



قياس مدى تأثير خصائص سهولة الاستخدام في استخدام نظام التعلم الإلكتروني

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Measure the Range Effect of Usability Characteristics in use E-learning System

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المخلص:

يجب أن تكون متطلبات البرمجيات محددة وموثقة بوضوح للتأكد من أن البرمجيات يلبي احتياجات وتوقعات المستخدمين وغالبًا ما تكون مشكلة استخدام التعليم الإلكتروني ترجع الي الجودة النظام مثل سهولة الاستخدام مع خصائصها الفرعية وإمكانية التذكر والكفاءة وقابلية التعلم حاسمة لنجاح نظام برمجي. بالإضافة إلى تحديد المتطلبات، من المهم قياس وتقييم جودة البرمجيات طوال عملية التطوير. يمكن القيام بذلك من خلال طرق مختلفة مثل الاختبار والمراجعات وعمليات التفتيش. من خلال القياس والتقييم المستمر لجودة البرمجيات، يمكن تحديد أي مشكلات أو عيوب ومعالجتها في وقت مبكر من عملية التطوير. علاوة على ذلك، يعد الحفاظ على التركيز على الجودة منذ بداية عملية تطوير البرمجيات أمرًا بالغ الأهمية. يتضمن ذلك وجود فهم واضح لما تعنيه الجودة بالنسبة للبرمجيات المحدد الذي يتم تطويره، بالإضافة إلى وجود خطة معمول بها لكيفية قياس الجودة والحفاظ عليها طوال عملية التطوير. بشكل عام، يعد ضمان تحديد متطلبات البرمجيات بوضوح وقياس الجودة والحفاظ عليها بشكل مستمر طوال عملية التطوير أمرًا ضروريًا لإنتاج برمجيات عالية الجودة تلبي احتياجات وتوقعات مستخدميها.

الكلمات الدالة: التعليم الإلكتروني - سهولة الاستخدام - التذكر - الكفاءة - قابلية التعلم.

Abstract

The software requirements should be clearly defined and documented to ensure that the software meets the needs and expectations of the users. The main issues to use e-learning system refer to quality system such as usability with

their sub characteristics, memorability, efficiency, and learnability are often affects to the satisfaction to continue to use of a e-learning system. In addition to defining the requirements, it is important to measure and assess the quality of the software throughout the development process. This can be done through various methods such as testing, reviews, and inspections. By continuously measuring and assessing the quality of the software, any issues or defects can be identified and addressed early on in the development process. Furthermore, maintaining a focus on quality from the beginning of the software development process is crucial. This includes having a clear understanding of what quality means for the specific software being developed, as well as having a plan in place for how quality will be measured and maintained throughout the development process. Overall, ensuring that software requirements are clearly defined and that quality is continuously measured and maintained throughout the development process is essential for producing high-quality software that meets the needs and expectations of its users.

Keywords: E-learning, Usability, Memorability, Efficiency, and Learnability

1.0 Introduction:

E-learning is the use of electronic media and information and communication technologies in education. It is said to be the most promising technology and method for broadening access to education and reducing costs in higher education. E-learning has begun to play significant roles in post-secondary education systems for its capacity to offer flexible and convenient higher education and lifelong training and learning. It redefines school time, opens up new possibilities for learning, broadens the range of stakeholders, and creates new learning methods, among others. The enormous development of technology offers opportunities and challenges. It brings opportunities to transform education, so as to make it more accessible, more supportive of quality, and more responsive to the demands of both external labor markets and internal accountability.

One of the important characteristics of usability in e-learning system is effectiveness (Gaoud Alghabban & Hendley, 2022). The concept of usability is typically confined to interfaces such as those encountered in human-computer interaction (Speicher, 2015). Usable interfaces produce a connection between human and computer system. According to Santoso et al. (Thuseethan et al.,

2014), during the era of digitization, there are many systems that feature multiple user interfaces. One such example is in the field of learning systems that are well known as e-learning. Usability in e-learning systems is found to have a great influence in increasing meaningful learning activities and interaction with technology. Though, usability in e-learning systems is still at its infant stage, still some valuable works have been found in the current literature. According to Kaur and Jain, the usability of any e-learning system has specific characteristics in terms of learnability, efficiency, memorably.

2.0 Usability Characteristics

Usability is a reflection of the human-computer-interaction (HCI), since users adopt a particular technological product to accomplish their task quickly and effortlessly. In other words, usability factors make a system easy to learn and easy to use, through a usable user interface. The inclusion of these sub-characteristics in the assessment of usability will provide a more comprehensive understanding of the quality of e-learning systems.

Memorability is measured by the task need to be performed with screen cues, the clear icons in system, the buttons symbol in the system intuitive and self-explanatory. Efficiency is the capability of the software product to provide appropriate performance, relative to the amount of resources used under state conditions, and learnability focuses on how quickly users can learn to use the system.

