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Measuring Performance and Effectiveness of online E-exam system in the Computer Center at Mosul University

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ABSTRACT

Recently, educational institutions have resorted to e-learning to train and educate students, especially those who have the desire to develop their scientific levels and develop their skills in quick and inexpensive ways. This paper focuses on measuring the performance of electronic exam systems, which is an important part of the e-learning process, especially the E-exam system used in the Mosul University computer center for examining people who aim to apply for postgraduate studies. The aim of this study is to measure the performance of the electronic examination system in the computer center at the University of Mosul. In this research, a questionnaire was made to measure the success of this system and the extent of users' satisfaction with it and its usefulness to them in performing their electronic exams. An online survey was conducted using a Google form and sent to the participants between August 21, 2021 and October 11, 2021 to find out the satisfaction of the system users. Microsoft Excel 2010 was used to analyze the data and get the results. This study produced several results, the most important of which are: there was a high degree of satisfaction with the E-exam system, reaching 63%; the percentage of neutrality in it was 25%, while rejection was 12%. According to these results, the system gives high confidence to its users.

1. Introduction

In recent decades, the world has witnessed remarkable progress in communication systems until it has penetrated all aspects of life, including the field of education. The term e-learning has become publicly available to become one of the teaching aids in schools and universities. The level of e-learning success is determined by the institution's infrastructure and the extent of development of the educational systems used, as well as the educational standards and controls in these institutions.

E-learning is a promising educational approach that can successfully convey knowledge to students. It is built on the use of modern communication technologies, including computers, computer networks, multimedia, audio-visual aids, graphics, hand-held devices, search engines, and electronic libraries on the Internet. As a result, e-learning refers to the use of various technologies to impart knowledge with effective interaction between professors and students in order to get maximum benefit in a short amount of time and with minimal effort. [1].

E-learning systems are not limited to educational institutions only, but non-educational organizations have also used e-learning systems to provide training for their employees [2], where the use of these systems has reduced training costs. For example, according to research, IBM provided 200 million dollars in 1999 when using e-learning systems, which led to raising the percentage of training to five times at a lower cost than traditional methods [3].

Individuals in many countries of the world talked about the actual application of electronic exams for university education in the light of scientific and technological progress, in order to eliminate the defects and negatives caused by paper exams in their traditional form, and this was already done when the COVID-19 pandemic hit traditional educational institutions in many countries. It does not have an educational system characterized by flexibility that makes it able to employ technology in the continuity

of the educational process and then present exams in an interactive electronic form, and from this view point, the importance of electronic exams at the University of Mosul appears as an alternative to the traditional paper-based exam system, which is a necessity imposed by the reality we live in light of the repercussions of the pandemic. As a result of the outbreak of the new Corona virus, due to the characteristics of these exams that make them the optimal and most appropriate alternative to assess the level of students without harming them, their families and the society in which they live.

According to the director of the E-exam Department at the Computer Center/University of Mosul, the examination system in the years preceding the COVID-19 pandemic from 2018 to 2020 was an electronic system designed by professors working in the Computer Center, and it is a system similar to what was approved by the Ministry of higher education and scientific research in 2017. The server for this system is located in the Computer Center. The center's professors prepare questions. The system interfaces start with personal information, academic qualifications, and contact information, then follow the test-specific question interfaces, which are multiple-choice questions and other questions appropriate to the type of electronic test, with short answers and others. At the time of the pandemic and after that, until today, Google Form was adopted as a test system that manages the process of setting questions, exam timings, and following up on results. The importance of electronic exams at the University of Mosul appears as an alternative to the traditional paper-based exam system, which is a necessity imposed by the reality we live in because of the pandemic. As a result of the outbreak of the new Corona virus, due to the characteristics of these exams that make them the optimal and most appropriate alternative to assess the level of students without harming them, their families and the society in which they live.

