


Efficiency Evaluation of E-Learning Courses at Payam Noor University Based on Learning Usability Criteria

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ABSTRACT

Background: The aim of this study is to evaluate e-learning systems at Payam Noor University (PNU) based on learning usability criteria.

Methods: This was an applied research in terms of purpose and a descriptive survey in terms of data analysis. The statistical population included 2600 undergraduate and graduate students at the Shahriar branch of PNU using e-learning methods in 2019-2020 academic year. The sample size was estimated using Morgan table. A total of 335 participants were selected through stratified sampling. The validity of questionnaire was verified by consulting 25 experts in distance education using Delphi method, and the reliability of the total questionnaire, as measured by Cronbach's alpha, was found to be ($\alpha=0.73$). Statistical analysis was conducted using SPSS 26.

Results: In the e-learning courses offered by PNU, the components of "visibility", "flexibility", "course management", "accessibility", "consistency and functionality", "memorability", "completeness" and "aesthetics" are in a favorable situation ($P<0.001$). However, the components of "error prevention", "interactivity, feedback and help", "assessment strategy" and "reducing redundancy" are not in a favorable situation ($P>0.05$).

Conclusion: Educational institutions should not merely focus on content in their design of e-learning courses. They should also incorporate interactive and group exercises so that students can understand educational materials, and actively and creatively engage in the learning process based on their personal experiences.

Keywords: Efficiency, E-learning, Usability, Payam Noor University

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Introduction

For years, universities have strived to determine whether electronic learning can be introduced as a novel technology in higher education. E-learning can be considered synonymous with terms such as web-based learning, online learning, internet-based learning, and virtual learning (1). E-learning can be defined as a process of teaching and learning, supported by information and communications technologies, in which there is no need for in-person meetings between teachers and learners. In fact, e-learning aims to provide a learner-centered learning process that is temporally and spatially flexible and interactive. Furthermore, e-learning is defined as an innovative approach that applies different digital technologies to develop a free, flexible, and distributed education system in line with other forms of educational environment, and provides anyone anywhere anytime with a well-equipped, well-designed, interactive, and learner-centered learning environment (2). In fact, e-learning refers to an education system in which teachers and learners communicate with each other via the devices and tools provided by technology (3). Holmes and Gardener (2006) believe that e-learning means benefiting from ICT technologies such as the Internet, media, and hypermedia systems to improve the quality of education by facilitating access to education sources and services, and providing certain mechanisms such as remote interaction and participation (4). This new paradigm has in fact transformed teacher-centered education into learner-centered education (5). E-learning has become popular and important because of distinct advantages such as cost reduction, elimination of temporal and spatial limitations, and support for conventional education (as a supplement) (6, 7).

It should be noted that e-learning projects have developed so fast that some of them have failed. Many of the famous and extensive leading projects have failed, as confirmed by a few studies analyzing the failure of e-learning courses (8). For instance, the Forster Group surveyed 2000 attendees of e-learning

courses held by 40 different companies and realized that 68% of employees were not willing to enroll in continuous courses except for those who had to pass those courses. Moreover, 30% of the employees who had to pass the courses avoided enrolment (9). According to another study, 50-80% of the individuals enrolling in continuous courses never succeeded in completing them. In other words, the failure rate of electronic courses has been reported to be much higher than that of the in-person courses. Moreover, Erhel and Jamet (10) reported a survival rate of lower than 50% among the students participating in e-learning courses, whereas Berge and Huang (2004) reported a 60-65% survival rate (7). These results indicate that although e-learning can bring about specific advantages to facilitate the educational interaction and enrich the learning environment by providing more learning opportunities and improving accessibility, special attention should be paid to its implementation, which can be successful through the analysis of previous experiences. Over the past decade, PNU has been one of the universities that have made great efforts in preparing information and communication technology subsystems. It is a distance learning institution that tries to ensure that its educational solutions meet the demands of the 21st century. It creates an electronic educational system within the current system to realize the objectives of the University and also to uphold its motto of providing higher education for all people, in all places, and at all times, and thereby to prepare adequate opportunities for learners. Since the use of the latest technologies would be in vain without assessing the principal learning components correctly, it is essential to evaluate the efficiency of e-learning courses before designing and developing them (11). Evaluation is an indispensable part of every education system and an effective and critical activity in the education process (12). Identifying the factors that are conducive to the effectiveness of e-learning systems can help education institutions adopt appropriate policies and invest in effective factors while

eliminating the ineffective ones (13).

