



## An Empirical Study of Students' Perceptions on the Technological Aspects of the E-Learning System

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### ABSTRACT

This study has two main objectives; first, to evaluate student perceptions on the technological aspects of the e-learning system, Second, to propose a model to determine the relationship between the technological factors and the perceived usefulness of e-learning. The main contribution of this paper is to propose and test six hypotheses that reinforce the relationship between technological aspects of e-learning and its perceived usefulness. A questionnaire survey of quantitative research methodology was applied and data was collected using an adapted survey instrument. The respondents were 306 Diploma of Engineering students. The findings revealed that four out of these six factors, namely the ease of access to portal, student-lecturer interaction, adequate technical support, and quality of Internet connectivity have a major influence on the perceived usefulness of e-learning. It is envisaged that the model can be very useful in increasing the usefulness and acceptance of e-learning in higher education institutions.

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## 1 Introduction

The use of e-learning in higher levels of education provides new and innovative ways in delivering educational materials to any person, at any time and at any location. In recent decades many universities worldwide use e-learning as an accepted educational standard to facilitate the teaching and learning process for everyone, anywhere and at any time. The effective use of IT components in e-learning is crucial to enhance the success and student acceptance of the e-learning systems [1]. Also the capability, reliability and richness

of the IT infrastructure of universities in delivering their courses as smoothly as possible are critical to the success of e-learning [2]. Information technology has changed the education methods dramatically and in recent years, the use of Information and Communication Technologies (ICT) for educational purposes has increased, and the spread of network technologies has caused e-learning practices to evolve significantly [3]. The Technology Standard Committee defines the e-learning system as an electronic device which facilitates the teaching and learning process by using web browsers to enable interaction between learners and others [4].

The usage of e-learning as a kind of learning device has created a convenience in the growth of education and many institutions are interested in acquiring more knowledge in this area. As a matter of fact many institutes use e-learning because it cuts costs and reduces the use of facilities. Therefore there is a reduction in

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the use of classrooms, and cut costs for training, traveling, printing materials, running laboratories, and also reducing the overloading of information [5–7].

The interest to implement e-learning has been expressed by many developing countries [8] but they are faced with difficulties with the infrastructure, resources, information access [9], personal characteristics, institution support [10], technology and connectivity, instructor design and technology confidence [11]. Challenges faced by academics regarding the use and success of e-learning in an academic environment can be divided into five categories including learning styles and culture, pedagogical e-learning, technology, technical training, and time management challenges [12]. Important variables that contributed significantly to the success of e-learning are learner, instructor, course, technology, design and environment [13]. The most important E-Learning critical success factors are grouped in five dimensions such as Student, Instructor, Design and Contents, System and Technological, and Institutional Management Services [14]. E-learning has a positive impact on both teachers and students in that it positively affects the duration of their attention, learning and training tenacity, and their attitudes towards collaboration and interaction [15].

Previous researchers concluded that students get better results from e-learning education process when comparing with the traditional methods. This shows that facilitating learning and allowing students to learn anytime and anywhere is the reason for the interest to use e-learning [16].

In previous researches the success in e-learning is defined in terms of reducing time and costs in training students or e-learners, ease of access for students and lecturers, learner satisfaction and being able to offer more services. Bhuasiri et al., (2011) reported that in developing countries e-learning represents the aim of providing education for poor students, because in developing countries the political, economic and cultural issues have influence on the usage of technology within education [17, 18]. But on the other hand, the aim of e-learning in developed countries is to develop an operative knowledge economy and to increase lifelong education [19].

Raja Maznah, (2004) pointed out that e-learning is committed in many higher education institutions (HEIs) in Malaysia for spreading information widely because they believe in its efficiency as an alternative approach to the traditional classroom method [20]. An initial interview with some students in Malaysia institutions indicated that the students have technological problems in using the e-learning and these problems are related to the internet connection, lack of access

to computer labs in using e-Learning system, weak interaction between students and lecturers in e-learning, and etc. Thus, more in-depth studies are needed to identify the success factors of the e-learning system to prevent the possibility of any failure. Apart from the studies conducted on the critical success factors for e-learning, there is a growing need to identify IT related factors and the effects of them in using the e-learning system in Malaysia.

Previous studies, show that the most common problems with e-learning are associated with technological aspects [11]. According to Arbaugh and Duray (2002), satisfaction of technological dimensions of e-learning plays an important role for user satisfaction, thus a study which investigates the technological aspects of the e-learning system by quantitative research methodology can provide an empirical basis for improvement in strategies to remedy the situation of dissatisfaction among learners. Learning more about the relationship between student perceptions of the technological aspects of e-learning and perceived usefulness of e-learning, should promote a successful implementation of the e-learning system and lead to learner satisfaction and a wider acceptance of e-learning among students.