The total number of students who took the final exams at the University of Mosul using Google Classroom and LMS was made up of 47,000 male and female students. Of those, 2100 were postgraduate studies and 44,900 were graduate students [4].

A. Motivation for study

The motivation for this study comes from the fact that managing student assessment is one of the most vital processes in any academic environment. This issue is already raising many concerns in the computer center at Mosul University. As a result of this center's transition from traditional to electronic exams. One of the main reasons is the increased satisfaction of students enrolled in the exam at this center. Assessment and evaluation of students has become very important to check if it is a successful process. Especially after turning to E-Exam.

B. problem statement

E-learning in Iraq has become a necessary issue, especially after the spread of the COVID-19 pandemic, as specialists in this field realize that it is necessary to keep pace with the development of this educational system despite all the difficulties and obstacles it faces in order to achieve the prevailing global standards.

C. Significance of study

The importance of the study lies in the fact that many countries in the world have taken it upon themselves to adopt and develop their expertise in the field of e-learning. With the spread of the COVID-19 pandemic in many countries of the world, the importance of e-learning has emerged, and since the e-exam is part of the e-learning process, this study was conducted to verify the success of this process at the Computer Center at the University of Mosul.

D. Contribution and Objectives

This paper serves as a basis for providing researchers with the necessary information about the electronic examination system in the Computer Center/University of Mosul. This research will focus on determining the extent of the success of the system adopted in the computer center at the University of Mosul to benefit from the experience if it proves successful. Moreover, the results of this study will help the university and those who use electronic examination systems to identify the challenges and solve them. The number of participants in the survey was 204 out of 230 participants.

E. Research Methodology

The methodology of this study was based on conducting a questionnaire for the opinions of applicants for the electronic exam in the Computer Center at Mosul University for the period between August 21, 2021 and October 11, 2021. The questionnaire forms were distributed to the participants after they took the electronic exam by the Director of the Electronic Examination Department at the Computer Center/Mosul University.

2. Literature Review

"Electronic exams" refer to the use of networked computers by candidates in a moderated (conducted) high-risk assessment, generally one at a time in a specified period of time [5]. this definition has been generally accepted in private and public higher education institutions as well as secondary schools. A. Fluck et al. [6] indicates that many exam authorities in Nigeria have preferred electronic exams over manual exams. Because of their flexibility, security, integrity, and ease of use, online assessments have been liked by staff and students.

In R. Hamdan et al. [7], electronic exams have emerged as a potential alternative to traditional methods of assessing student learning. It allows us flexibility in terms of examination location and can give quick feedback. Students and institutions can be confident in the correctness of the knowledge test, which encourages them to pursue deep learning and

achieve better results, as well as a higher quality and more rigorous learning process.

O. Adebayo et al. [8] show that many exam options are still available even when teaching is done remotely, because assessment is the most important point of education, and the global trend seeks to keep up with the latest developments in the field of ICT, increasing the demand for E-exams in education.

According to A. Fatima et al. [9], students who took electronic exams performed well academically. The desire to adopt the electronic exam is not limited to developed countries; West African countries plan to integrate it into their education systems. An online exam has been implemented in Nigerian universities, and the West African Examinations Council has already implemented it.

A. Advantages and challenges of electronic exams

Fortunately, many new technologies were constantly serving education and helping universities improve the teaching and learning process when COVID-19 expanded across the world in early 2020. The technology is nowadays also used for evaluation purposes. Electronic testing, on the other hand, has prospered in the twenty-first century since test takers are accustomed to seeing and using new technologies [10]. They can conduct such tests more easily because they utilize smartphones and other technological devices on a daily basis. In addition, technology lowers the cost of complicated exam elements, makes scoring quick, ensures more accurate marking than humans, avoids biased scoring due to handwriting and student identity, and lessens the impact of student spelling errors [11]. Electronic test difficulties have been greatly minimized as a result of tremendous technological advancements. However, there are still some potential drawbacks to this system, such as interoperability, which could jeopardize the accuracy of students' answers; the need for adequate facilities; security testing (fraud prevention); the need for backup in the event of unexpected problems; and limitations in the student/technological user's skills [12]. These issues arose during screening and have been the subject of follow-up research aimed at preventing them. According to several studies, electronic testing is well-liked by students and has a positive impact on college evaluations as well as boosts the number of students supervised by a faculty member [13].

