Exploring and Developing an Instrument for Measuring System Quality Construct in The Context of E-Learning

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Abstract
In this study, an instrument for measuring system quality was examined for analyzing the acceptance of the e-learning system in higher education in Jordan. This study thereby obtained twenty-four system quality items from prior studies and different industries, and these were modified according to the e-learning industry. The items were validated by experts, and a pilot study was then executed with 150 randomly chosen students from three Jordanian public universities as participants for this study. Five dimensions (i.e., adaptability, availability, reliability, response time, and usability) were created using the Exploratory Factor Analysis (EFA), and internal reliability was achieved for the five dimensions.
Keywords: E-Learning System, System Quality, Instrument, Measurement.

Perpose of the Study
The main objective of this study:
- To inspect a multidimensional instrument employed in measuring the items related to the system quality construct in context of e-learning system in higher education.

The instrument items were obtained from prior literature and modified to ensure they fit with the purpose of this study. As per the suggestions of Awang (2016), the content validity, criterion validity, and face validity of the instrument were examined. Further, the exploratory factor analysis (EFA) test was implemented to verify its validity and reliability.

Background
Various e-learning structures are available at present. However, it has been challenging to develop a successful e-learning environment. In fact, issues related to the quality of e-learning in the context of higher education in Jordan have become a serious concern. As highlighted by Arkorful (2015), the

quality issues and challenges need to be extensively examined from the viewpoints of learners. Furthermore, effective solutions need to be established to increase the involvement of students.

E-learning has been utilized as a static learning method by the majority of universities in Jordan. Aladwan et al. (2018) reported that the e-learning process in most Jordanian universities involves the use of standardized online materials; students log in to the e-learning system to access studying materials and interact with their teachers. The literature review makes it clear that there are system quality issues that directly affect the students' behaviors toward the system, and several studies have been carried out with the aim to improve the quality of the e-learning system (Pham, Williamson, & Berry, 2018; Alkhawaja & Halim, 2019).

Delone and Mclean (2003) described system quality as the level to which the utilization of a given system is effortless. Accordingly, upon measuring the preferred features of a system, DeLone and McLean (2013) presented five attributes of system quality, namely availability, usability, adaptability, response time, and reliability. Further, Calisir et al, (2015) identified system quality as a key factor for the formation of an effective e-learning system that students can benefit from. Jaber (2016) illustrated that students that have positive attitudes toward the system and advised by their friends to use the system would change their behavior towards the system if they simply lack access to the system and students are expected to be competent in accessing the system at any time and location as well as have the ability to effectively and efficiently use the system. They should be able to quickly download items and perform transactions on the system pages to attain the optimum level of benefits offered by e-learning.

Methodology
Public universities were considered over private universities for this study due to the fact that private universities have better infrastructure and receive funds of private institutions which leaves the public universities with in a weaker situation regarding the e-learning system sophistication. Three Jordanian public universities that represent three regions of the country were randomly chosen. The northern region was represented by Al Yarmouk University, the central region was represented by Al Balqa University, while the southern region was represented by Mua'ta University.

For the EFA, Spielberger and Gorsuch (1983) proposed using a minimum of 100 samples to obtain valid results. For the present study, questionnaires were distributed to a total of 150 students, who were chosen randomly. These students were excluded from the final sample. The questionnaires were randomly distributed and collected. A total of 120 questionnaires were valid to be analyzed.

Instrument
The 24 items included in the questionnaire were equipped with a 10-point interval scale. As explained by Hoque et al. (2017a) and Hoque and Awang (2016b), the 10-point interval scale presents the respondents with more response options that correspond with their specific judgment of a question. The score of 1 denotes "strongly disagree," whereas the score of 10 denotes "strongly agree." The items in the instrument were adapted from past studies. The respondents were also asked to provide demographic details such as age group, gender, university name, current year of education and years of internet experience through the questionnaire.

