Evaluation of the Feasibility and Usefulness of the LMS Acceptance Questionnaire: Technology Confirmation During the Covid-19 Pandemic in Medical Students Users in Iran

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Abstract

Background: Technology acceptance comprises cognitive and psychological elements about using technology.

Objectives: This descriptive study evaluated the feasibility and applicability of the LMS acceptance questionnaire in medical sciences students using native LMS during the COVID-19 pandemic.

Methods: This study was conducted to assess LMS acceptance and the validity of the questionnaires in Iranian society. Ten faculty members and ten students reviewed and evaluated the questionnaires for the validity of translation (content validity). Exploratory and confirmatory factor analysis methods were used for questionnaire items to determine the constructive validity. Moreover, a technology acceptance questionnaire was distributed among 200 users to determine the convergence validity. Finally, the reliability of the questionnaire was assessed by 30 people before, after, and simultaneously.

Results: The results of this descriptive study showed that the average scores of people in finding helpful content for lessons, having a support system for problem-solving, and being convenient to use were high. In another part, confirmatory factor analysis confirmed the criteria and items by four factors. Test reliability on 30 students before and after showed that the questionnaire has good reliability in all factors. Convergence validity with the technology acceptance questionnaire showed that there was a direct and positive relationship.

Conclusion: The four factors questionnaire, which comprised performance expectations, effort expectations, facilitative situations, and social influence, with feasibility, and usability, can be used as a valid questionnaire in an Iranian population.

Keywords: LMS, Usability, Feasibility, Validation, Iran, Medical education, Active learning

Background

The third millennium has exposed man to challenging terms, such as the century of speed and change and the age of information and communication. An era that is considered a powerful platform and tool that can have tremendous economic, social, cultural, and political impacts (1). In the third millennium, human is trying to accelerate the development and use of information technology in different aspects of life in terms of distancing from traditional models and creating a new model per the requirements of the information age (2, 3).

Integrating Information Communication Technology (ICT) into the learning process facilitates communication and access to a wide range of learning resources, provides a curriculum tailored to the learners' needs, ensures equitable opportunities for all learners, and promotes social and cultural development of communities through widespread internet access (4). One of the characteristics of electronic learning is the provision of the potential for learning at any time and place. This advantage enabled information to transform education in the all users and extend the main knowledge (5).

Today, numerous shortcomings of the face-to-face education system have led to the development of various educational methods exploiting information and communication technologies (6). It is necessary to plan for the development of new technology, secure the positive attitude of managers towards this technology, equip training workshops, and create a suitable atmosphere for the use of this technology (7, 8). Based

on several studies, various models and methods have been used to investigate factors affecting the adoption of information technology.

The Framework for the Rational Analysis of the Mobile Education model (FRAME) describes how mobile technology, human learning capacities, and sociocultural factors interact and the processes involved in virtual learning (9, 10). One of the most valid models is the Technology Acceptance Model (TAM), which examines factors at an individual level. The TAM model is used for different technologies in different situations with varying control factors and diverse statistical populations (11). The acceptance technology model is based on acceptance information systems. It is determined by two main variables: mental perception of usefulness and mental perception of ease of use (12, 13) (Figure 1).

Technology in educational environments facilitates every step of the training process (course design, classes, and assessment) (14, 15). learning management system (LMS) is an example of such technology (16-18). LMS is an integrated management tool and system for teaching content management, monitoring learners and teachers, customized learning and teaching processes, and a software program for managing learning activities. Malikowski (2007) used a three-tier structure based on the frequency of the use of LMS to group system user interaction. They found that LMS was mainly used to convey content to the learners. In this context, files were uploaded to the learning environment, learning content was transferred to the system, announcements were made, and students' progress level was assessed (19). LMS systems play an undeniable and important role in education (20). To achieve the optimal use of these technologies in educational environments, students should have a positive attitude, belief, and intention toward them. The relevant literature shows that the use of technology is related to the beliefs, attitudes, and goals of potential users (21).

LMS has several functions: sharing educational materials, discussing, managing classes, assigning assignments or tasks, holding exams, receiving feedback, arranging learning materials, keeping records of students and teachers, and creating a reporting system. LMS systems are potential tools in education with the following advantages. LMS systems improve the effectiveness of education (22, 23), learning (24), interaction (25), performance (26, 27), motivation (28), and communication in students (29) and facilitate their wider use. Using different models of technology acceptance, several studies on LMS acceptance have examined the acceptance of these technologies at various academic levels (30).