Studies by Thomas P. et al. [14] and A. Trotter [15] report that a large number of medical students support electronic testing because they believe it is objective and meets high quality requirements.

In Hai-yan LV et al. [16] study, he stressed that there is a widespread demand for them to adopt the electronic test across the United States, and that it might soon become the dominant instrument for evaluation. Several studies support this desire, such as the Mirarab A et al. [17] study, where students who took computerized assessments scored well in education. The ambition to use an electronic exam is not exclusive to developed countries. Even countries in West Africa are planning to include it in their educational systems. In Nigeria, in universities and schools, the e-exam multiple-choice test has been implemented [18], and it has already been introduced by the West African Examinations Council [19].

B. The main objectives of the electronic exams process

Normally, exams can be a logistical nightmare for most educational institutions' teaching personnel, which has resulted in certain exams. This has a detrimental impact on some students' desire to take more than one test during the semester [19–21]. One of the most essential concerns of interest to faculty in the educational environment is how to create and write high-quality exam questions, as well as how to answer them. As well as keeping an eye on any possible examples of student fraud. The answers are then manually corrected before the results are announced [22]. Recently, the transition from a traditional exam to an electronic exam has become a pressing necessity that represents a new educational approach. Many frequent difficulties with traditional testing can be handled using electronic tests, resulting in a high-quality test [23]. The electronic testing process has four basic objectives:

1. reducing costs by a considerable Question sets and student answer sheets, as well as toner and hardware resources for printing and copying, consume a significant amount of paper [24].
2. Reducing Time: The E-exam saves time by eliminating the need to write questions, correct papers, and print results [25].
3. Security: Only the computer networks in the labs can be used to take e-exams. Each student is given an account with a unique username and password for the test they have chosen. The results are submitted immediately to the database at the end of the exam to be processed and saved [26].
4. Flexibility: it gives detailed instructions on how to answer exam questions, which reduces the number of unclear questions, which lowers the test's dependability. Because they incorporate a high number of variables, long tests are more trustworthy than short tests. In most cases, these exams make use of Multiple-Choice Questions (MCQ) [27].

3. Important notes about the analysis

a) The circuit diagram is used to clarify variables that have few divisions or branches.

b) The graph is used to illustrate the variables that have many sections or branches:

- Numbers are used to show that there are differences in the lengths of the columns.
- Ratios are used to show the relative importance of each column or to compare two samples for the same phenomenon

c) Numerical analysis (numerical measures such as mean, standard deviation, and others) is used in the event that there are options that can be converted into

numbers (such as the questionnaire form in the research).

It is noticed from the circular graph in Fig. (1) that a percentage of 51% of the research sample is female, which is slightly higher than the percentage of males, amounting to 49%, and this gives clear homogeneity in the research sample in terms of gender.

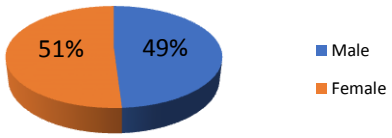

Fig. 1: Distribution of the research sample according to the Gender variable

The circular graph in Fig. (2) indicates that the largest proportion of the research sample of 49% is the age group (less than 30 year), followed by the age group (30-40 year) with a rate of 37%, and followed by the age group (41-50 year) in the third place at a rate of 13%, then comes the age group (more than 50 year) only 1%. This means that the sample studied varies in terms of age groups in favor of the two younger age groups, and this is logical because the majority of applicants for the study are from relatively young age groups and because applicable laws prevent advanced age groups from applying for postgraduate studies.