According to the research literature, various studies have evaluated e-learning systems from different aspects, among which usability of e-learning systems is a rather neglected one. Usability can be defined as ease of use, referring to the ease with which a person can handle a system. In this regard, computer system quality measurement techniques were discussed under the title of ergonomics and ease of use for a few decades, after which they were introduced as usability. In addition, usability has been defined as the degree to which an application can be learned, allowing users to achieve the determined goals efficiently, effectively, and satisfactorily (14). There are also other terms describing the concept of usability such as applied quality (an ability that is easily and efficiently put to use), efficiency, efficacy, and the final quality factor for software developers. International Organization for Standardization (ISO), defines usability as the extent to which a product is used by specified users to achieve specified goals with efficiency, effectiveness, and satisfaction in a particular context. Therefore, usability can be defined as a factor by which users can easily and thoroughly communicate with a specific system. In this respect, Karahoca et al. (15) analyzed the effect of cognitive abilities and personal differences in evaluating the usability of an e-learning portal. According to their results, the usability of every software program is related to cognitive abilities and personal differences of users in addition to their needs. Their results also indicated a high correlation between the grade point average (GPA) and usability. Fernandez et al. (16) analyzed the methods of evaluating the Web usability. Their results showed that the user evaluation method was employed more extensively (16). In a study entitled *E-Learning Preparation Evaluation Model: A Case Study of Higher Education Centers in Uganda*, Onyat and Logba concluded that an appropriate e-learning preparation evaluation model for the top eight Ugandan universities had to consider knowledge, culture, technology, pedagogy, and content (17, 18).

In Iran, many studies have evaluated e-learning from different perspectives. Esmaeeli et al. (19) concluded that e-learning status was favorable in terms of learners' traits, infrastructure, and technology, while relatively favorable in support, and unfavorable in education content and evaluation. In her evaluation and comparison of e-learning courses offered by PNU and other selected universities across Iran and worldwide, Khatib Zanjani (20) concluded that PNU was significantly different from other studied universities in Iran and the selected countries in terms of history, number of students, number of majors, policies and standards, administrative departments, evaluation type, assignment presentation type, dropout rate, free courses, single-subject and short-term courses, and e-learning types and methods. Amanzadeh and Namanov (21) argued that learning based on novel education technologies had significant effects on students' life skills and that the effects were not different in terms of gender. Anarnejad and Mohammadi (22) performed an organizational and program evaluation of e-learning at universities and higher education institutes. According to their results, universities were in adequate conditions in the areas of presentation, environmental design, management, educational aspects, and organizational affairs; however, they were not well-prepared in the areas of support services, ethical considerations, technology, and assessment. Zeytoonli and Rezaei Soufi (2016) revealed that the cyberspace was accessible to the students studying at PNU and that students' activities in academic presentation were in a favorable condition (23). Regarding the evaluation of e-learning efficiency in human resources training, Tseng et al. (24) realized that students did not have appropriate educational content and that the exercises and assignments were inadequate for users, although they enjoyed relatively good support.

Accordingly, this study attempts to address the question as to what extent e-learning courses at PNU are efficient based on usability

criteria in learning.

Methods

This quantitative study was an applied research in terms of purpose and a descriptive survey aiming to evaluate the efficiency of e-learning courses at PNU based on usability criteria in learning. The statistical population included 2600 undergraduate and graduate students at Shahriar Branch of PNU. The criteria for inclusion in the study included being an active user of Golestan Education System and taking electronic courses at least once in 2019-2020 academic year. Exclusion criteria included the unwillingness to continue participation and failure to complete the questionnaires. Stratified random sampling and Krejcie-Morgan table were employed to select 335 participants as the research sample, among whom 282 students completed the questionnaires. Stratified random sampling is a type of probability sampling using which a research organization can branch off the entire population into multiple non-overlapping, homogeneous groups (strata) and randomly choose final members from various strata for research which reduces cost and improves efficiency. This method was selected since the statistical population consisted of a class of undergraduate and graduate students.