Due to the innovative nature of e-learning in Iran and many other countries, it is essential to examine its related challenges. On the other hand, the Covid-19 crisis and its circumstances have influenced education and quality. Exploring the tools and infrastructures of virtual education and its application in local environments and their usage can be considered essential issues in any country, highlighting the importance of their evaluation.

Objectives

The aim of this study was evaluation of the Feasibility and Usefulness of the LMS Acceptance Questionnaire in Medical Sciences Students Technology acceptance in e-learning during the Covid-19 pandemic in Iran.

Methods

To answer research questions about evaluating the feasibility and application of the LMS acceptance questionnaire in medical sciences students, a national LMS (Navid LMS in the web address of jumsnavid.ac.ir) was used. This research was a descriptive study by consensus sampling on LMS users at Jahrom University of Medical Sciences. As mentioned above, the first part of the study analysis was followed by descriptive analysis. Items were analyzed for their means and variance of main dimensions. The second part of the study was the validation of the questionnaire (Figure 2).
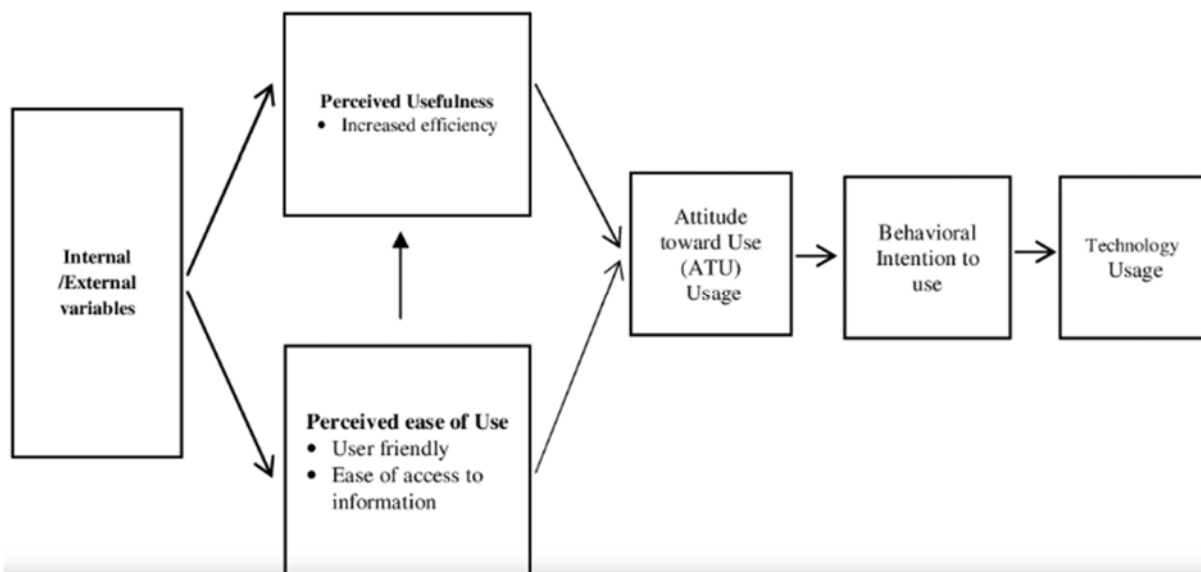
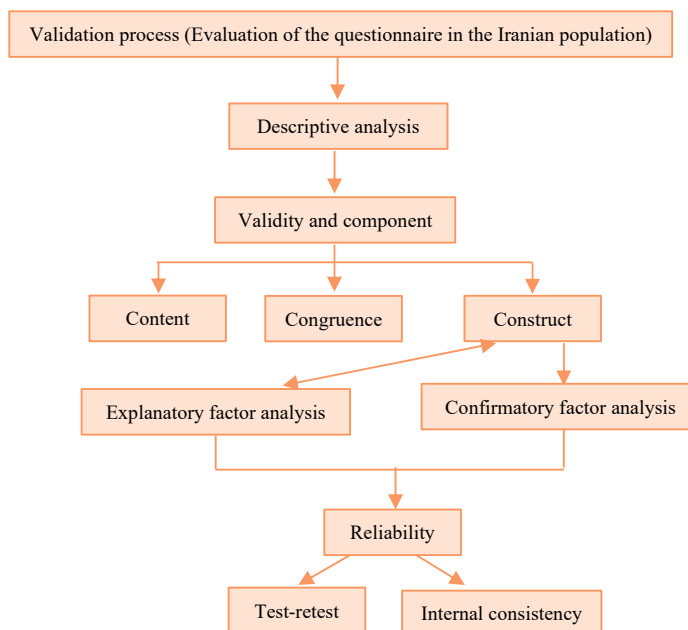**Figure 1.** Technology acceptance model and elements

Figure 2. Study design and process

We proceeded with this study with item analysis of the questionnaire by assessing validity (content, concurrent, and construct). Construct validity was followed by exploratory factor analysis (EFA), confirmatory factor analysis (CFA), and then reliability tests. The 21 items of the questionnaire Learning Management System Acceptance Scale (LMSSAS) were analyzed.

