Predictive Study of the Factors and Challenges Affecting the Usability of E-Learning Platforms in the Light of COVID-19

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Article Info	Abstract
	In the light of the accelerating trends in recent years towards the adoption of e-learning and its delivery platforms, e-learning has become a strategic solution to face many challenges, especially those imposed by the coronavirus pandemic (COVID-19). The findings of previous studies revealed the effectiveness of e-learning in reducing negative effects resulting from COVID-19. However, those studies emphasized the need for more research on the factors that enhance the effectiveness of e-learning, especially those factors related to instructional design, attractiveness, availability, and usability. Therefore, the study explored the factors that affect the usability of e-learning platforms by developing a predictive model to reveal student satisfaction with the use of e-learning platforms. The model consisted of four predictive factors (learnability, efficiency, effectiveness, and the instructional design of electronic content). In order to achieve the objective of the study, a scale was designed. It included five variables and 36 items. The results concluded that the factors in the scale (learnability, efficiency, effectiveness, and the instructional design of electronic content) contribute to the explanation of 62% of the variance value in the dependent variable (student satisfaction). Also, the factors of the instructional design of electronic content, and the effectiveness of using e-learning platforms showed a high ability to predict usability through the indicator of student satisfaction with the use of e-learning platforms. In addition, the results unveiled that the factors of learnability and efficiency did not show a significant effect in predicting usability. Finally, the prediction model had a moderate degree in predicting the changes that could affect the dependent variable (usability through the indicator of student satisfaction).

Introduction

In the light of the accelerating trends in recent years towards the Countries seek to develop their educational systems to absorb the rapid increase in the number of learners and to keep pace with the changes of the era of digital transformation. In the meanwhile, other challenges have arisen and have been imposed on those countries

to readjust their educational systems, in response to these changes. Among those challenges are the effects resulting from the emerging coronavirus (COVID-19). The World Health Organization announced its transformation into a global pandemic on March 11, 2020. The pandemic imposed the necessity of shifting towards e-learning and distance education as a strategic solution to mitigate the negative effects of the spread of this pandemic. The government of the Kingdom of Saudi Arabia was keen to avoid the dangers resulting from this pandemic, and the continuity of the educational process at the same time. The Ministry of Education has taken the initiative to suspend the study in person and to shift towards e-learning so that educational institutions can achieve their goals. The Kingdom of Saudi Arabia had taken a proactive step in establishing the National Center for E-Learning. Among its strategic priorities in the future is to enhance confidence in e-learning programs and systems.

The transformation plan towards e-learning includes providing alternatives to face-to-face education within educational institutions and providing safe access to learning content, educational resources, support, and assistance. This transformation requires the necessity of paying attention to the fulfillment of global standards related to the availability, accessibility, and usability of e-learning systems. These standards have an effective impact on the ability of e-learning systems and platforms to achieve the expected benefits, especially in the light of the uncertain end of this pandemic, or the emergence of new variants. This makes e-learning more than an emergency solution, but rather a strategic option, which requires more research in order to reveal the factors that predict the learner and the teacher's acceptance to use e-learning platforms and systems.

E-learning platforms are among the strategic solutions to activate e-learning plans. The studies by Ramadhan et al. (2021) and Milicevic et al. (2021) indicated that e-learning platforms and systems achieve several benefits. These benefits include diversifying options for monitoring teaching and learning processes, detecting strengths and weaknesses, predicting plan factors and lagging aspects, providing educational solutions and experiences that simulate reality with appropriate effort and cost, diversifying and facilitating educational and social interactions taking into account Individual differences and the learners' potentials and abilities. In the same context, other studies revealed the advantages and benefits of using e-learning platforms (Rodriguez-Sevillano et al., 2016; Araugo et al., 2020; Daniela, 2020). These benefits include providing learning opportunities and experiences that contribute to the development of self-learning skills, diversifying forms and scenarios for providing learning, accommodating the steady increase in the number of students enrolled in education in general and online learning environments in particular, speeding up the identification of teaching and learning resources, reuse, accessibility, and availability.

Johnsons et al. (2020) confirm that e-learning systems and environments considered alternative options for continuing teaching and learning and a solution to secure students and learning communities. But at the same time, they emphasize that these systems must have the factors that enhance their effectiveness in order to achieve learners' satisfaction and acceptance to use them. In the same vein, Devi et al. (2020) indicated to centeredness of e-learning platforms and environments around the learner, the diversity and spread of digital teaching and learning applications, and the diversity in the desires and categories of users. This has imposed several necessities, including the need to understand the learner's behaviors and his perceptions about e-learning

environments. This was confirmed by the study of Lin and Fang (2008) that emphasized the need to explore students' perceptions and evaluate their experiences with the use of e-learning systems. Also, Owusu-Fordjour et al. (2020) emphasized the potential of e-learning systems, especially in the light of facing the challenges of dangers and epidemics, and solving the problems of the study lagging in person. They also highlighted linking the success of plans to benefit from those capabilities with the availability of the factors of availability, access, flexibility, attractiveness, and ensuring continuity of use.

