considered to have a "low" agreement rating as

it indicated some level of disagreement. A response of 3 was labeled "neutral," while a response of more than 3 was labeled "high."

### Results

As detailed in the previous section, the empirical data in this study were obtained primarily through a self-reported questionnaire. Analysis results were presented in three subsections. In Subsection 1, students' ICT and English language preparedness and skills were investigated. Subsection 2 presents an exploratory quantitative analysis conducted to assess individual dimensions of the D&M ISS model. In Subsection 3, structural equation modeling (SEM) is used as the main tool to test the study hypotheses developed from the six dimensions discussed in Subsection 2 to evaluate the success of the blended learning mode at UAEU.

# Participants' ICT Profile

Students' performance on some of the UAE university curricular requirements that are necessary to enhance the learning process include preexisting Internet and ICT skills, together with oral and writing skills in English—the main language of instruction in UAEU colleges. Communication in English seemed not to be a problem, as over 90% of participants had intermediate fluency or above, and only approximately 8% had elementary skills. Over 90% of participants indicated above-average level of experience in the use of Internet technologies, social media, and multimedia applications.

The Blackboard educational management system, Internet, social media, and multimedia applications were important tools of communication. Four to six or more communications and interactions per week with instructors during the blended course delivery represent the norm for more than two thirds of the surveyed students. This is compared to over one half of the participants when interactions were with classmates.

# **Evaluating the Dimensions of Blended-Learning Success**

Table 4 depicts participants' evaluation of several desirable characteristics of SQ and performance. Although all statements intended to measure SQ received an above-average rating, system reliability showed the highest percentage of students who agreed or strongly agreed. Only approximately 9% of the students expressed concerns about system interactivity and learner interactions.

Table 5 shows the percentages and mean responses intended to summarize different measures and characteristics of IQ of the UAEU blended-learning system. More than 80% of students highly valued the IQ in terms of information precision, organization, currency, relevancy, and reliability. All evaluations were favorable, with an average score exceeding 4 points.

Table 6 indicates that students gave high ratings to instructors' experience regarding the use of the learning technology and timely feedback on assignments and tests. All other characteristics of SERQ, including adequate communications between instructors and students and among students, also received high ratings (>80%).

Table 7 indicates that students were highly satisfied with the blended-learning system. Factors contributing to satisfaction included user-friendly technology and ease of navigation that aided the learning process. This might explain the favorable responses regarding willingness to take another blended-learning course. Approximately 80% of the students said they would recommend a blended course to friends.

As Table 8 shows, students indicated they used the course online materials frequently. They rated as high the ease of use of the technology utilized in the blended-learning process. Over 85% of participants reported feeling "satisfied with how they are able to apply what they have learned in the course from both the online and face-to-face parts."

As Table 9 indicates, the blended learning delivery enhanced students' study activities and contributed to improving their productivity and time to accomplish tasks.

Variable	n (%)
Gender	
Male	43 (22.5)
Female	145 (75.9)
Nationality	
UAE	162 (84.8)
Non-UAE	25 (13.1)
Do you consider yourself fluent in reading in English?	
Proficient	52 (27.2)
Intermediate	119 (62.3)
Elementary	16 (8.4)
Do you consider yourself fluent in writing in English?	
Proficient	55 (28.8)
Intermediate	117 (61.3)
Elementary	15 (7.9)
What is your experience using Internet technologies (e.g., emailing, blogs, wikis)?	
Yes	121 (63.4)
Some	60 (31.4)
No	5 (2.6)
What is your experience using social media and multimedia applications (e.g., graphics, audios, videos, animations)?	
Yes	106 (55.5)
Some	69 (36.1)
No	11 (5.8)
How many times per week do you use Blackboard/Internet/social media apps to interact with an instructor?	
Zero	6 (3.1)
1–3	50 (26.2)
4-6	67 (35.1)
≥7	64 (33.5)
How many times per week do you use Blackboard/Internet/social apps to interact with classmates?	
Zero	4 (2.1)
1–3	77 (40.3)
4-6	52 (27.2)
≥7	53 (27.7)

*Note*. ICT = information and communication technology; UAE = United Arab Emirates.