## 2 Literature Review

This part has provided the foundation to this research through the literature review carried out preceding the critical success factors for the e-learning system, which forms the groundwork of the study. This equips the study with the most important success factors for e-learning, technology related factors, perceived usefulness, user satisfaction and technology acceptance. It can be concluded that information technology is the most important success factor that affects the usage of e-learning. In addition, technological related factors that affect the using of e-learning include, the ease of access, and the interface design, the level of interaction, the system quality, the service quality, and the internet quality.

### 2.1 Technology Acceptance

The Technology Acceptance Model (TAM) presented by Davis [21] proposes that the perceived ease of use and the perceived usefulness of technology are predictors of user attitude towards using the technology, subsequent behavioral intentions and actual usage. The perceived ease of use was also considered to influence perceived usefulness of technology. The individual acceptance and use of new technologies has been studied extensively over the last two decades. The TAM model especially by Davis et al., (1989) and its successor TAM2 Venkatesh and Davis (2000) have received a lot of attention. These models have established them-



selves as being robust and parsimonious for predicting user adoption of a wide variety of new technologies. The majority of models, including the TAM, are inspired by the Theory of Reasoned Action (TRA) [22]. TRA asserts that both the attitude towards a specific behavior and subjective norm have an impact on behavioral intention, which in turn determines actual behavior.

Venkatesh, et al. [23] conducted an empirical study in comparing eight theoretical models including: the Theory of Reasoned Action (TRA), the Theory of Planned -Behavior (TPB), TAM, the Motivational Model (MM), the Model of PC Utilization (MPCU), the combined TAM and TPB model, the Innovation Diffusion Theory (IDT) and the Social Cognitive Theory (SCT) which resulted in the Unified Theory of Acceptance and the Use of Technology (UTAUT).

The authors used the TAM model to propose a model for this study because TAM is a referral model that in recent years many researchers have used the TAM model as the basis of their studies on education to accept the technological aspects of e-learning. Many studies have been conducted in this regard, for instance, [24–31]. a Alsabawy, et al. [32] reviewed literature existing on the e-learning technology and evaluates the TAM as 86% application in the e-learning acceptance studies as the most common ground theory than UTAUT, TTF, TPB, TAM, and other approximately 4%, 2%, 2%, 2%, and 4%. In addition King and He [33] conclude that TAM is an influential and powerful predictive model.

Technological contexts including IT infrastructure and perceived ease of use determined in previous studies as jointly responsible for e-learning adoption [34]. Personalized e-learning facilities improve online learning effectiveness in terms of examination, satisfaction, and self-efficacy criteria [35]. Examining the relationship between e-learners' perceptions, and perceived usefulness, is essential because system use is an important indicator of the system's success [36]. System quality, perceived ease of use, and perceived usefulness, improve instructors' intentions to use web-based learning systems [37]. However, only a limited number of published works have applied an integrated model of IS success model and TAM to explore e-learning usage drivers in the context of developing countries [36].

As a matter of fact, an individual's willingness to use a specific information system for their activities depends on their perception of its use [38]. Individuals' satisfactions towards e-learning, mostly resulted from both environmental and job-specific factors while their dissatisfactions, mostly resulted from only environmental factors [39]. In this study the focus is on one part of the TAM model which is the perceived

usefulness, because some previous researchers found that the perceived usefulness has a stronger effect on user satisfaction and intend to use it as the perceived ease of use [40–42].

E-learning as a kind of asynchronous learning, which means “not at the same time,” allows the participants to complete the WBT (Web-based training) at their own pace, without live interaction with the instructor. Basically, it is information that is accessible on a self-help basis. The advantage is that this kind of e-Learning offers the learners the information they need whenever they need it. It also has interaction amongst participants through message boards, bulletin boards and discussion forums.

This study describes Moodle learning environment as an important kind of e-learning system in Malaysia. Moodle is a virtual learning environment where course materials can be easily managed and accessed. In other words Moodle is a virtual learning environment (VLE) that allows staff to create courses online. In Moodle, the content such as lecture notes, timetables and reading lists can be easily uploaded to course pages, providing a constant and easily accessible reference for students to consult. Moodle also offers a number of interactive tools, to get students engaging with course content and collaborating with their peers.

Moodle supports group work by allowing members to create their own areas in which to talk and share files. It also facilitates forums, which encourage the continuation of discussions outside the lecture theatre, and wikis and blogs to promote student contribution.