The research tool was a learning usability questionnaire known as *UseLearn*, designed by Oztekin et al. in 2010. Apart from demographic items, this questionnaire includes 36 items evaluating 12 different dimensions of an e-learning course in terms of usability in learning. In this questionnaire, the participants answered the items on a five-point Likert scale (from 1=very low to 5=very

high). It should be noted that Item 35 was coded negatively. In fact, allocating lower values to this item would mean the higher favorability of an e-learning course. After the questionnaire was translated, a copy and the original version were given to 25 faculty members delivering e-learning courses to determine the psychometric indices and validate the questionnaire. Then the Delphi method – multiple transformations and modifications of the questionnaire – was employed to apply their opinions in editing and codifying the final form. Some items were changed and edited before the content validity was confirmed by the faculty members. Moreover, the total reliability coefficient was reported as 0.726, showing the relatively appropriate reliability of the questionnaire. After data collection, the confirmatory factor analysis was used for the questionnaire reliability in LISREL. Also, one sample t-test in SPSS was used to examine the variables in normal and optimal conditions. Table 1 indicates the fitness indices of the questionnaire.

Regarding the approval of the proposed model, RMSEA was reported to be 0.074 (<0.08) while GFI and AGI stood at 0.94 and 0.92, respectively. These values indicate the good fitness of the model. In addition, χ^2/df was measured at 2.55 (<3), showing that the model had good fitness.

Results

First, the demographic information of the participants in the study was examined. According to this analysis, the majority of participants were female (80.8%) and most of them (57.7%) were 30 years of age or younger.

Table 1. Goodness-of-Fit Indices of the *UseLearn* questionnaire

Indices	Limit	Outputs	Results
χ^2/df	<3	2.55	Good fitness
RMSEA	<0.08	0.074	Good fitness
GFI	>0.9	0.94	Good fitness
AGFI	>0.9	0.92	Good fitness
CFI	>0.9	0.96	Good fitness
NFI	>0.9	0.96	Good fitness
NNFI	>0.9	0.94	Good fitness

53.1% of the participants reported spending less than 3 hours per week on academic activities, and 45.1% stated that they spent more than 10 hours per week on the Internet.

One-sample t-test was conducted to analyze e-learning courses of PNU based on usability in learning. For this purpose, the average scores of PNU in each of the 12 indices and the total index were compared with the normal and favorable conditions. The rates of 50% and 75% were used as the criteria for determining normal and favorable scores. The scores 3 and 3.5 were specified to correspond to 50% and 75% points respectively. The average score of the University on the *usability in learning* scale and its subcomponents were compared with these scores. Given the fact that the components had different numbers of items, the weight mean was applied. Tables 2 and 3 show the results of the analysis.

According to Table 2, there was a significant difference between the mean PNU score and the mean score at the 50% point (3) on the

total learning usability scale and all of its subscales ($P < 0.001$). Therefore, participants believed that e-learning courses of PNU were better than the normal conditions in terms of usability in learning.

According to Table 3, there is a significant difference between the mean PNU scores and the mean score calculated for the 50% point (3) in all subcomponents of learning usability ($P < 0.001$). Therefore, it is fair to state that the participants believed that e-learning courses of PNU were better than the normal conditions in all subcomponents of learning usability.

The mean PNU scores were also compared with the favorable conditions as well. As discussed earlier, the 75% point was designated for comparison. Tables 4 and 5 indicate the results.

According to Table 4, there is a significant difference between the mean PNU scores and the mean score calculated for the 75% point (3.5) in the total learning usability scale ($P < 0.001$). In other words, the participants

Table 2. One-sample t-test results of the total UseLearn Scale for PNU in normal conditions

Variable	Quantity	Mean	Standard Deviation	Test Value=3 (50% point)			
				T	Df	P	Mean Difference
Total UseLearn Scale	282	3.35	0.315	45.27	281	0.000	0.85

Table 3. The One-Sample t-Test Results of the Total UseLearn Subscales for PNU in Normal Conditions