Wang et al. (2019) pointed out that the availability of e-learning systems does not mean achieving the desired benefit, but rather it is necessary to search for usability factors that predict the continuity of the trend towards the use of e-learning and acceptance by the user. They listed usability in five factors: self-efficacy, enjoyment or involvement in learning, ease of use as perceived by the user, expected benefit, and user experience. Al-Qahtani (2016) stressed the need to research the interpretation of user behaviors towards e-learning, and to reveal the predictive factors (motivating - discouraging) to accept the use of e-learning applications, with the aim of interpreting learning outcomes in their light and identifying educational and administrative interactions and organizations that contribute to the effectiveness of e-learning.

Despite the several advantages of e-learning, the learners' feeling of its failure predicts danger, especially in weak learning outcomes, and the occurrence of psychological disorders for the learner. This was confirmed by the study of Hasan and Bao (2020), which confirmed the existence of a negative impact of anticipating e-learning failure in the light of the Coronavirus pandemic, learning outcomes as well as psychological disorders for the learner. The study also recommended the necessity of researching factors to reduce the feeling of expecting e-learning failure by identifying the factors that can predict this behavior or feeling in the learner.

Yunusa and Umar (2021) pointed out that research interests in the field of e-learning focus on researching post-adoption factors to evaluate the effectiveness of e-learning. There was a lack of research interest in studying the predictive factors through which it is possible to predict the features and effectiveness of e-learning. The researchers recommended more research on the classification of predictive factors for effectiveness and satisfaction. Sharma et al.'s (2017) study is in agreement with Yunusa and Umar's study. They emphasized that the success of e-learning management systems on the student's use and acceptance. They recommended the need to pay attention to developing models to predict user acceptance factors for e-learning platforms.

Perez-Perez et al. (2020) confirmed that although there is a positive impact of e-learning management systems on learning outcomes, there is very limited, if not, research on the factors affecting learners' satisfaction and their perceptions of the benefits achieved. There is a need to explore the factors that affect the learners' acceptance of the use of e-learning management systems. Zaharias and Poylymenakou (2009) pointed out that e-learning usability assessment is not only related to the quality of learning outcomes. Rather, it is used to judge the effectiveness of the instructional design for e-learning.

The effect of usability extends to other factors such as the learners' level of participation and continuity in the e-learning environment. Lee et al. (2019) pointed out that exploring factors predictive of usability and satisfaction

with learning helps identify appropriate conditions, arrangements, and organizations to ensure an increased level of participation and continuity. Also, they indicated that psychological factors are among the strongest predictors of the effectiveness of participation and involvement in learning, indicating a positive correlation between the level of usability and psychological satisfaction. Mtebe and Raphael (2018) mentioned that the quality of services and applications in e-learning is a strong predictor of learners' satisfaction with learning and that the quality of services is related to usability, availability, and accessibility.

Gunesekera et al. (2019) mentioned that there is a correlation between the level of usability of e-learning and the level of quality of educational interaction patterns (the learner with the learner, the learner with the teacher, the learner with the learning content). Based on this correlation, the level of learners' satisfaction and their continuity in learning have resulted. In the same context, Salloum et al. (2019) emphasized that the level of access to and sharing educational materials positively affects the prediction of the usability of e-learning. Ali et al. (2018) claimed that the development of conceptual frameworks for the factors that affect the implementation of e-learning contributes to predicting the effectiveness of e-learning and the level of usability. Cheok and Wong (2015) stressed the need to take into account the determinants associated with user characteristics, e-learning system characteristics, and organizational characteristics to ensure that usability is achieved, and thus achieve the effectiveness of the e-learning system.

In the light of the foregoing, it can be concluded that e-learning is a strategic option to reduce the effects of the current developments, especially developments related to the effects of the Coronavirus pandemic. The presence of e-learning platforms and systems achieves several educational benefits. Also, there is a correlation between the effectiveness of e-learning environments and their ability to achieve their goals in the level of its usability and learners' perceptions of its expected benefits and the resulting joy of learning. Several studies confirm the need to pay attention to developing predictive models and conceptual frameworks to explore the factors and determinants that predict the usability of e-learning.