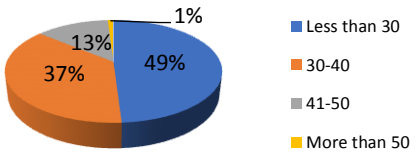

Fig. 2: Distribution of the research sample according to the age groups

It is noticed from the circular graph in Fig. (3) that a percentage of 58% of the research sample have a job or a specific job, which is significantly higher than the percentage of those who do not have a job or a specific job, which is 42.2%.

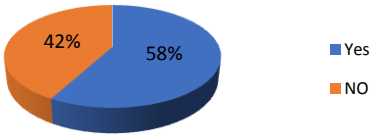

Fig. 3: Distribution of the research sample according to who has job opportunity

It is noticed from Fig. (4) that a percentage of 40% of the research sample (who have a job) had their own office businesses and the computer was used in them, which is slightly less than the percentage of those whose businesses were not office businesses and the computer was not used in them, which amounted to 60%. So, the e-exam is supposed to be successful for those who use computers in their jobs.

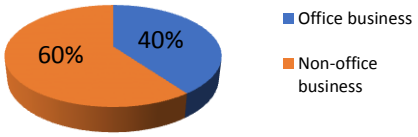

Fig. 4: Distribution of the research sample according to type of job

Fig. (5) clearly shows that most of the respondents had passed the test in less than one hour, with a rate of 63%, while the low percentage of 37% had passed the test in the full available time.

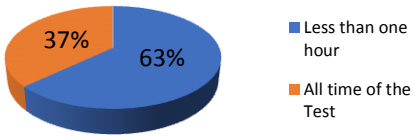

Fig. 5: Distribution of the research sample according to the time of the test.

Fig. (6) shows that 53% of the research sample working on computers dealt with information systems, which is slightly higher than the 47% of those who worked on computers and did not deal with information systems, so it is likely that e-exam is more difficult for these people.

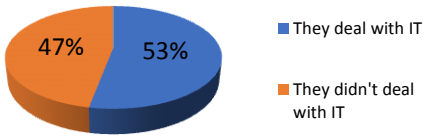

Fig. 6: Distribution of the research sample according to dealing with information systems

It is noted from Fig. (7) that the majority of the research sample had entered the computer center to qualify for the M.Sc. study, with a rate of 77%, and that 20% of the research sample had entered the computer center to qualify for the Ph.D. study, and that only 3% of the research sample had entered the computer center to qualify for the Diploma study.

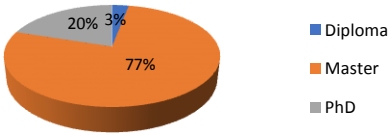

Fig. 7: Distribution of the research sample according to the type of scientific degree

Fig. (8) clearly indicates that the percentage of those who passed the test for the first time was the highest and to a large extent, which is 79%, followed by the percentage of those who passed the exam twice, which was 14%, and then came in third place, the percentage of those who passed the exam more than twice, which amounted to 7%.

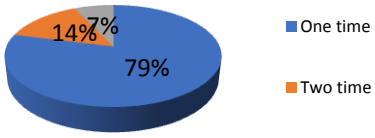

Fig. 8: Distribution of the research sample according to the number of test attempt

It is noted from Fig. (9) that a percentage of 68% of the research sample had been trained by the test supervisors before the time of the test, while the percentage of those who entered the test and had not been trained by the test supervisors before the test time was 32%.

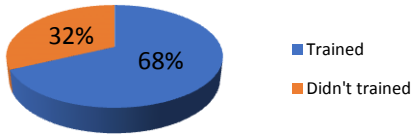

Fig. 9: Distribution of the research sample according to the number of trained persons

Table 1. shows the symbols for each question that used in this study.