# Testing the Study Hypotheses Using SEM

SEM, based on the updated D&M ISS model, was utilized to evaluate the success of the blended-

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### Table 4. Participants' Evaluation of System Quality

Survey item	% Low	% Neutral	% High	Mean	SD
The technology used for blended teaching is reliable.	1.6	10.5	87.9	4.2	0.701
Information (such as online help) provided with the course website is clear.	4.2	20.1	75.6	4.1	0.861
Information (such as online help) provided with the course websites is accurate.	4.8	19.0	76.2	4.0	0.877
The educational technology and multimedia used in this course support interactivity between learners and instructors by chat, forums, discussions, etc.	8.9	17.8	73.3	4.0	0.989

### Table 5. Participants' Evaluation of Information Quality

Survey item	% Low	% Neutral	% High	Mean	SD
The course website provides the precise information I need to complete the tasks.	1.6	12.6	85.8	4.2	0.727
The information provided on the course website is well organized.	1.6	13.1	85.3	4.3	0.740
The information provided on the course website is up to date.	1.0	14.7	84.3	4.2	0.755
The information used for blended teaching is relevant and reliable.	1.1	13.2	85.7	4.3	0.747

#### Table 6. Respondents' Evaluation of Service Quality

Survey item	% Low	% Neutral	% High	Mean	SD
The instructor uses blended-learning technology appropriately.	2.1	12.0	85.9	4.4	0.798
Feedback on evaluation of tests and other assignments was given in timely manner.	2.1	12.0	85.9	4.3	0.789
Sending feedback messages to other students encourages me to explore and learn.	2.1	13.6	84.3	4.3	0.769
Interaction and communication were adequately maintained with the course instructor.	2.1	12.8	85.1	4.3	0.780

#### Table 7. Student (User) Satisfaction

Survey item	% Low	% Neutral	% High	Mean	SD
The technology and multimedia (appropriate audio and video content, animations, computer simulations, etc.) used for blended learning are user friendly.	1.6	9.4	89.0	4.3	0.731
The directions and navigation required to use the blended-learning technology and multimedia (including the Blackboard system) are clear.	1.0	12.0	86.9	4.3	0.746
I am willing to take another course using blended learning.	5.2	15.7	79.1	4.2	0.948
I would recommend taking a blended-learning course to a friend.	6.3	14.1	79.6	4.2	0.973

#### Table 8. Participants' Evaluation of System Use

Survey item	% Low	% Neutral	% High	Mean	SD
I use the course online materials and multimedia frequently.	3.1	8.9	88.0	4.3	0.793
It is easy to get the technology used in the blended-learning course to do what I want it to do.	1.6	10.5	87.9	4.3	0.743
I am satisfied with how I am able to apply what I have learned in this course from both the online and face-to-face parts.	1.6	12.2	86.2	4.3	0.792

#### Table 9. Participants' Evaluation of Net Benefits

Survey item	% Low	% Neutral	% High	Mean	SD
Blended learning improved my learning productivity.	2.6	15.9	81.5	4.2	0.835
Blended learning enhanced the effectiveness of my study activities.	2.1	18.4	79.5	4.2	0.827
Blended learning made it easier to study/learn.	4.2	13.2	82.6	4.2	0.887

learning methodology at UAEU. The framework examines the extent of the relationships between different qualities expected to positively affect the success and NB of blended learning. These included system reliability and ease of use, system precision and organization of information, service quality provided through the use of appropriate technology, and high-quality interactions between involved parties. According to the D&M ISS model, these qualities are expected to positively influence the SU, SS, and NB of the blended-learning delivery system. As such, the nine hypotheses introduced above were postulated and tested.

*Model fit.* Model fit was performed with the lavaan version 0.6-6 package in R (Rosseel, 2012). Confirmatory factor analysis results reflected high levels of internal consistency within the constructs, with Cronbach's  $\alpha$  values higher than .8, exceeding a recommended level of .7 (see Table 10). Model reliability was further assessed by estimating respective construct reliability, employing the index of composite reliability (CR) to review convergent validity. All CR values exceeded the acceptable base level of .7 (see Table 10).

Similar conclusions were evident when the index of average variance extracted (AVE) was employed to measure convergent validity. AVE measures the level of variance captured by a construct versus the level caused by measurement error. In the current study, a reported value exceeding 0.5 and less than the corresponding CR was declared acceptable.

Maximum shared variance and average shared variance were used to assess the model's discriminant validity. Both measures confirmed the discriminant validity of the fitted SEM model,

showing values less than the AVE. Moreover, the square root of AVE (boldface in Table 10) provided further support for the discriminant validity of the fitted model; for each construct, the produced value is higher than inter-construct correlations.