Review of Literature

 With the advancement in information and communication technology, web-based learning environments and e-learning platforms have gained special importance. Open learning resources can be used, accompanied by diversity and increase in the number of learners, diversity of approaches and methods of promoting teaching and learning, and facilitating the processes of interaction and sharing. E-learning platforms are integrated digital systems that enable learners to interact with their peers and teachers and access learning resources at any time and from anywhere. They also include educational resources, tests, activities, instructions, and guidelines. In addition, they have tools and applications for synchronous and asynchronous communication and tools for educational interactions. They are usually linked to systems for delivering and managing e-learning.

Blackboard is one of the e-learning management systems that universities have used. This system provides a number of services, tools, and applications that develop an interactive learning environment. Previous studies focused on revealing the educational benefits and potentials of the Blackboard Learning Management System

(Daniela, 2020; Milicevic et al., 2021; Ramadhan et al., 2021). The findings of those studies revealed that the learning environment designed and implemented using Blackboard contributes to achieving many educational benefits. It enhances active and collaborative learning approaches and provides adaptive learning environments. Also, it meets the needs of learners and provides many educational alternatives. Some studies explored the factors and obstacles facing users in using the Blackboard system. Among those factors are learners' acceptance to use the system and achieve the perceived benefit.

The Blackboard Learning Management System is the officially approved e-learning platform at Najran University. It has many capabilities including providing the necessary tools for course management and registration and support services. It also keeps files and documents and has the ability to track students' cases and extracts the necessary reports. In addition to that, it provides synchronous and asynchronous communication tools and that enhance students' interaction with peers and teachers. Blackboard includes easy-to-use and flexible tools for creating and managing exams of various types, replying to inquiries, and providing feedback in various forms. It consists of several components: announcements, information about the course and faculty member, assignments and tasks, course contents, communication, and interactive tools. Blackboard is characterized as a learning management and delivery system that enables educational institutions of all levels to manage and deliver their learning via the Internet. It has several advantages such as discussion forums and downloading and sharing files easily. Also, it supports e-mail functions and calendar and language applications and customizes interaction interfaces. It supports synchronous video and audio meetings and the creation of tests and question banks. In addition, it supports individual and cooperative learning patterns through group split feature, announcement feature, SCORM, and QM standards compatibility. It provides digital learning repositories and a center for keeping documents, records, and reports. Finally, it supports many tools and applications such as blogs, wikis, and others, and various file formats.

The Blackboard e-learning management system has a number of functions reported by several studies (Stenholm et al., 2019; Chen et al., 2020; Hamill, 2020; AL-Hunaiyyan et al., 2021). These functions include ease of use, availability, and ease of access, providing the necessary support for the design, development, and management of electronic content and courses. Also, it facilitates the processes of managing educational and social interactions and provides various tools and applications for synchronous and asynchronous communication. It manages, documents, and protects data, information, records, and reports. In addition, it tracks and monitors student progress rates and overcomes restrictions of time and place. Further, it includes designing presentation patterns and displaying electronic content in an attractive and interesting way. It provides the capabilities of customization, adaptation, and taking into account the preferences of learners. Furthermore, it provides tools for managing and organizing time and meetings. It has a variety of forms of providing feedback and seeking help and support. It varies in assessment methods and patterns and provides tools for diagnosing strengths and weaknesses. The reuse of learning resources and electronic content is possible, and it has a diversity of channels for providing support, compatibility with many software and applications. Finally, it provides printing capabilities and exporting and extracting reports.

Because of these features, several studies have examined its effectiveness as a management and delivery

platform for e-learning. The study conducted by Julian et al. (2019) revealed the effectiveness of Blackboard in enhancing the efficiency of peer and collaborative learning methods and patterns, as well as providing teachers with the skills of designing and developing electronic courses, thus enhancing the self-efficacy of teachers. Al-khresheh's study (2021) also indicated the effectiveness of using the blackboard in developing language skills and recommended the necessity of conducting further studies to reveal the perceptions of teachers and learners regarding the use of learning management systems and their expectations for its benefits. Hamill (2020) conducted a study that concluded that the blackboard is a mainstay for teachers to enable them to continue providing teaching and learning processes, especially in the light of challenges and dangers. Chen et al. (2020) stressed that the Blackboard learning management system enhanced the learners' self-learning skills and assumption of responsibility and higher-order thinking skills.