EFA followed by Bartlett sphericity fest and the KMO index for the suitability of factor analysis in the study. Then Scree plot diagram assessed the number of questionnaire factors after adjustment for Iranian society.

The principal axis factoring method with varimax rotation was used in EFA, and the Eigenvalue of 1.00 was considered to determine the number of factors/dimensions. The threshold factor loading of 0.40 was chosen.

CFA was also followed by a confirmatory factor analysis on the questionnaire (relationship between each item and dimension/item with overall score/domain

factor load and calculating the overall variance of the questions).

Reliability was checked on 30 students to evaluate the reliability of the questionnaire in the pretest-posttest and the correlation between them for internal consistency. A relationship higher than 0.50 was considered an acceptable correlation for reliability.

Ethical consideration: All ethical considerations were adhered to in this study.

Users were not forced to complete the questionnaire.

Participants completed the online questionnaire quite willingly. No credits or merits were considered for participation. The proposal of this study was approved by the ethics committee with the registration number (IR.JUMS.REC.1399.087).

Learning management system acceptance scale (LMSSAS): LMSAS consists of 21 items. A scale ranging from *strongly disagree* to strongly agree was chosen as the response format. The total score on the scale varied between 21 and 105. Higher scores on the scale indicated high levels of LMS acceptance among students.

Questionnaire areas included: performance expectancy, effort expectancy, facilitating conditions, and social influence (31).

Participants: All users of Navid (National LMS) in the web address of (jums.navid.ac.ir) were included in this study in the departments of medicine (two courses), health (two courses), and laboratory sciences by consensus sampling.

Validity

Content validity (cultural): This study aimed to standardize the LMS acceptance questionnaire. The following steps were taken to evaluate and standardize the questionnaire. Content validity, including translation and retranslation, was conducted by a researcher and reviewed by an English expert. Ten faculty members reviewed the questionnaire for translation validity, and ten students ensured fluency and comprehensibility of the translation.

Construct validity: explanatory factor analysis: Exploratory factor analysis was performed to investigate domains and items in an Iranian population.

Firstly, the Bartlett sphericity test and the KMO index were calculated to determine the suitability of factor analysis in the study.

The size of the Kaiser test was at least 0.6. The values of the test (0.78) and Bartlett test ($\chi2 = 766.28$ $p = 0.000$) indicated that the completed questionnaire was suitable for factor analysis.

Then Scree plot diagram assessed the number of questionnaire factors after adjustment in the Iranian society. The principal axis factoring method with varimax rotation was used in EFA, and the Eigenvalue of 1.00 was considered to determine the number of factors/dimensions. The threshold factor loading of 0.40 was set. Finally, all dimensions and factors were extracted from Iranian society.

Investigation of domains and items in terms of the possibility of application, feasibility, and usefulness in the Iranian sample (approval factors and items or reducing and correcting it) was conducted.

Confirmatory factor analysis: A confirmatory factor on the questionnaire (relationship between each item with dimension/item with overall score/domain factor load and calculating the overall variance of questions) was performed.

Congruent validity: Congruent validity evaluation was performed with the Technology Acceptance Questionnaire as a valid and reliable questionnaire in the Iranian population. The technology acceptance questionnaire was used to assess convergence. This questionnaire was standardized in Iranian society. The scoring of the questionnaire was as follows:

Electronic learning acceptance is the score that respondents give to an 11-item electronic learning acceptance question in 5 continua (strongly agree to disagree strongly)

The scoring of the questionnaires was as follows:

Analysis (Interpretation) based on the score of questionnaires. The score was collectively obtained in this T-analysis method and then marked based on the table below. Note that the following scores are for the questionnaire. For example, if you have ten questionnaires, you should multiply the following scores by 10.

The minimum score will be 11, and the maximum score will be 55.