### 3 Research Methodology

This section describes the methodology of the research, participants, the experimental system, instrument development, procedures and the measures. A pilot test of the survey instrument was conducted to evaluate the usability of the survey instrument. Based on feedback from the pilot test, modifications to the instrument were made. The reliability of the sampling was tested using standard analysis with Cronbach's Alpha. The main purpose of this research is to identify the technological related factors that can affect the use of e-learning. To evaluate the relationship between the technological related factors and the perceived usefulness of e-learning system among students in a higher education institution, 306 Diploma students from University Technology Malaysia, Kuala Lumpur were chosen. Data for the research was collected by using a survey questionnaire.



### 3.1 Conceptual Framework and Hypothesis

The researcher designed a framework based on previous researches and six variables of technology are to be discussed. Hypotheses for testing the relationships between the technological aspects and the perceived usefulness are also presented in this framework. Independent variables or the external variables in this framework are technological related factors including ease of access, interface design, level of interaction, system quality, service quality and internet quality that will affect the use of e-learning. A dependent variable in this framework is the perceived usefulness. Previous studies identified information technology (IT) as the most important success factor that influences the usage of e-learning systems. Technological-related factors that affect the usage of e-learning include ease of access, interface design, level of interaction, system quality, service quality and internet quality [43].

Ease of access (EOA) in e-learning refers to the easy access and usability of the website for students. Interface design (ID) is related to the visual structure and design of the internet course to make it appealing and well-structured [15]. One of the critical part of a software is user interface [44]. Level of interaction (LOI) refers to interactive communication in the e-learning course between students and the instructor. System quality (SQ) represents technical success and the accuracy and efficiency of the communication system that produces information such as the presence and absence of a bug in system [45, 46]. Internet quality is network quality as perceived by learner (IQ). Service quality (SEQ) refers to quality of the services provided by the administrative staff such as training and helpdesk [36]. Service quality identified in previous studies as a significant contributor in increasing the users' satisfaction towards usage of e-learning system [47].

This framework is designed based on the original TAM model and findings from the reviewed literature. In this framework the findings from the literature reviews which are technologically related are factors including the ease of access, the interface design, the level of interaction, the system quality, the service quality and the internet quality which are related to the perceived usefulness component of the TAM. Also in this framework the relationship between the six variables and the perceived usefulness are evaluated to identify and compare as to which one of the independent variables will affect the perceived usefulness more. In this study a new model is presented based on the original TAM model and previous studies to describe the relationships between the research variables (Dependent Variables & Independent Variables). The list of research hypotheses in the e-learning content

are the following:

- H 1: There is a relationship between ease of access and perceived usefulness of e-learning.
- H 2: There is a relationship between interface design and perceived usefulness of e-learning.
- H 3: There is a relationship between level of interaction and perceived usefulness of e-learning.
- H 4: There is a relationship between system quality and perceived usefulness of e-learning.
- H 5: There is a relationship between service quality and perceived usefulness of e-learning.
- H 6: There is a relationship between internet quality and perceived usefulness of e-learning.

### 3.2 Instrument Development

This research utilizes the quantitative research methodology. The instrument that is used to collect the data is the questionnaire. A set of questionnaire containing 32 questions is developed based on some adopted questionnaire used previously by other studies and also some of the questions are self-developed from the perspective of the researcher based on the interview with the students about their problems in using the e-learning system. For designing the instrument the researcher uses the five Likert scale questions (1, 2, 3, 4 and 5) to obtain a precise level of agreement and disagreement. The items used in constructing the survey for this study were adapted from several relevant prior research studies. All the adopted items are modified for the context of this study and, if necessary, paraphrased to suit a five point Likert-type scale (refer Appendix A). The questionnaire is divided into eight constructs including: i) demographic information, ii) EOA: ease of access iii) ID: interface design, iv) LI: level of interaction, v) SQ: system quality, vi) SR: service quality, vii) IQ: internet quality, viii) perceived usefulness.

A pilot study was conducted to validate the questionnaire with a group of 30 students as the face validity in understanding the items of the questionnaire. After that the adapted questionnaire was prepared for a pilot study for a group of 30 students to assess its reliability before distribution. To validate the questionnaire, three experts in the topic area were chosen for consultation on the validation of questions. The experts had some comments on items, purpose, the Likert scale, demographic questions and the other parts to review and corrected some parts of the questionnaire to receive more accurate results.