The items in the questionnaire were comprehensively evaluated for reliability and validity, and for this purpose, experts in the field were sought. As described by Cooper and Schindler (2003), reliability is the degree to which a measure is not afflicted by random errors, and a reliable instrument provides

consistent results, whereas validity is the extent to which a score truly denotes a concept. It can, therefore, be described as the accurateness of the measurement method and indicates the scale's capacity to measure what it should (Cooper & Emory, 1994; Zikmund, 2000). Face validity, content validity, and criterion validity are the three forms of validity evaluation. Specifically, face validity is the degree to which a measure denotes the content of a given concept. Directly linked to face validity, content validity relates to whether a measure includes a descriptive set of items to represent a given concept. As for criterion validity, Zikmund (2000) described it as the correlation level of a measure with other ordinary measures for an exact construct. The instrument's items were evaluated by experts, including associate doctors and professors in social sciences and e-learning.

The Exploratory Factor Analysis (EFA) Procedure
The revised questionnaire was distributed to the 150 randomly chosen respondents for the purpose of collecting data for the pilot study. The EFA was employed using the collected data to discover and measure the dimensionality of the items measuring the construct. Many researchers, such as Awang (2010, 2012), Hoque et al. (2017, 2018), and Yahaya et al. (2018), have stressed that EFA should be employed for every construct to determine if the items will create different dimensions of previous studies . The dimensionality of the items may change if items are adapted from different fields to a new field of study. Furthermore, differences in the cultural background and socio-economic status of the population as well as the lapse in time (duration) between the present and earlier studies may also change the dimensionality. In other words, it is expected that the current study will produce new dimensions, especially that the present study is conducted in a new environment (Awang, 2010, 2012; Hoque et al., 2018).

EfA for the construct System Quality
In the questionnaire for this study, the construct system quality was represented by 24 items. Accordingly, Table 1 show the descriptive statistics for every item measuring the construct. The interval scale from 1 (strongly disagree) to 10 (strongly agree) was employed to give a wide range of options as recommended by (Awang et al., 2016; Hoque et al., 2018; Bahkia et al., 2019). Standard deviation was calculated to understand the data distribution. Standard deviation defines the normal distribution of the data based on the error and variance values to identify the mean. Table 1 shows the mean and standard deviation cuts for each item.

Table 1: The mean and standard deviation for items measuring System Quality Construct

	Item Statement	Mean	Std. Deviation
SQ1	It is easy to communicate with my teacher through the e-learning system.	9.46	.709
SQ2	It is easy to communicate with other students through the e-learning system.	9.26	.680
SQ3	The e-learning system allows to download files.	9.43	.683
SQ4	The e-learning system allows to upload files.	9.28	.724
SQ5	The e-learning system is flexible in addressing needs.	9.43	.683
SQ6	The e-learning system can be adapted to meet variety of tasks.	9.27	.733
SQ7	The e-learning system can be used anywhere	9.43	.682

SQ8	The e-learning system is available at any time of the day.	8.92	.842
SQ9	The e-learning system allows me to access the needed information whenever I need to.	8.84	.789
SQ10	The e-learning system make Information more easy to access.	8.83	.967
SQ11	The e-learning system is always available.	9.10	.771
SQ12	Course materials are quickly accessible through the e-learning system.	8.83	.984
SQ13	The e-learning system content loads quickly.	8.58	.958
SQ14	The e-learning system enables quick interactive communication.	8.50	.879
SQ15	The response time of the e-learning system is consistent.	8.62	.900
SQ16	The e-learning system is reliable.	8.77	.974
SQ17	The operation of the e-learning system is dependable.	8.61	.823
SQ18	The e-learning system consistently provides good services.	8.85	.847
SQ19	The e-learning system operates sufficient features.	9.00	.944
SQ20	It is easy to navigate the e-learning system.	8.91	.879
SQ21	The e-learning system is user-friendly.	8.97	.798
SQ22	The size and resolution of the e-learning system interface is good.	9.05	.818
SQ23	The e-learning system's functions are considered to be satisfied.	9.01	.783
SQ24	It is easy to navigate the e-learning system.	9.17	.771

As indicated by the results in Table 2, Bartletts' test of sphericity was significant (p-value < 0.05). Furthermore, the Kaiser–Meyer–Olkin (KMO) measuring the adequacy of sampling has exceeded the required value of 0.6 (Awang, 2010, 2012; Hoque et al., 2018; Bahkia et al., 2019). Accordingly, the achieved results of the two tests (Bartlett's test significance and KMO > 0.6) indicate that the data is adequate for data reduction procedure.