- Score between 11 and 18: The acceptance rate of e-learning is low

- Score between 18 and 37: The acceptance rate of e-learning is moderate

- Score above 37: e-learning acceptance rate is high (13, 15).

Reliability

The sample size for reliability testing should be at least 5 to 10 people per item. A questionnaire was distributed among 200 students by the census. Due to the drop in the questionnaires and the number of respondents, 170 questionnaires were used as an online open test on 30 students to evaluate the reliability of the questionnaire in pre-test- post-test, and the correlation between them for internal consistency and stability was analyzed. Relationships higher than 0.70 were considered an acceptable correlation for reliability (32, 33).

Results

The questionnaire was distributed among 200 students by census sampling. Due to the drop in the questionnaires and respondents, 170 questionnaires were used online. Different groups and disciplines participated in this study. Medical / public health/laboratory sciences with three groups of two entrances participated in this study. Medical students were in three groups (120 people), the field of laboratory sciences with two groups (35 people), and the rest were public health groups. Among them, 58.4% were women, and the rest were men.

Explanatory Factor Analysis (EFA): In the first stage, all items of the questionnaire were analyzed. Factor load and descriptive results showed that due to the high factor load of each item with a high value of 0.3, all items could be analyzed, and none were deleted. SPSS 18 was used for the analysis of the data Analysis based on the components of the questionnaire.

Table 1 shows that the average score of people in finding useful content for lessons, the existence of a support system in problem-solving, and ease of use were the highest levels required. It was easy to start working with LMS, people had higher prestige in using it more effectively in LMS, and their peers thought that more individual efficiency in LMS had lower average scores. The total item predicted 64.39 % of the variance.

The diagram shows four factors in the diagram that can be considered as a factor (Figure 3). These four factors were extracted in the exploratory factor analysis section and were included in other analyses.

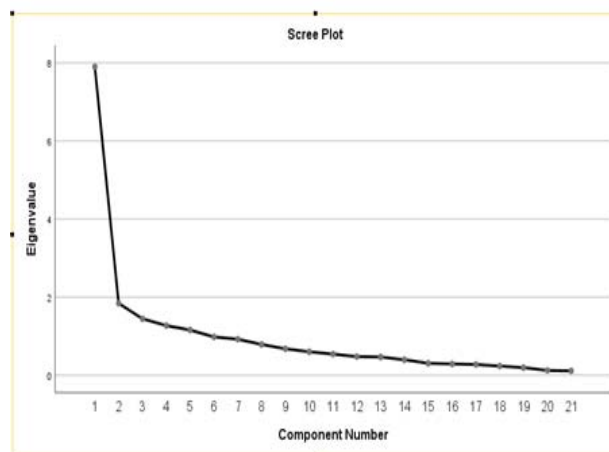Extraction Method: Principal Component Analysis.

Figure 3. Scree plot diagram on several questionnaire factors after adjustment for the Iranian population.

The size of the Kaiser test was at least 0.6. The values of the test (0.78) and Bartlett test ($\chi2 = 766.28$ p = 0.000) indicated that completed questionnaires were suitable for factor analysis (31).

Four factors were extracted in EFA and included in CFA. A confirmatory factor analysis examined the items in the target community. In the first part, descriptive analysis and in the second part, the relationship and coherence of items were examined. All dimensions had high mean averages.

Table 1. Descriptive analysis and factor loading of each questionnaire item

	Questions	Mean (SD)	Factor loading
1	Using an LMS in my courses enables me to accomplish tasks more quickly.	3.306 (1.05)	0.817
2	Using an LMS in my courses improves my performance.	3.321(0.97)	0.835
3	Using an LMS in my courses improves my productivity.	2.874(0.98)	0.689
4	Using an LMS in my courses improves my motivation.	3.024(0.92)	0.811
5	Using an LMS in my courses makes it easier to do my homework.	3.291(1.13)	0.816
6	Using an LMS in my courses improves the quality of the work I do.	3.323(1.25)	0.703
7	I find using an LMS in my courses applicable.	3.719(1.20)	0.607
8	Using an LMS in my courses enhances the effectiveness of the learning process.	3.251(1.18)	0.763
9	I find learning how to use an LMS easy.	2.273(1.02)	0.558
10	I can easily use an LMS	3.512(1.29)	0.814
11	I can accomplish tasks more quickly when I use an LMS.	2.893(1.23)	0.604
12	I feel comfortable when using an LMS.	2.922(1.18)	0.754
13	I can do anything I want using an LMS.	2.921(1.10)	0.694
14	I have the required information to make effective use of an LMS.	3.034(1.16)	0.781
15	There are people I can turn to for support when I have difficulty using an LMS.	3.149(1.21)	0.803
16	Using an LMS is similar to using other computer systems.	2.946(1.15)	0.683
17	When using an LMS, I know whom to ask for help to solve problems I encounter.	3.46(1.35)	0.773
18	The help function of an LMS is sufficient to solve the problems I encounter.	3.36(1.20)	0.757
19	People around me think I need to use an LMS effectively.	2.16 (1.30)	0.675
20	My effective use of an LMS increases my prestige among fellow students.	2.45(1.17)	0.623
21	Friends of mine who make effective use of an LMS have more prestige.	2.04(1.08)	0.795
	% variance explained (total = 64.39)	3/00(1.07)	0.817