### 3.3 Research Sample and Data Collection

The goal of sampling is to create a sample that best represents the population. The researchers referred to



Morgan's Table, presented by Krejcie and Morgan [48] to determine the sample size from a given population for the research activities in order to recognize a valid statistical sample for this study. According to the Morgan's Table and the given population (1500), the sample for this study is 306 Diploma students. A total of 360 questionnaires were distributed to the students. Out of the 360 questionnaires a total of 320 were returned of which 306 questionnaires were complete and useful for this study. So the response rate or the number of students who participated in the survey for this study is 90.55%.

### 3.4 Statistical Methods

To achieve the research objective a range of statistical methods are adopted in this study. Cronbach Alpha is used to test the reliability. Two tests were run to test the validity: the face validity and the content validity. SPSS software is used for the structural equation modeling to test the hypotheses.

## 4 Results and Analysis

The essential purpose of the empirical study is to assess the validity and reliability of the constructs, to test the whole model via the goodness-of-fit indicators, and to examine the effects among the constructs of the model. The empirical study includes five stages.

### 4.1 Stage One: Factor Analysis

The Principal Axis Factor Analysis with a Varimax Rotation is conducted to assess the underlying structure for the 32 items of the e-learning success factors in the survey questionnaire. The requested six factors are based on the fact that the items are designed to index six constructs which are the ease of access, the interface design, the level of interaction, the system quality, the service quality and the internet quality. After rotation, the first factor accounted for 19.41% of the variance, the second factor accounted for 17.70%, the third and fourth factors accounted for 13.49% which explains the total variance of 64.1% in the dataset with 0.906 of KMO (Kaiser-Meyer-Olkin Measure of Sampling Adequacy). The first factor, which is seen to index the level of interaction, loads most strongly on the first five items, with loadings in the first column. The second factor, indexes the service quality, is composed of five items with loadings in the second column of the table. The third factor, indexes the ease of access, comprise the three items with loadings in the third column. EOA1 "E-learning system is easily accessible via internet," which has its highest loading from the ease of access factor. The fourth factor, which seems to index internet quality, is composed of the three items with loadings in the fourth column.

**Table 1.** Factor Loadings for the Rotated Factors

Item	1	2	3	4	Communality
EOA1			0.867		0.803
EOA2			0.836		0.754
EOA5			0.543		0.400
LOI1	0.67				0.554
LOI2	0.724				0.631
LOI3	0.775				0.663
LOI4	0.765				0.641
LOI5	0.599				0.502
SQ5		0.638			0.56
SEQ1		0.591			0.595
SEQ2		0.772			0.643
SEQ3		0.72			0.674
SEQ4		0.614			0.566
IQ1				0.674	0.666
IQ4				0.877	0.825
IQ5				0.767	0.786
Eigenvalues	6.42	1.57	1.253	1.014	
% of Vari- ance	19.41	17.7	13.49	13.49	
Cumulative Percentages	19.41	37.11	50.61	64.1	

Note. Loadings < 0.40 are omitted; KMO= 0.906

In order to identify the factors underlying the construct in this study, the researchers according to previous research use a minimum eigenvalue of 1 as a cut-off value for extraction, and also deleted items with factor loadings less than 0.4 on all factors, or cross loadings on two or more factors [49]. An iterative sequence of factor analysis is executed. Fourteen of the items are deleted in this phase. At the end of the factor analysis procedure, an instrument of 4-factor and 16-items is obtained. The four factors are interpreted as the ease of access, the level of interaction, the service quality and the internet quality. In this phase the two factors of the interface design and the system quality eliminates the research model. Table 1 summarizes the factor loadings for the 16-item instrument.

### 4.2 Stage Two: Reliability Test

To assess whether the sixteen items that are put together to create the ease of access, the level of interaction, the service quality, the internet quality and the perceived usefulness form a reliable scale is computed in Cronbach's Alpha (CA). According to Baars et al., [50] the amount of high reliability for CA is the value of 0.7 and above. In this study the Cronbach's Alpha



**Table 2.** Reliability Test After Eliminating 14 Items

Variable	Cronbach's Alpha	No of Items	Mean
EOA	0.707	3	3.473
LOI	0.818	5	3.218
SEQ	0.827	5	3.302
IQ	0.815	3	3.345
PU	0.816	2	3.596
Overall	0.913	18	3.343

for the three items of ease of access was (.70), which indicates that the items form a scale that has reasonable internal consistency reliability. The Cronbach's Alpha for the five items of level of interaction scale is at (.81). The Cronbach's Alpha for the service quality scale (.82) indicates a good internal consistency. Similarly the alpha for both of the internet quality and perceived usefulness scale (.81) indicates good internal consistency.