Table 1: The used symbols for express the research questions

Question	Symbol
Gender	Y1
Age	Y2
Do you have a job?	Y3
If you have a job, is your work in an office and you use a computer?	Y4
How many hours of your time did you spend on the test?	Y5
If you work on a computer, have you ever dealt with information systems?	Y6
I entered the test at the Computer Center to study.	Y7
How many times did you take the test in the calculator center?	Y8
Were you trained by test supervisors prior to test time?	Y9
The electronic examination system in the computer center is easy to use.	X1
The electronic examinations system is useful.	X2
The electronic examinations system is easy to learn.	X3
Information from the system is relevant to my Job	X4
The information I get from the system is accurate.	X5
Easy to understand the information from the system.	X6
The information is presented in a useful form.	X7
I can easily retrieve the information I need.	X8
In general, I am satisfied with the electronic examinations system	X9
When I take the test on the computer, I feel confident about what I'm doing.	X10
I feel comfortable using the electronic exam system.	X11
There was plenty of time to get acquainted with the system.	X12
I can have continuous training.	X13
The training I received was very relevant to how to use the system.	X14
Using the system helped me for passing the exam.	X15
The communications improved with educational service providers.	X16
The system has facilitated the exchange of exam strategies with professors.	X17
The system has made it easier to identify trends and patterns.	X18
The system has facilitated the development of exam plans.	X19

Tables (2) and (3) show the qualitative and quantitative statistics of respondents' answers, including the following:

1. The respondents' answers to all questions gave approval rates for the axis paragraphs higher than disapproval, as the rate of approval was equal to (63.1%), while the rate of disapproval was only (11.7%). This was supported by the arithmetic mean of all questions if it was higher than (3), and this was reflected in the general average of all questions, which was equal to 3.59, which indicates the positive view of the research sample about the ideas presented in the questions, and this was explained by the direction of the sample, which indicated approval of all questions. Except for the two questions (X12, X4) in which the trend indicated neutrality.
2. The respondents' answers to all questions were significant (that is, the respondents' answers are important and have logical and correct connotations and are reliable in the conclusions related to the research idea) through the calculated t-values that exceeded the tabular value equal to (1.97) (that is, it is different from neutrality).

3. There is great homogeneity in the respondents' opinions through the values of small standard deviations (less than the correct one or close to zero) for all questions except for the two questions (X9, X2), and this indicates the realism and greater reliability of the respondents' answers.

Table 2: Statistics for qualitative analysis of research questions

Mean	Standard Deviation	t-test	Direction of view
3.45	0.927	6.95	Agree
3.62	1.003	8.8	Agree
3.51	0.965	7.55	Agree
3.2	0.998	2.81	Neutral
3.71	0.865	11.74	Agree
3.54	0.933	8.33	Agree
3.85	0.782	15.48	Agree
3.65	0.932	9.99	Agree
3.69	1.021	9.67	Agree
3.62	0.953	9.26	Agree
3.5	0.995	7.25	Agree
3.34	0.982	4.92	Neutral
3.52	0.885	8.47	Agree
3.64	0.896	10.24	Agree
3.81	0.887	13.03	Agree
3.69	0.806	12.16	Agree
3.7	0.924	10.77	Agree
3.57	0.848	9.66	Agree
3.68	0.922	10.48	Agree
3.59			