Mean and SD of all dimensions concluded: Performance expectancy 25.21 (6.55), effort expectancy, 13.92 (3.49), facilitating conditions 15.77 (3.72), social influence, 7.67 (2.36); the number of question in each dimensions was 8,5,5,3 questions, respectively.

Based on the above table and considering the load and variance factor of the items, it was found that there were four factors in compiling items that explain the factor load of the questionnaire (Table 2).

Results from EFA showed that four factors in compiling items explain the factor load of the questionnaire. The study's results (validity) showed that all factors were related to the questionnaire. Results showed that all four elements positively correlate with the total test and other items (Table 3).

Table 2. Factors of the questionnaire with varimax rotation to identify factors

Factors	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	10.62	44.28	44.28	10.62	44.28	44.28	60.05	25.22	25.22
2	2.53	10.55	54.83	2.53	10.55	54.83	3.67	15.30	40.52
3	2.00	8.35	63.19	2.00	8.35	63.19	3.21	13.82	54.34
4	1.33	5.57	68.76	1.33	5.57	68.76	2.79	11.63	65.97
5	1.29	5.39	74.16	-	-	-	-	-	-
6	0.96	4.02	78.19	-	-	-	-	-	-
7	0.96	4.00	82.19	-	-	-	-	-	-
8	0.64	2.68	84.88	-	-	-	-	-	-
9	0.55	2.29	87.17	-	-	-	-	-	-
10	0.42	1.77	88.95	-	-	-	-	-	-
11	0.39	1.64	90.60	-	-	-	-	-	-
12	0.34	1.43	92.03	-	-	-	-	-	-
13	0.30	1.26	93.30	-	-	-	-	-	-
14	0.26	1.09	94.39	-	-	-	-	-	-
15	0.23	0.95	95.35	-	-	-	-	-	-
16	0.21	0.88	92.24	-	-	-	-	-	-
17	0.19	0.80	97.04	-	-	-	-	-	-
18	0.15	0.65	97.69	-	-	-	-	-	-
19	0.15	0.63	98.32	-	-	-	-	-	-
20	0.11	0.47	98.79	-	-	-	-	-	-
21	0.08	0.36	99.16	-	-	-	-	-	-

Convergence validity: The study showed that there was a direct and positive relationship between the LMS acceptance questionnaire and the technology acceptance questionnaire, although the statistical values were not significant (r = 0.45, p = 0.39).

Reliability: The internal consistency of the questionnaire in each dimension was good, with Cronbach's Alpha coefficient (0.89). Moreover, the reliability of the test before and after in 30 students showed that the questionnaire had good reliability in all factors on test-retest. This relationship between the two-part was (0.82) (Table 4).

It can be concluded that the questionnaire with four factors of performance expectations, effort expectations, facilitative situation, and social influence was valid in Iranian society.

Discussion

The results showed that the questionnaire with data validity and reliability, including four areas, can be used in the Iranian population.

Considering the increasing use of technology in education, it is necessary to examine its level of acceptance in Iranian populations and justify its use in Iranian society (34, 35). LMS is used as a distance learning method (36). Several studies have demonstrated that using LMS in higher education can increase students' motivation and attention, provide a more flexible learning environment, and enable better management of learning-teaching time. It also helps facilitate electronic learning that provides educational material without the constraint of time or place (37-39)

All the above findings confirmed the importance of technology acceptance and relative components in all cultures.

The existing literature suggests that the acceptance of LMS among students in higher education vary from country to country (40). Arab universities in the Middle Eastern region have recorded low levels of electronic learning acceptance (41). In contrast, a high acceptance rate of the electronic learning system is reported in Western countries (42).