In summary, based on the Table 2, the service quality has the highest value of CA which is 0.827 and the ease of access has the lowest value of CA which is 0.7. Table 2 shows the reliability test results.

### 4.3 Stage Three: Correlation Analysis

A Pearson's correlation was computed to assess the relationship between factors which are used in research model and in this case includes the perceived usefulness (PU) and the ease of access, the interface design, the level of interaction, the service quality, and the internet quality. According to Table 3 in this study the perceived usefulness positively correlates with 'ease of access' ( $p < 0.01$ ), 'Level of interaction' ( $p < 0.01$ ), 'service quality' ( $p < 0.01$ ) and 'internet quality' ( $p < 0.01$ ). The value of correlation coefficient ranges from -1.00 to 1.00 which indicates the strength and direction of the relationship between the two variables [51].

Table 3 indicates the correlation for all the variables. According to a study conducted by Cohen [52] in order to determine the strength of the relationship, the  $r$  value between 0.10 and 0.29 interprets as a small correlation, the  $r$  value between 0.30 and 0.49 interprets as medium, and the  $r$  value between 0.50 and 1.0 interprets as a large correlation. The results of the correlation table in this study show that there is a large correlation between 0.5 of the variable means.

### 4.4 Stage Four: Regression

Multiple regressions are conducted to determine the best linear combination of the ease of access, the level of interaction, the service quality, the internet quality and the perceived usefulness of the learning

**Table 3.** Correlation Analysis

Constructs	PU	EOA	LOI	SEQ	IQ
Perceived Usefulness	1				
Ease of Access	0.521**	1			
Level of Interaction	0.536**	0.373**	1		
Service Quality	0.588**	0.456**	0.628**	1	
Internet Quality	0.630**	0.413**	0.461**	0.591**	1

\*\* Correlation is significant at the 0.01 level (2-tailed).

system. The means, standard deviations, and inter correlations can be found in Table 4. This combination of variables is significantly predicted as the perceived usefulness,  $F(4, 301) = 84.42, p < 0.001$ , with all four variables significantly contributing to the prediction. The beta ( $\beta$ ) weights, presented in Table 5, suggest that the internet quality (IQ) contributes most when predicting the perceived usefulness (PU), while the ease of access is next in contributing to the e-learning system. The Regression illustrates how much of the variance in the dependent variable can be explained by the independent variables [51]. In this study the adjusted  $R$  squared value is 0.531 which indicates that 53% of the variance in the perceived usefulness (PU) is explained by the independent variables (EOA, LOI, SEQ, IQ). According to Cohen (1988), this is a large effect.

### 4.5 Stage Five: Testing the Models and the Hypothesis

For testing the hypotheses of this research the regression analysis is used where six hypotheses are formulated in the conceptual framework of this study and four of them are confirmed by the data (refer to Table 6).

According to previous researches in order to identify the factors underlying the construct in this study the researcher used a minimum eigenvalue of 1 as a cut-off value for extraction, also deleted items with factor loadings less than 0.4 on all factors, or cross loadings on two or more factors. An iterative sequence of factor analysis was executed. Fourteen of the items were deleted in this phase. At the end of the factor analysis procedure, an instrument of 4-factor and 16-items is obtained. The four factors are interpreted as the ease of access, the level of interaction, the service quality and the internet quality. In factor analysis phase the two factors of the interface design and the system quality eliminates the research model so the two hypothesized of interface design and the system quality were not participated in correlation and regression analysis. Therefore, the interface design and the system quality factors were unsupported in the hypothesis testing



**Table 4.** The Means, Standard Deviations, and Inter Correlations for Perceived Ease of Use and Predictor Variables (N=306)

Variable	M	SD	1	2	3	4
Perceived Usefulness (PU)	3.59	0.756	0.52***	0.53***	0.58***	0.63***
1. Ease of access (EOA)	3.53	0.662	-	0.37***	0.45***	0.41***
2. Level of interaction (LOI)	3.14	0.661		-	0.62***	0.46***
3. Service quality (SEQ)	3.33	0.639			-	0.59***
4. Internet quality (IQ)	3.33	0.75				-

Note. \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$

**Table 5.** Simultaneous Multiple Regression Analysis Summary

Variable	B	SEB(std.Error)	$\beta$	Tolerance	VIF
Ease of access (EOA)	0.27	0.05	0.23***	0.753	1.32
Level of interaction (LOI)	0.22	0.05	0.19***	0.587	1.70
Service quality (SEQ)	0.18	0.06	0.15**	0.468	2.13
Internet quality (IQ)	0.36	0.05	0.36***	0.616	1.62
Constant	0.18	0.19			

Note.  $R^2 = 0.531$ ;  $F(4, 301) = 87.42$ , \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$

results.