Table 2: The KMO and Bartlett's Test Score

KMO and Bartlett's Test			
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.			.859
Bartlett's Test of Sphericity	Approx. Chi-Square		1710.815
	Df		276
	Sig.		.000

Figure 1 specifies the components that emerged from the scree plot in EFA procedure. This procedure resulted in grouping the 24 items into five components. Each component represents a set of measuring items. According to (Awang, 2010, 2012; Hoque et al., 2018), The rotated component matrix will specify which item belong to which component.
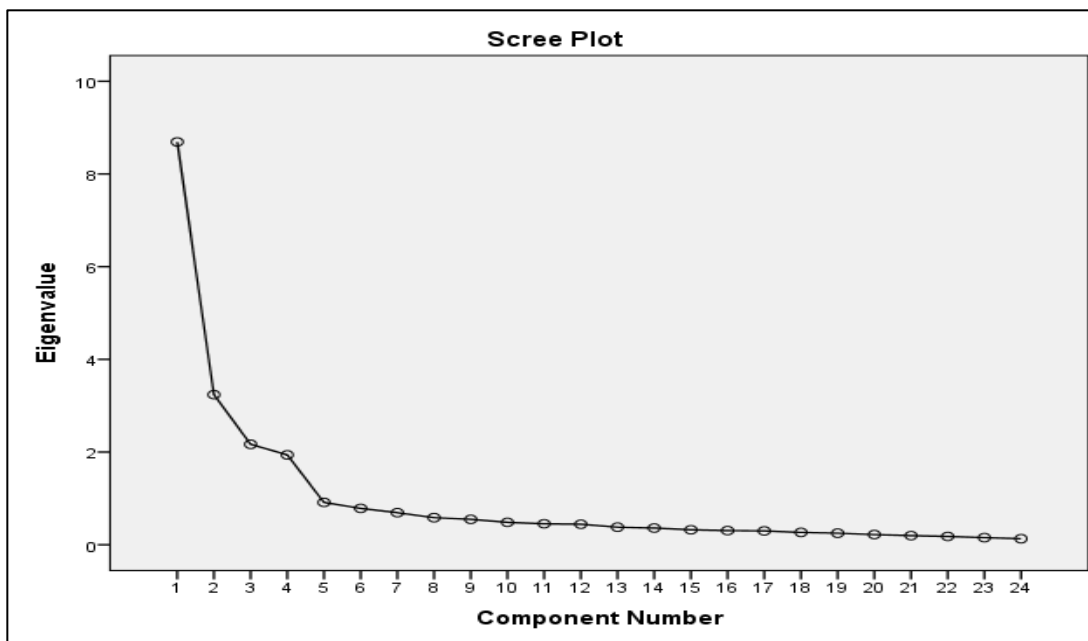
Figure 1: The Scree Plot shows five components emerged from the EFA procedure

Dimensions and Total Variance

Results given in Table 3 show the five components that are greater than 1.0 that emerged from computing eigenvalue. The values extended between 1.352 and 8.7.688. Meanwhile, the explained variance for the first component was 32.0325%, 46.804% for the second, 56.014% for the third, 63.871% for the fourth, and 69.503% for the fifth. The total explained variance upon measuring this construct was 69.503%, which was acceptable, as it exceeded the least possible requirement of 60% (Awang, 2010, 2012; Hoque et al., 2017, 2018; Yahaya et al., 2018 and Bahkia et al., 2019).