Variable	Quantity	Mean	SD	Test Value=3 (50% point)			
				t	df	P	Mean Difference
Error Prevention	282	3.65	0.71	27.12	281	0.000	1.15
Visibility	282	3.50	0.77	21.77	281	0.000	1.00
Flexibility	282	2.91	1.09	6.34	281	0.000	0.41
Course Management	282	3.27	0.74	17.56	281	0.000	0.77
Interactivity, Feedback, Help	282	3.71	0.58	35.07	281	0.000	1.21
Accessibility	282	3.32	0.74	18.66	281	0.000	0.82
Consistency and Functionality	282	3.38	0.94	15.70	281	0.000	0.88
Assessment Strategies	282	3.82	0.63	35.33	281	0.000	1.31
Memorability	282	3.15	0.62	17.78	281	0.000	0.65
Completeness	282	3.06	0.83	10.19	281	0.000	0.51
Aesthetics	282	3.35	0.75	18.99	281	0.000	0.85
Reducing Redundancy	282	3.16	0.56	18.48	281	0.000	0.62

Table 4. The One-sample t-test results of the total UseLearn Scale for PNU in favorable conditions

Variable	Quantity	Mean	SD	Test Value=3.5 (75% point)			
				T	df	P	Mean Difference
Total UseLearn Scale	282	3.35	0.315	-21.43	281	0.000	-0.40

Table 5. The one-sample t-test results of UseLearn subcomponents for PNU in Favorable Conditions

Variable	Quantity	Mean	SD	Test Value=3.5 (75% point)			
				t	df	P	Mean Difference
Error Prevention	282	3.65	0.71	-2.39	281	0.118	-0.10
Visibility	282	3.50	0.77	-5.44	281	0.000	-0.25
Flexibility	282	2.91	1.09	-12.92	281	0.000	-0.84
Course Management	282	3.27	0.76	-10.97	281	0.000	-0.48
Interactivity, Feedback, Help	282	3.71	0.58	-1.04	281	0.298	-0.04
Accessibility	282	3.32	0.74	-9.69	281	0.000	-0.43
Consistency and Functionality	282	3.38	0.94	-6.66	281	0.000	-0.37
Assessment Strategies	282	3.81	0.63	1.74	281	0.083	0.06
Memorability	282	3.15	0.62	-16.38	281	0.000	-0.60
Completeness	282	3.01	0.83	-14.98	281	0.000	-0.74
Aesthetics	282	3.35	0.75	-8.98	281	0.000	-0.40
Reducing Redundancy	282	3.16	0.56	-19.03	281	0.063	-0.63

believed that e-learning courses of PNU were generally favorable based on usability in learning.

According to the analysis of learning usability subcomponents, e-learning courses of PNU were favorable in terms of “visibility”, “flexibility”, “course management”, “accessibility”, “consistency and functionality”, “memorability”, “completeness”, and “aesthetics” ($P < 0.001$). However, there was no significant difference in terms of “error prevention”, “interactivity, feedback, and help”, “assessment strategies”, and “reducing redundancy” ($P > 0.05$). In other words, participants believed that e-learning courses of PNU were not favorable in terms of “error prevention”, “interactivity, feedback, help”, “assessment strategies”, and “reducing redundancy”.

Discussion

According to the results and based on the learning usability scale or usability in learning, e-learning courses of PNU were in a favorable

condition in terms of “visibility”, “flexibility”, “course management”, “accessibility”, “consistency and functionality”, “memorability”, “completeness”, and “aesthetics”. However, these courses were not favorable in terms of “error prevention”, “interactivity, feedback, and help”, “assessment strategies”, and “duplication reduction”. In this regard, Hanafizadeh *et al.* (25) reviewed the reputable electronic evaluation models of several countries and extracted the relevant indices of universities and higher education systems. Consulting the experts, they introduced the concepts of “ICT-based management, strategies, and policies”, “ICT infrastructure accessibility”, “human resources”, and “ICT usability” as the main components of evaluation, which are in consistence with the components in this study. In another study, Farazkish and Montazer (26) evaluated different models, reviewed comparative studies, and analyzed the findings of Iranian studies and surveys of experts to introduce a conceptual framework

consisting of “soft preparation indices” such as flexibility, accessibility, and ability to establish interaction and “hard preparation indices” such as hardware equipment, communication networks, and technical support. The resultant model indicated the undeniable superiority of “soft preparation” to “hard preparation” in developing an e-learning environment (26). Regarding the components used to evaluate the efficiency of e-learning courses, this study appears to be in line with other relevant studies in specifying relatively universal and extensive components for efficiency evaluation.