The H2 and H4 (interface design and level of interaction) questionnaire items are inserted in Appendix A (Questionnaire items used to measure the constructs of the model). The final questionnaire items in Appendix A include the questionnaire items of supported hypothesis in Table 6.

In order to test the relationship between the ease of access and the perceived usefulness of e-learning system, hypothesis H1 is used.

H1: There is a relationship between ease of access and perceived usefulness of e-learning. According to the results of the Regression Table ( $\beta = 0.23, p < 0.001$ ) it can be concluded that at a significant level of 0.001, H1 is proven true and that there is a significant relationship between the ease of access and the perceived usefulness of e-learning.

In order to test the relationship between the level of interaction and the frequency of the use of e-learning system, hypothesis H3 is used.

H3: There is a relationship between the level of interaction and perceived usefulness of e-learning. According to the results of the Regression Table ( $\beta = 0.19, p < 0.001$ ) it can be concluded that at the significant level of 0.001, H3 is proven true and that the level of interaction has significant relationship with the perceived usefulness of e-learning.

In order to test the relationship between service quality and the perceived usefulness of e-learning sys-

tem, hypothesis H5 is used.

H5: There is a relationship between the service quality and the perceived usefulness of e-learning. According to the results of Regression Table ( $\beta = 0.15, p < 0.001$ ) it can be concluded that at the significant level of 0.001, H5 is proven true that service quality has significant relationship with the perceived usefulness of e-learning. In order to test the relationship between internet quality and the perceived usefulness of e-learning system, hypothesis H6 is used.

H6: There is a relationship between internet quality and perceived usefulness of e-learning. According to the results of the Regression Table ( $\beta = 0.36, p < 0.001$ ) it can be concluded that at the significant level of 0.001, H6 is proven true that there is a significant relationship between the internet quality and the perceived usefulness of e-learning.

The six hypotheses of this study are conducted according to the relationships between dependent and independent variables of the conceptual framework form the basis of this research. According to the above results, four hypotheses of the six hypotheses conducted in the conceptual framework are supported which include EOA, LOI, SEQ and IQ. Based on the results of the factor analysis test, the interface design and the system quality constructs are two unsupported hypotheses of this study. Table 6 demonstrates the results of the hypothesis analysis.

The Research Model is developed according to the above results, which shows that the independent vari-



**Table 6.** Summary of Hypothesis Testing

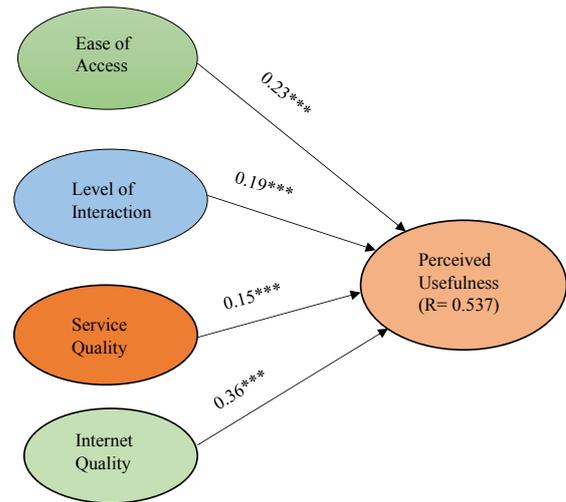
H#	Hypothesis Summary	Result
1	Relationship between ease of access and perceived Usefulness	Supported
2	Relationship between interface design and perceived usefulness	Unsupported
3	Relationship between level of interaction and perceived usefulness	Supported
4	Relationship between system quality and perceived usefulness	Unsupported
5	Relationship between service quality and perceived usefulness	Supported

ables include the ease of access, the level of interaction, the service quality, and the internet quality where all the variables have significant and positive relationships with the perceived usefulness of e-learning as a dependent variable.

The six hypotheses presented above are tested collectively using the Regression analysis and performed using SPSS 20. Figure 1 displays the standardized path coefficients and path significances. All six hypothesized associations are strongly significant at  $p < 0.05$ , except for the two links between the interface design and the perceived usefulness and between the system quality and the perceived usefulness. The perceived usefulness of e-learning in this study is jointly predicted by ease of access ( $\beta = 0.23, < 0.001$ ), level of interaction ( $\beta = 0.19, < 0.001$ ), internet quality ( $\beta = 0.36, < 0.001$ ), and service quality ( $\beta = 0.15, < 0.001$ ) and these variables together explain 53% of the variance of perceived usefulness ( $R^2 = 0.537$ ). The represented values and directions of the arrows in the proposed model of Figure 1 are according to the r values and coefficient ranges of the correlation test in Table 3. In this model the ease of access, the level of interaction, the internet quality and the service quality respectively have the r value of 0.52, 0.54, 0.63, 0.59 which shows that they have significant relationships with the perceived usefulness of e-learning.