Table 3: Statistics for quantitative analysis of research questions

Research Scale									
Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree	
number	%	number	%	number	%	number	%	number	%
15	7.4	97	47.5	69	33.8	11	5.4	12	5.9
29	14.2	107	52.5	39	19.1	19	9.3	10	4.9
23	11.3	95	46.6	58	28.4	19	9.3	9	4.4
13	6.4	74	36.3	69	33.8	36	17.6	12	5.9
25	12.3	119	58.3	42	20.6	12	5.9	6	2.9
23	11.3	97	47.5	60	29.4	16	7.8	8	3.9
32	15.7	123	60.3	38	18.6	8	3.9	3	1.5
29	14.2	105	51.5	46	22.5	18	8.8	6	2.9
40	19.6	95	46.6	45	22.1	14	6.9	10	4.9
28	13.7	103	50.5	47	23	19	9.3	7	3.4
24	11.8	96	47.1	53	26	21	10.3	10	4.9
19	9.3	78	38.2	69	33.8	29	14.2	9	4.4
14	6.9	112	54.9	52	25.5	19	9.3	7	3.4
24	11.8	109	53.4	53	26	10	4.9	8	3.9
36	17.6	115	56.4	37	18.1	10	4.9	6	2.9
19	9.3	122	59.8	48	23.5	10	4.9	5	2.5
27	13.2	116	56.9	43	21.1	8	3.9	10	4.9
18	8.8	106	52	60	29.4	15	7.4	5	2.5
25	12.3	117	57.4	43	21.1	9	4.4	10	4.9
11.9		**51.2**		**25.2**		**7.8**		**3.9**	
63.1				**25.2**		**11.7**			

Fig. (10) shows the rate of approval (agree, strongly agree) and neutrality and rejection (I do not agree, strongly disagree) of the questions asked, and from it is clearly noticed that the approval rates are much more than the percentages of neutrality and rejection rates, followed by the percentages of neutrality and then come in the third rejection percentages. This indicates the agreement of the views and opinions of the studied sample with the ideas put forward regarding the studied variable.

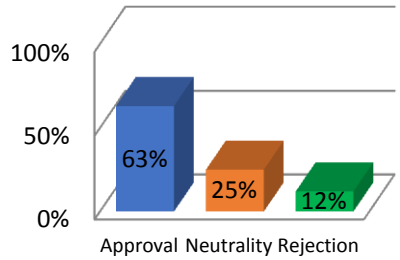

Fig. 10: The average answers rate of the research sample members

Sample direction: means the category in which the arithmetic mean of the question is located, according to the following division in Table (4).

Table 4: The direction of opinion in the five-point Likert Scale

Mean	Direction of view
1 - 1.79	Strongly Disagree
1.80 - 2.59	Disagree
2.60 - 3.39	Neutral
3.40 - 4.19	Agree
4.20 to 5	Strongly Agree

4. Conclusions and recommendations

A. Conclusions

The E-exam is gaining more and more popularity during the ongoing COVID-19 pandemic. Its benefits are very encouraging for students, teachers, and universities as well, and in this competitive era, every university looks forward to cost-effective and quality testing methods. It has become necessary for universities to adopt an E-exam system during the outbreak of the COVID-19 pandemic, but nevertheless, it is a double-edged sword, as it has both benefits and drawbacks. Through the statistical description of the data represented by the research sample, the research concludes the following:

- The research sample and, through the graphic description (represented by the graphic circle), agreed with the logical information from the expected ratios for the type of certificate required and the age groups applying for the test.
- A high percentage of test takers were trained, which was reflected in the percentage of those who passed the test on the first attempt.

Through the statistical analysis of the questionnaire questions measuring the success of the electronic test system at the Computer Center at the University of Mosul, the research concludes the following:

a) The computer center's electronic exam system is simple to learn and use, so it can be used for future work.
b) The information from the system is useful, accurate, and relevant to the applicants' work, and it can be retrieved flexibly and easily.
c) There is a high degree of satisfaction with the E-exam system, which amounted to 63%, and the percentage of neutrality in it reached 25%, while the percentage of rejection is very low, amounting to 12%, and thus this system gives high confidence to its users.
d) The system facilitates the exchange of exam strategies with professors, improves communication with educational service providers, and enables the system to perform exams better.
e) According to the foregoing, the E-exam system of the Computer Center at the University of Mosul was successful in its performance during the pandemic period in which electronic exams were used for