Table 3: The Total Variance Explained for the Construct

Total Variance Explained						
	Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Compon ent	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.688	32.032	32.032	7.688	32.032	32.032
2	3.545	14.772	46.804	3.545	14.772	46.804
3	2.211	9.211	56.014	2.211	9.211	56.014
4	1.886	7.857	63.871	1.886	7.857	63.871
5	1.352	5.632	69.503	1.352	5.632	69.503
Extraction Method: Principal Component Analysis.						

The extraction method of Principal Component Analysis (PCA) with VariMax (Variation Maximization) rotation was implemented on the 24 items. The five components and their respective items that were obtained from the EFA procedure are presented in Table 4. The required factor loading for an item to be retained should be greater than 0.6, items with lower factor loadings would be deleted (Awang,

2010, 2012; Yahaya et al., 2018; Bahkia et al., 2019). However, as Table 4 shows, all the factor loadings for the rotated items are greater than 0.6.

Table 4: The components and their respective items

Rotated Component Matrix[a]

	Component				
	1	2	3	4	5
ADA1	.855				
ADA2	.798				
ADA3	.838				
ADA4	.755				
ADA5	.794				
ADA6	.789				
AVA1			.680		
AVA2			.768		
AVA3			.778		
AVA4			.744		
AVA5			.797		
RST1					.726
RST2					.812
RST3					.785
RST4					.782
REL1				.684	
REL2				.762	
REL3				.810	
REL4				.786	
USA1		.741			
USA2		.705			
USA3		.788			
USA4		.813			
USA5		.774			

Extraction Method: Principal Component Analysis.
a. Rotation converged in 6 iterations.

The combined items performed five components. Namely, Adaptability, Availability, Response time, Reliability and Usability. The 24 items were retained due to high factor loading (>0.6).

The Instrument Internal Reliability
Finally, the internal reliability of the retained items was computed through the Cronbach's alpha value. The internal reliability specifies the effectiveness level of a particular set of items in measuring the respective construct. The threshold value of Cronbach's alpha for the items to achieve internal reliability is greater than 0.7 (Awang, 2010, 2012). Table 5 presents the Cronbach alpha score for each component.

Table 5: The Internal Reliability for the Construct

Component	N of Items	Cronbach's Alpha
Adaptability	6	0.914
Availability	5	0.844
Reliability	4	0.854
Response Time	4	0.875
Usability	5	0.849
All items	**24**	**0.904**

The items were all found to be internally reliable, as their Cronbach's alpha scores exceeded 0.7.

Conclusion

The present study contributes to the measurement of the system quality construct, particularly in the context of e-learning field in Jordanian universities. five dimensions of system quality were extracted: adaptability, availability, reliability, response time, and usability. Further, these dimensions were measured using 24 items, and the reliability measures for the five dimensions/components of system quality resulted in high Cronbach's alpha values, thereby meeting the Bartlett test requirements (significant), satisfactory KMO scores (> 0.6) and factor loadings that exceeded the minimum value of 0.6. The obtained results showed that the considered items were applicable for this study. The severe scale improvement and validation measures for this study ensure that the novel system-quality instrument is internally consistent and stable crosswise the sample.

Contribution

This study contributes to the field of e-learning system by evaluating and testing items that fit for testing the construct system quality in context of e-learning system. a novel survey was developed and validated. this instrument is a methodological contribution for the field. Items were adapted from diverse fields and modified to fit the field of e-learning system. The instrument has been validated through face validation, content validity and reliability.
Researchers in the field of e-learning system can use this survey in different locations and different levels of population.

Recommendations

This instrument is recommended to be used among the information system field, specially e-learning system. Additionally, it is recommended for future studies in the field of e-learning to measure different items and more questions that can explain different components of the construct system quality. Moreover, the output of this investigation can be expanded by implementing this instrument in different fields of knowledge and test in in additional populations and diverse industries. As this study targeted students of public universities, it is recommended to adopt this instrument and investigate the outcome in private universities in Jordan or even to use it in different countries. Another recommendation for future work is to utilize a different analysis tools to analyze the instrument of this study and compare the output.

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