## 5 Discussion

In this study, the perceptions of students on the technological aspects of e-learning are analyzed. Firstly, the technological related factors that affect the use of e-learning among students conducted in the reviewed literature are identified. Then the relationship between the related technological factors (ease of access, level of interaction, service quality, and internet quality) and perceived usefulness of e-learning among students are analyzed. Finally a model is developed based on the relationships between the technological related factors and perceived usefulness of e-learning. Out of the six hypotheses formulated at the start, only four of the hypotheses are confirmed by the data. The following paragraph discusses the significant results which summarizes the research framework.



**Figure 1.** Test Results of the Proposed Research Model  
\*\*\* $p < 0.001$ .

From the multiple regression analysis, four variables are proven to have critical relationships with the perceived usefulness; namely ease of access, level of interaction, service quality and internet quality. The results suggest that 53% (adjusted  $R^2 = 53%$ , F-value = 82.96,  $p < 0.001$ ) of the variance of the perceived usefulness can be explained by four critical variables. Based on the results of this study a research model is proposed and proved by the hypotheses and the linkages presented among the variables in the research model. The overall R-square of 54% for perceived usefulness of e-learning, reveal that the proposed research model is capable in representing a relatively high proportion of variation on the technological aspects of e-learning.

The effects of the ease of access, the interface design, the level of interaction, the system quality, the service quality and the internet quality on the perceived usefulness of e-learning are examined and the results of the study indicate that the internet quality is the strongest predictor of the perceived usefulness ( $\beta = 0.35, p < 0.001$ ).

In this research, the influence of the internet quality on the perceived usefulness is much stronger than the ease of access, level of interaction and service



quality which therefore suggests that user satisfaction in the internet quality is a decisive antecedent of the perceptions on usefulness.

This research identifies the internet quality in terms of satisfaction in speed and connection tools as an important factor which has a significant role in the perceived usefulness and is irrelevant to the system quality. This result is consistent with a study conducted by Bhuasiri, et al. [18]. With the consistence to prior studies as well, the findings of this study reveal that the service quality is positively related to the perceived usefulness and learner satisfaction [18, 53–55]. It is however confirmed in the model proposed by Roca, et al. [28] that the service quality has an indirect effect on the usefulness through a confirmation variable.

From the results, the proposed model of this study includes four independent variables, one dependent variable that perceives usefulness acts as a dependent variable for the other variables where it is inconsistent with previous models that the perceived usefulness acts as a mediator and an independent variable for the intended use [27, 31]. In the proposed model by Roca, et al. [28] system quality has an indirect effect on the perceived usefulness while in this study system quality does not any effect on the perceived usefulness. According to the results of this study the ease of access, the level of interaction, the internet quality and the service quality are independent variables for the perceived usefulness, also EOA, LOI, SEQ, and IQ have direct effects on the perceived usefulness.

Demographic factors (like gender, age, educational background, learning styles, personal goals and attitudes, preferences, cultural background, experience, motivation etc) have been recognized as the determinants of the intensity of using e-learning tools by students, teachers, and administrators [56, 57]. In addition, demographic and contextual impacts on user perceptions reported as critical points for the administrative and decision makers to investigate when developing and implementing e-learning in higher education [58]. For instance, previous experience with e-learning and computer/non-computer skills, which predicate the digitalization of the society, identified by Allah Nawaz (2010) as leading attributes of the respondents that are clearly changing their responses [56]. Therefore, the e-learning systems must be compatible with the contextual and human factors of any country. Future studies are recommend to investigate the impacts of demographics on the user perceptions on the technological aspects of e-learning.

## 6 Conclusion

This study attempts to enhance the technological aspects of e-learning. The contribution of this study will be in increasing the usefulness and acceptance of e-learning in education systems and at institutions of higher education. In order to achieve the perceived usefulness and improve learning performance in the e-learning system, top management personnel and employees should be equipped to allow easy access to all subjects for students in e-learning, support the advanced tools for better interaction between learners and instructors, have sufficient professional knowledge on the provided services in the e-learning system so as to have effective communications with students, and improve the connecting tools and the speed of internet connections. Therefore, the internet quality and level of interaction are two vital components of the perceived usefulness in e-learning.