By considering these sub-characteristics in evaluations, developers can gain insights into specific areas for improvement in their e-learning systems. This can lead to the development of more user-friendly and effective collaborative software applications. Additionally, by addressing these sub-characteristics, barriers that prevent learners from using a system smoothly can be identified and mitigated.

In conclusion, usability is a crucial attribute in the development of successful collaborative software applications. By including specific sub-characteristics such as memorability, efficiency, and learnability, in assessments, developers can gain a more comprehensive understanding of the quality of e-learning systems and make improvements that enhance usability for users.

Usability refers to the ability of using the system in an easy manner (Davids et al., 2014). According to Hollender et al. (2010), total usability consists of few key factors, such as learnability, efficiency, and memorability. Heim (2008)

defines, the attributes of usability as: learnability is how fast a user can learn to accomplish a task, efficiency demands how fast an experienced user will complete a given task, memorability refers to whether it is easily memorable for a user to use the system each time he or she access the system.

An e-learning system is really easily to use, in my opinion, if the user interface is nicely layout, compatible colour, clear font, and navigate linked buttons.

Usability is measured in percentages. Generally, there is formula to measure usability. This method takes into account the questions and calculates usability depending on the answers. If it is to measure the usability of the system, this could be achieved by measuring the usability of the layout, color, font, and navigate linked buttons of the e-learning materials are some of the elements to assess the usability of that interface when using the system.

In order to achieve 100 % usability, the following formula can be used

$$Usab = W_{\text{layout}} + W_{\text{color}} + W_{\text{font}} + W_{\text{navigate link}}$$

Where: 21.7% + 25.6% + 24.3% + 27.4% =100%

The values for each criterion attribute of the guiding principles were obtained from the results of the questionnaire. Each attribute was represented by questions that were related to the criteria of the attribute. Respondents indicated the value using items loading results, and the values have been calculated to obtain the percentage for each criterion of the attribute.

2.1 Memorability

Memorability is measured by the ease of reestablishing proficiency after a period of not using the system. In order to improve memorability, designers should focus on creating a user-friendly interface with clear navigation and intuitive features. Providing visual cues and prompts can also help users remember how to use the portal. Additionally, incorporating feedback mechanisms and personalized recommendations can enhance the overall user experience and make the portal more memorable. Ultimately, the goal is to create a seamless and enjoyable learning experience that users will easily remember and want to return to.

Additionally, images can help break up long blocks of text and make the content more engaging for learners. They can also help to clarify complex concepts and make the learning experience more interactive When using images in eLearning, it's important to ensure that they are relevant to the content and support the

learning objectives. High-quality images that are clear and visually appealing will enhance the overall learning experience. It's also important to consider accessibility when using images in learning, ensuring that they are descriptive and meaningful for all learners.

In conclusion, images play a crucial role in e-learning by enhancing retention, engagement, and understanding of content. When used effectively, they can greatly improve the overall learning experience for students.

In order to achieve 100 % memorability, the following formula can be used:

$$\text{Mem} = W_{\text{scues}} + W_{\text{Cicons}} + W_{\text{Bs}} + W_{\text{images}}$$

Where: mem = memorability, measured in %; W_{scues} = The task need to be performed with screen cues at most 24%; W_{Cicons} = The clear icons in system, at most 26 %; W_{Bs} =The buttons symbol in the system intuitive and self-explanatory, at most 26.4%; W_{images} = The images able to recall information more easily , at most 23.6%.

2.2 Efficiency

E-learning also allows for personalized learning experiences, as students can progress at their own pace and focus on areas where they need more support. It also provides flexibility in terms of scheduling and location, as students can access materials and participate in discussions from anywhere with an internet connection. Additionally, e-learning can lead to a reduction in the environmental impact of traditional classroom-based learning, as it often requires fewer resources such as paper and transportation.

Overall, the efficiency of e-learning is measured by its ability to provide a high-quality education while minimizing time, cost, and environmental impact. It is important for educators and institutions to continually assess and improve their e-learning programs to ensure that they are meeting these goals.

Efficiency is the relationship between the precision and perfection in helping users to achieve particular tasks and goals, and the resources that have been used in achieving them, the ability of users to complete their tasks without wasting time or effort.

In general, the descriptions were formulated for improving the efficiency of the system. Well-known systems of e-learning perform various functions with a faster response, control of links and ability to load resources, and can therefore be considered efficient.

Formula: Efficiency is measured in percentages. The formula to measure efficiency takes into account the questions and descriptions. Efficiency is calculated depending on the answers. To measure the efficiency of system, it is necessary to measure the efficiency and speed with which the system performs functions, its ability to control, and its ability to load and organize resources.