Variable	Cronbach's α	CR	AVE	MSV	ASV	SQ	IQ	SERQ	SS	SU	NB
SQ	.86	.88	.65	.58	.46	.807					
IQ	.89	.92	.75	.53	.45	.676	.864				
SERQ	.82	.88	.66	.62	.54	.713	.726	.810			
SS	.88	.92	.74	.67	.59	.759	.696	.785	.862		
SU	.84	.91	.76	.60	.51	.618	.661	.748	.773	.874	
NB	.89	.89	.73	.67	.49	.628	.602	.680	.817	.742	.857

Table 10. Assessment of Reliability, Convergent and Divergent Validity, and Constructs' Correlation Matrix

Note. SQ = system quality; IQ = information quality; SERQ = service quality; SS = student satisfaction; SU = system use; NB = net benefits.

Finally, the model's goodness-of-fit was assessed using five indices: chi-square/degrees of freedom of 2.1, a comparative fit index of 0.924, Tucker–Lewis index of 0.911, root-mean-square error of approximation of 0.076, and root-mean-square residual of 0.053. The values for all indices were compared with the recommended cut-off level, noted respectively as  $\leq 3.0$ , > 0.90, > 0.90,  $\leq 0.08$ , and  $\leq 0.10$ .

The results of the fitted SEM model (Table 11 and Figure 2) display the standardized path coefficients and beta coefficients, which determine the effect size of the hypothesized path between the two variables. The larger absolute value of the beta coefficient reflects a stronger effect. Approximately 70% of the variance in the students' NB from the blended-learning delivery system was explained by two constructs: SU of the blended-learning system, and SS with blended learning. The respective quality dimensions (SQ, IQ, and SERQ) and SS with the UAEU blended-learning delivery system explained >65% of the SU.

All hypotheses were supported at different levels of significance (Table 11 and Figure 2), although IQ had an insignificant impact on both SS ( $H_3$ ) and SU ( $H_4$ ). Similar conclusions apply when describing the relationship between SQ and SU ( $H_3$ ). SERQ appeared as a strong predictor of SU and SS.

### **Discussion and Conclusion**

This study evaluated the success of the blended-learning teaching mode utilizing the updated D&M ISS model. Exploratory analysis revealed favorable student opinions regarding almost all characteristics of blended learning that were hypothesized to positively influence its success. SEM was also utilized to investigate the interrelationships between critical dimensions in blended-learning system success.

Both actual SU and SS had significant positive influences on NB. SS significantly supported the blended-learning SU. SU received indirect support, via student satisfaction, from SQ and SERQ. SERQ provided strong support to both SU and SS. These results were consistent with those of Wu et al. (2010) and Pituch and Lee (2006). Students seemed to appreciate the active learning paradigm wherein learning is a collaborative social activity (Poelmans & Wessa, 2015).

Several studies have indicated that in a mandatory setting of an IS, irrespective of the quality antecedents, the SQ and IQ would have no or little effect on SU (Iivari, 2005; Jagannathan et al., 2018; Lwoga, 2012; Yakubu & Dasuki, 2018). This study supports this notion, as no significant link was found between SQ and SU, or between IQ and SU. Even though all items utilized in measuring the information construct received high positive scores, IQ did not achieve the expected levels for SS. Other factors, such as instructor support and peer interaction, might have influenced SS more than IQ.

Path	β	р	Remarks
$SQ \rightarrow SS: H_1$	.358	.000	Supported
$SQ \rightarrow SU: H_2$	065	.176	Not supported
$IQ \rightarrow SS: H_3$	.147	.115	Not supported
$IQ \rightarrow SU: H_4$	.145	.149	Not supported
SERQ $\rightarrow$ SS: H <sub>5</sub>	.423	.000	Supported
SERQ $\rightarrow$ SU: H <sub>6</sub>	.320	.019	Supported
$SS \rightarrow NB: H_7$	.604	.000	Supported
$SU \rightarrow NB: H_8$	.275	.008	Supported
$SS \rightarrow SU: H_9$	.471	.001	Supported

Table 11. Standardized Path Coefficients (β)





This study is one of few to have evaluated the performance and quality of a blended-learning model in higher education institutions in the Arabian Gulf region. The findings, therefore, provide greater understanding of blended-learning model functioning and the level of SS with blended learning. This will aid curriculum development and assist relevant stakeholders in the process of resource allocation, adoption, and customization of blended learning. The UAEU, for example, could act on the high level of SS reported in this study by developing a strategy to build a community of learners that enjoys flexible access to academic caring and social interaction. The strategy could be centered around the use of the most appropriate technology to enhance the learning process, stimulate social interaction, and dispel feelings of isolation.

# **Study Limitations**

One limitation of this study is that the courses surveyed were all in the fields of humanities and social sciences. Blended-science courses in such field as physics or mathematics might provide different challenges and could trigger different student feedback. Because of the apparent difficulties of their curricula, they might also trigger the need for more social interaction with instructors.

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