Considering virtual education's novelty and wide use in the Covid pandemic, it is necessary to examine the

different dimensions of technology acceptance and its effects in Iran.

Considering the obtained results, it seems that students of medical sciences have accepted this technology in

Iran based on the factors analyzed in this study. These results were confirmed in other countries in Asia (41).

Table 3. Relationship between factors and technology acceptance questionnaire in the samples

Dimensions	PE	EE	FS	SI	Total
Performance expectations	1	*0.747	*0.789	*0.654	*0.918
Effort expectations	*0.747	1	*0.748	*.549	*0.870
Facilitative situation	*0.789	*0.74	1	*0.80	*0.94
Social influence	*0.65	*0.54	*.80	1	*0.83
Total	*0.91	*0.87	*0.94	*0.83	1

PE: Performance Expectation, EE: Effort Expectation, FS: Facilitative Situation, SI: Social Influences
*P<0.05

Table 4. Examination of the reliability of the test by two indicators

Factors	Cronbach's alpha	Test-retest reliability
PE	0.88	0.86
EX	0.87	0.76
FC	0.83	0.82
SI	0.89	0.72

PE: Performance Expectation, EE: Effort Expectation, FS: Facilitative Situation, SI: Social Influences

Technology acceptance models have similar criteria for acceptance and use (4). Other models confirmed factors extracted in this study.

The technology measures people's willingness and intention to use based on perceived usefulness, perceived ease, and behavioral intention to use (11, 12).

Many criteria in this model were similar to the LMS acceptance model.

Another model was the unified theory of acceptance and use of technology (UTAUT Model). The four essential elements defined in this model (hope for performance, hope for effort, facilitation of conditions, and social influence) determine behavioral intention for using this model (43). Also, in this technology acceptance model, LMS acceptance elements (hoping to try, social influence, and functional expectations) are considered.

Some of these factors are similar to the LMS acceptance model in recent research.

Regarding models employed in LMS studies in SSA, the Technology Acceptance Model (TAM) was the most dominant framework used by researchers. UTAUT was the next, in terms of frequency of usage, in the LMS-related reviewed studies (43, 44).

TAM was the dominant model employed, and students were the main subjects of studies. Moreover, the quantitative approach was the preferred design, with regression as the primary statistical tool for data analysis. The study recommended, among others, that more UTAUT or TAM3-based studies employing mixed method design with instructors as subjects, using

structural equation modeling analysis, are needed in LMSAS research. Leadership and top management of higher education institutions should focus more on ICT infrastructure, LMS usage skills/training, LMS quality-related issues, support, and ICT policy formulation (43, 44).

A systematic review of 31 studies revealed key determinants of LMS acceptance/adoption: attitude and perceived usefulness followed by performance expectancy, perceived ease of use, and social influence (45).

Significant challenges to LMS implementation were ICT infrastructure, LMS usage skills and training, LMS system quality, and LMS use policy and management support.

The above research results can be seen in the current questionnaire with four factors (performance expectations, search expectations, facilitation measures, and social influence). It was demonstrated that instructors' belief about technology needs to be understood to support the complex interrelationships between students and the general educational setting (46). Also, instructors' and students' behavioral intentions to use LMS are examples of specific functional environments and social intervention factors. To enhance an information system's effectiveness and ease of use, end users may only utilize the system after they have been motivated by essential others, which later influences their attitude and behavior (47).

These results emphasized the similarity of items/dimensions and indicators from technology acceptance models with LMS acceptance. All Dimensions extracted by this study were similar to other countries in the Region, and congruent models confirm this.

Some essential factors in the LMS acceptance questionnaire are individual motivation, social influence, and functional expectations, which are also observed in this realization. Also, a positive impact on perceived ease of use is essential. Users' perception of the ease of LMS use determines how the system is practical

for them. Later, other factors convince them to accept it (48, 49), such as policy comprises goals, values, and resources that institutions are eager to commit to LMS implementation (50).

It is recommended that this study should be conducted in other universities and multi-central universities to investigate the effects of virtual learning infrastructure in these environments. Also, this research can help policy maker in planning in this regard.

Conclusion

It can be concluded that this questionnaire with four components can be used as an indicator of LMS acceptance in Iran. The rate of accepting new technologies in education is acceptable. It is noteworthy that qualitative studies on the extent of acceptance of the questionnaire have been performed on other users, and researchers also considered Iranian samples.

Conflict of interests: None to declare.

Ethical approval: Proposal extracted from this paper confirmed by ethical committee in Jahrom University of Medical Sciences.

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