Certain components such as “visibility”, “flexibility”, “course management”, “accessibility”, “consistency and functionality”, “memorability”, “completeness”, and “aesthetics” were considered favorable in this study. This was in agreement with Rafiei et al.’s study (27) in which students believed that access to the electronic system and online support were favorable. In another study, Zeytoonli and Rezaei (23) stated in their findings that sports management students attending a virtual course at PNU were satisfied with quality of access and security, access via PCs and mobile phones anywhere and anytime, e-learning system accessibility without specific configurations, technical support, timely accountability, support services for software installations, and necessary instructions for proper system deployment (23). These findings were also replicated in the present study. Moreover, the present results are consistent with a study by Anarinejad and Mohammadi (22) which addressed the organizational and curricular evaluation of e-learning courses at universities and higher education systems. According to their results, universities were in favorable conditions in terms of “designing a presentation environment”, “educational aspects”, and “organizational affairs” (22). However, they were not in an ideal situation with regard to “support services and ethical considerations” as well as “technology and evaluation” compared to the other dimensions. These two findings are consistent with the

results of this study.

According to the research findings, students believe that e-learning courses of PNU were not favorable in certain components such as “error prevention”, “interactivity, feedback, and help”, “assessment strategies”, and “reducing redundancy”. These findings fall in line with those of Khatib Zanjani (20), Zeytoonli and Rezaei (23), and Anarinejad and Mohammadi (22). In her study, Khatib Zanjani (20) argued that e-learning system of PNU had some defects, the most important of which was the lack of independent policies and standards for e-learning, nonuse of blended learning methods in education, and students’ unpreparedness to enter the virtual learning system (20). The absence of short-term courses for employee training (in-service training) and instructor training (continuous training) would be another defect of PNU in comparison with other open universities across Iran and the globe. In another study, Zeytoonli and Rezaei (23) concluded that the system was not favorable in terms of proper feedback, quality and amount of assignments for each topic, quality of communication with instructors, and availability of instructional materials from students’ perspective. Moreover, Anarinejad and Mohammadi (22) showed that certain components such as support services, ethical considerations, technology, and evaluation were usually among the least favorable dimensions in the institutions providing e-learning services. This finding is consistent with the results of this study. Finally, it can be concluded that PNU should recruit experienced and skilled experts in interdisciplinary fields to help with the process of designing, producing, executing, and evaluating e-learning courses. These experts should be sufficiently acquainted with both areas of pedagogy and IT. A major limitation of the study was that the findings were obtained from individuals’ personal accounts, and it is not clear to what extent they reflect real behaviors in respondents’ daily lives. Another limitation was related to the spatial and temporal scope of the study. This study was performed among undergraduate

and graduate students of Shahriar Branch in 2019-2020 academic year.

In view of the results, especially the less favorable dimensions reflected in respondents' opinions, the following suggestions are provided:

- Educational institutions should not merely focus on content in their design of e-learning courses. They should incorporate interactive and group exercises, so that students can understand the educational materials, and actively and creatively engage in learning based on their personal experiences.

- Emphasis should be placed on anticipating the mechanisms that provide concurrent or asynchronous feedback to students, which makes them more interested in e-learning and encourages them in their learning endeavors.

- E-learning systems should be designed in a way that it will be possible to customize learning contents for learners. There should be supplementary segments and modules for each lesson so that learners can benefit from them according to their needs.

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Ethical Declarations

At the beginning of the data collection stage, the participants were given a thorough explanation of the study and its objectives. With respect to ethical considerations, an attempt was made to preserve the confidentiality of the collected data and privacy of the participants. All procedures performed in studies involving humans were conducted in accordance with PNU regulations.

Authors' Contributions

M. Mah And M. Mas developed the

research methodology, performed the statistical analysis and wrote the conclusion. N. Kh And M. Ah collected the required data, developed the statement of problem and literature review. All of authors contributed to the final revision of the manuscript.

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Conflict of interests

The authors declare that there is no conflict of interest in this study.

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