In the initial stage, related literature was widely reviewed and twelve critical factors which are regarded as the most prevalent success factors in previous works by technological dimensions were identified for the success of e-learning. For the technological aspects of e-learning, the ease of access, the level of interaction, the service quality and the internet quality were the important considerations for e-learning success. In the present study as expected, the ease of access, the level of interaction, the service quality and the internet quality are found to be important factors influencing e-learning usefulness. Also the results of this study suggest that when e-learners consider the speed of internet and connection tools to the internet as satisfactory, they were more agreeable to the usefulness of e-learning and this increased their performance in learning. By understanding the determinants of perceived usefulness the findings of this study can be appropriate indicators in order to increase the usefulness, and acceptance of e-learning in education systems and institutions.

E-learning systems in universities face many problems and these may range from user dissatisfaction, disapproval, and inaccessibility and cause challenges in implementing e-learning. The lack of adequate and comprehensive attention to the technological aspects of the e-learning systems may lead to further challenges and dissatisfaction. Therefore, it is very important to implement an e-learning system with more advanced and updated technologies. To grasp this objective, the top management in the universities should have long term planning and make appropriate investments in their IT departments and encourage the staff to assist them in all aspects. In fact enough support and attention from the top management of the technology departments will increase the e-learning



success and perceived usefulness.

To achieve the perceived usefulness and to improve the learning performance in using the e-learning system, the top management and the employees should be well equipped to provide easy access to students for all e-learning, subjects support the advanced tools for better interaction between learners and instructors, have sufficient professional knowledge on the services provided in the e-learning system and to have effective communication with students, and improve the connection tools and the speed of connection to the internet. The internet quality and the level of interaction are two vital components of the perceived usefulness in e-learning. Furthermore, instructors can make use of online chat-rooms to have more interaction with students. One of the most valuable outcomes of the process of identifying relationship between the technological related factors and perceived usefulness of e-learning system is the opportunity it offers to reflect on the current systems, consider future directions and to spend time exploring how e-learning would move forward.

In order to obtain more beneficial results in future research it is necessary to consider the following recommendations. Further researches should extend and validate the research model according to the other components of the TAM Model and other models to evaluate the effects of the technological aspects of e-learning on the perceived ease of use, attitude and intention to the usage of e-learning. The research scope should be extended to other universities including their students, teachers and academic staff to increase the reliability of the results and in addition this study could be further expanded for a more concise evaluation with a larger number of respondents and by including more elements and factors that affect the using of e-learning in the research to achieve a more in-depth understanding regarding the effectiveness of e-learning. Evaluating the e-learning system from other angles like security and engaging biometrics as a security factor would probably increase the e-learning success. Both the quantitative and the qualitative data collection methods could be combined to gain more complete results in this area. The researchers hope that this study gives a preliminary insight and understanding on the success factors of e-learning to increase the acceptance of e-learning in higher education.

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## A Questionnaire Items Used to Measure the Constructs of the Model.

Item	Question	Reference
<b>Ease of Access</b>		
EOA1	E-learning system is easily accessible via Internet.	[54]
EOA2	I can easily access the e-learning system anytime I need to use it.	[59]
EOA3	All subjects that I registered for this semester can be accessed through e-learning.	(Self-developed)
<b>Level of Interaction</b>		
LOI1	I can interact with classmates through e-learning.	[60]
LOI2	I can easily contact the instructor.	[60]
LOI3	I gather more information in using e-learning compared to class actions.	(Self-developed)
LOI4	I feel that the quality of class discussions is high throughout the course in e-learning.	[61]
LOI5	E-learning system supports different kinds of tools for interactivity between learners and instructors.	(Self-developed)
<b>Service Quality</b>		
SEQ1	The web-based learning system is updated regularly.	(Self-developed)
SEQ2	I feel comfortable using the functions and services provided by the Web-based learning site.	[62]
SEQ3	I do not experience any problems during registrations for courses in e-learning.	[54]
SEQ4	The staffs of the information service department have sufficient professional knowledge on e-learning.	[63]
SEQ5	I can communicate with the staff of the information service department through multiple channels when I encounter technical problems which require quick responses.	[63]
<b>Internet Quality</b>		
IQ1	I am satisfied with the speed of the Internet.	[64]
IQ2	I feel it is easy to go online for e-learning at campus.	[64]
IQ3	I am satisfied with the connection tools to the internet.	(self-developed)
<b>Perceived Usefulness</b>		
PU1	Using e-learning can improve my learning performance.	[21]
PU2	I find e-learning as useful.	[21]