B. Recommendations

1. Universities must carefully design their strategy for the electronic exam and stay away from the complete imitation of the experiences of others, in order to reap the benefits of technology and the needs of students simultaneously, as each has their own experience and its own circumstances.
2. Creating a question bank for electronic exams requires additional efforts, and the questions must live up to the suggested level of knowledge, as teachers need adequate training to organize courses and exams online. Organizational units must also enhance the teaching and learning environment and provide the required structure for the system. In addition, the e-learning and online examination systems work effectively through modern technologies such as computers, network devices, etc.
3. Teachers and educational institutions must use the necessary time, effort, and cost to produce a positive view of electronic assessment, and then it is possible to achieve the effectiveness of electronic tests by creating them to be reliable, safe, and compatible in enhancing learning and ensuring compatibility with the intended learning outcomes.
4. For the successful implementation of electronic exams, higher education institutions must provide support, including the formulation of appropriate conditions required for conducting electronic exams in universities.

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Many thanks to all my colleagues from Mosul University, appreciating their support to complete this research; also, I'm grateful to the efforts of colleagues at the Computer Center, especially the director, who made the communication with individuals in the sample search easier; and many thanks to Mr. Nather from the Computer Center, who helped with collecting data for this research.

Questionnaire for E-Exam system in the Computer Center / University of Mosul

General Information:

Tick the appropriate choice please

1.	**Gender**	Male:	Female:		
2.	**Age**	Less than 30:	30-40:	31-50:	More than 50:
3.	**Do you have a job?**	Yes:	No:		
4.	**If you have a job, is your work in an office and you use a computer?**	Yes:	No:		
5.	**How many hours of your time did you spend on the test?**	Less than one hour:	All time:		
6.	**If you work on a computer, have you ever dealt with information systems?**	Yes:	No:		
7.	**I entered the test at the Computer Center to study**	Diploma:	Master:	PhD:	
8.	**How many times did you take the test in the calculator center?**	One time:	Two time:		
9.	**Were you trained by test supervisors prior to test time?**	Yes:	No:		

Note: Choose the descriptive number based on your experiences and feelings. There are no good or bad answers.

No.	Question	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
1.	The electronic examination system in the computer center is easy to use.					
2.	The electronic examinations system is useful.					
3.	The electronic examinations system is easy to learn.					
4.	Information from the system is relevant to my Job					
5.	The information I get from the system is accurate.					
6.	Easy to understand the information from the system.					
7.	The information is presented in a useful form.					
8.	I can easily retrieve the information I need.					
9.	In general, I am satisfied with the electronic examinations system					
10.	When I take the test on the computer, I feel confident about what I'm doing.					
11.	I feel comfortable using the electronic exam system.					
12.	There was plenty of time to get acquainted with the system.					
13.	I can have continuous training.					
14.	The training I received was very relevant to how to use the system.					
15.	Using the system helped me for passing the exam.					
16.	The communications improved with educational service providers.					
17.	The system has facilitated the exchange of exam strategies with professors.					
18.	The system has made it easier to identify trends and patterns.					
19.	The system has facilitated the development of exam plans.					

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قياس نجاح نظام الاختبارات الالكترونية في مركز الحاسبة/ جامعة الموصل

شيماء مظفر النقيب

كلية الاثار ، جامعة الموصل ، الموصل ، العراق

الملخص

هناك عدة طرق لتدريب وتعليم الطلاب وخاصة أولئك الذين لديهم الرغبة في تطويرهم المستويات العلمية وتنمي مهاراتهم بطرق سريعة وغير مكلفة بما في ذلك التعلم الإلكتروني. في هذا البحث تم عمل استبانة لقياس مدى نجاح نظام الامتحانات الالكترونية لمركز الحاسبات في جامعة الموصل ومدى رضاهم عنه وفائدته لهم في أداء امتحاناتهم الالكترونية. استعرض البحث عددا من النتائج المهمة لعل اهمها: وجود درجة عالية من الرضا عن نظام الاختبار الالكتروني بلغت 63.1٪ ونسبة الحياد فيه 25.2٪ بينما الرفض. كان 11.7٪ ، وبالتالي فإن هذا النظام يعطي ثقة عالية لمستخدميه.