In order to achieve 100 % efficiency, the following formula can be used:

$$\text{Eff} = \text{WPER} + \text{WCONT} + \text{WRES}$$

Where: Eff = efficiency, measured in %; WPER = The system perform various functions, with a rapid response, at most 33%; WCONT = The system is able to control all links, at most 33 %; WRES = The system loads resources, organize groups., loads pages and graphics quickly, at most 34%.

2.3 Learnability

Learnability is easy it for users to learn to use a system, can the users quickly learn to use it, Learnability, the system must be easy to learn. In this way, the user will be able to complete a task over the system rapidly. The values for each criterion attribute of the guiding principles were obtained from the results of the questionnaire. Each attribute was represented by questions that were related to the criteria of the attribute. Respondents indicated the value using items loading results, and the values have been calculated to obtain the percentage for each criterion of the attribute. This process was repeated for all the attributes in this paper.

To demonstrate learnability, let us consider a user who wishes to learn to use the system: the e-learning system provides visibility of operations, feedback is given to the user in response to an action, there is continuity of tasks by links between the different steps of a task, tasks are integrated, and the basic steps of a task are easily visible. The system provides help to design conventions, design descriptive labels, and measures to prevent errors. Moreover, guidelines are provided to finish a task. It is assumed that these elements improve the system and therefore contribute to learnability

In order to achieve 100 % learnability, the following formula can be used

$$\text{Learn} = \text{W}_{\text{UF}} + \text{W}_{\text{HELP}} + \text{W}_{\text{EOREM}}$$

Where: Learn = learnability, measured in %; WUF = the visibility of operations, feedback, continuity of task, at most 31.6 %; WHELP = the design conventions, design of descriptive labels, user assistance, error prevention, at

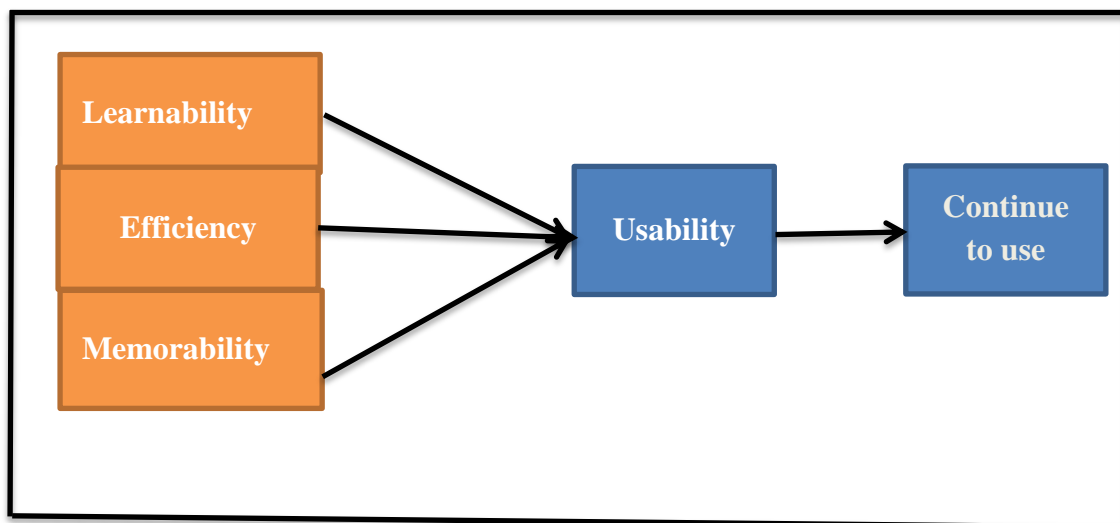
most 34.8 %; WEOREM = A small number of steps to finish a task; information provided as guidelines to complete a task, at most 33.6 %.

3.0 Continue to use

The phrase "continue to use" serves as a key indicator for understanding factors influencing preferred behavior (Losavio, F. et al., 2003). Success of e-learning hinges on user satisfaction and their intent to persist with it, necessitating identification of predictive factors for continued use (Freeze, R. D. et al., 2010). User intention plays a vital role in determining actual system utilization .

4.0 Framework of Usability Characteristic

Basically, Usability characteristics in e-learning impact user experience and satisfaction. Prioritizing these attributes is crucial for successful e-learning system development, as they directly influence user retention and completion rates of courses. Neglecting usability can lead to frustration and dropout rates. It's vital to integrate these attributes effectively to enhance the quality of the software product and ensure user engagement. Therefore, it is essential to prioritize these characteristics as a framework component see (Fig 1).



4 1.Research Hypothesis: The hypothesis in this paper about usability characteristics including:

- 1- Learnability significantly influence students' continued use of e-learning system.
- 2- Efficiency significantly influence students' continued use of e-learning system.
- 3- Memorability significantly influence students' continued use of e-learning system.

5 0. Survey Analysis

5.1 Data collection

Data was collected from 213 students as they were from Libya Open University where used a structured questionnaire which was derived from the review of the literature. The questionnaire consisted of 2 sections. The first section was about the demographic information and the second section was about the components of the framework. The demographic information was related to age, gender, . While the components of the framework focused on the usability, learnability , efficiency, memorability and continue to use.

5.2. Sample Profile

The demographics of the respondents are the majority of the 213 respondents (57.7 %) were male while 123 respondents (42.3%) were female. As for the age of the participants, more than three-quarters of the 94 respondents were from 35 years or younger (44.1%) while 68 respondents (31.9%) were 36 years to 46 years, and 51 respondents (24%) were from 47 years to 57 years.

5.3. Data Analysis

In the process of collected data analysis, the structural equation model (SEM) procedure was followed, which was suggested by Anderson and Garbing .This model consists of two major parts that are measurement and structure model. Where was using the measurement model to examine the reliability and discriminant validity which detailed it in Table 1, where were all latent variables in the survey had high construct reliability.

Table 1 : Results of Evaluation the Measurement Model

Latent Variable	Indicator	Factor Loading	Composite Reliability	AVE	Cronbach's alpha
Learnability	LQ1	.864	.9143	0.8652	.8532
	LQ2	.911			
	LQ3	.876			
Efficiency	EQ1	.912	.9324	0.7436	.8456
	EQ2	.905			
	EQ3	.858			

Memorability	MQ1	.841			
	MQ2	.822	.9467	0.8147	.8759
	MQ3	.810			
	MQ4	.794			
Usability	UQ1	.894			
	UQ2	.936	.9053	0.7834	.8346
	UQ3	.836			
	UQ4	.868			
Continue to use	CQ1	.914			
	CQ2	.878	.9265	0.7732	.8634
	CQ3	.832			

The validity of the structural model is assessed using the coefficient of determination (R^2), path Coefficients, and the strength of the effect (f^2), which demonstrated in Table III. Examining the structural model enables the assessment of its explanatory power. In other words, how much variance in the dependent variables of interest can the independent variable explain or account for. The main objective of this analysis is the demonstration of the three additional dimensions as a complete measurement model.

Table 2. Results of Evaluation the Structure Models

Run	Removed	R-square	R-square Included	Effect Size Excluded	Interpretation
	Continue to use	0.5478			
	Usability	0.5732			
1	Learnability		.3211	0.14	Medium effect
2	Efficiency		.3518	0.19	Medium effect
3	Memorability		.4134	0.05	Small effect

The result of hypothesizes testing showed significant support for all of hypothesis in this study as shown in Table 3. Where were the attributes of usability which are learnability ,efficiency , memorability are affects directly in usability , also usability affect directly in continue to use.

Table 3. Summary of Hypothesis Testing

No	Hypothesis	β	<i>t</i> -value	<i>p</i> -value	Support
H1	Learnability →Usability	0.324	2.54	0.01	Yes
H2	Efficiency →Usability	0.256	3.25	0.01	Yes
H3	Memorability →Usability	0.185	2.89	0.01	Yes
H4	Usability → continue to use	0.743	13.47	0.01	Yes

6.0 Discussions and Conclusion

The metric for usability is efficiency, which can be measured by the time it takes for users to complete tasks within the system. Another metric is learnability, which can be measured by the time it takes for users to learn how to use the system, the last metric in this paper is memorability the system must be easy to remember, in this way, an average user will not have to learn everything over again once s/he returns to the system after a while. These metrics can be used as criteria in the requirements phase to ensure that the system is designed with usability in mind from the beginning. By including these metrics in the development life cycle, potential issues can be identified and addressed early on, leading to more usable and efficient system overall.

The paper aims to measure the usability characteristics of system quality that impact learners' satisfaction with e-learning. It employs quantitative methods, collecting data through a questionnaire distributed to 213 students at Libya Open University in the 2023–2024 academic year. The analysis will utilize SEM to evaluate reliability and validity before testing structural models to assess the relationships within the proposed model. This will clarify the extent effect of the characteristics of sub attributes of usability (learnability, memorability, efficiency) with usability, and finally towards to use the e-learning system. After the verification of the reliability and validity of the questionnaire, the final version of the questionnaire was developed and ready to be administered to the research

sample. The aim of this paper is to measure the quality attributes of the usability with sub characteristics system, which significantly impacts learners' their continued use of the e-learning system. This measured process will focus on key characteristics such as usability, including sub-attributes like learnability and efficiency and memorability, in Libya Open University. These factors are widely recognized in various aspects of system quality, including quality in use, end user factors, and product process, and play a crucial role in fostering continue to use the e-learning system.

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