Usability is among the key requirements for the success of e-learning systems and environments. It is concerned with teachers and learners' acceptance to use these systems and adopt them as a platform for managing and delivering teaching and learning processes. According to ISO 9241-11 (2018), usability is the extent to which a particular system, platform, or product can be used by specific users to achieve pre-determined goals, efficiently, effectively, and satisfactorily in a specific context of use. Nielson et al. (2014) see that it is the user's ability to interact with the system efficiently and easily. Accordingly, it can be said that it is a criterion for quality and assessment of how easy it is to use a specific system or platform. The term usability includes three main components: effectiveness, efficiency, and satisfaction. Effectiveness refers to the percentage of utilization of functions and tools available in the system. Efficiency refers to the amount of time and effort spent to achieve the goal. Satisfaction refers to the amount of comfort and contentment that the user feels while using the system (Kumar et al., 2020).

There is a difference between ease of use and usability. While ease of use is related to the ability to use the system or platform, usability extends to ensuring the continuity and regularity of the use process (ISO 9241- 11, 2018). Nielson et al. (2014) identify a set of features or maybe components for usability. These features or components are:

- Learnability: the learner's ability to use the learning management system or the user interface to achieve the required task from the first attempt. The learnability of the system is inferred by the system's ability to reduce the time taken to complete the required tasks and more practice leads to reducing the time required for implementation. Learnability is also inferred through a number of indicators such as ease of access to educational materials, availability of instructions and ease of perceiving and following them, availability of self-motivation and support factors, ability to ask questions and take notes, and availability of additional educational resources. Accordingly, the learnability of the learning management system can be measured by determining the degree of ease that the learner feels while completing the required tasks from the first attempt.

-Efficiency/ the strength of the effect or expected benefit: the ability of the system to create learning as a result of the learner's interaction with the available applications and tools. Also, it is referred to as the speed in performing and completing the required tasks.

- Recall/retrieval ability: the ability of the learner to remember and recall the steps of using the system

when returning to it after a period of time.

- Errors: the percentage of errors expected to occur as a result of the learner's use of the system, the mechanisms provided by the system to avoid those errors, the extent of their impact on the effectiveness of learning, and the ease of expected solutions to those errors.

- The learner's characteristics: the level of availability of adaptation factors and personalization, as well as the factors of distraction and increase in the cognitive load.

- Satisfaction: the degree of enjoyment and contentment, whether while using the system or as a result of using it, in addition to the learner's level of support for using the system in the future.

- Navigation: the ease of navigation between the components of the system and the adjustment and customization of the system components in the light of the learner's preferences.

There are requirements that must be available in the e-learning management and delivery systems to be able to achieve user satisfaction, usability, and predict continuity of use in the future. AL-Fraihat et al. (2020) pointed out several principles to achieve the usability of e-learning systems and environments. These principles include the ability of the learner to control the interface of the system interaction or the learning environment, flexibility, adaptation. Also, they refer to the learner's ability to customize the applications and capabilities of the e-learning system in the light of the needs and behaviors of the user. In addition, they include the availability of tools, applications, and software required to accomplish the specific tasks and functions and the ability to manage usage errors and address their impact on the effectiveness of the system. Moreover, they are the alignment of user preferences and expectations and the provision of immediate replies and feedback on system use and support and assistance. Finally, they are about the consistency of design and tools, the consideration of the mental effort required, and the level of the cognitive load imposed.

McSweeney (2010) extracted a set of requirements that must be available in e-learning systems and environments such as ease of use. It includes ease of communication, broadcasting, document sharing, interaction, customization of the interface, recording, archiving, and access. It also has the availability of support materials and training manuals, support for devices and different display media, diversity of communication tools, and sharing such as whiteboard, file, and application sharing, screen, and polls, ability to manage participants and control access, scalability, and functionality. Vertesi et al. (2020) identified the requirements for the ability to use e-learning systems and environments in several requirements: ease of use. It includes simplicity of the interface, availability of navigation instructions, availability of support, uploading and sharing of files, ability to learn, support and training, and learning time management. Also, it contains the diversity of applications and forms of communication, diversity of modes of communication, diversity of educational delivery patterns, and assessment reports and performance tracking of the system and participants.

Several studies have reported the educational benefits of measuring usability and taking them into consideration when designing and developing e-learning systems and environments. Gunesekera et al. (2019) pointed out that revealing and enhancing the factors affecting usability contributes to improving the patterns of educational interactions and leads to the promotion of learning engagement. Lee et al. (2019) concluded that there was a positive correlation between usability and intentions to continue learning during e-learning environments. The

findings of the study conducted by Mtebe and Raphael (2018) found a positive correlation between the availability level of usability and the level of learners' satisfaction with learning using e-learning environments. Kumar et al. (2020) emphasized that the provision of a high degree of usability directs the learner's focus towards learning the content more than on how to access the content. The educational benefit of revealing and improving usability is not only about improving learning outcomes and increasing the efficiency of learners and teachers. Rather, its impact extends to developers and designers of e-learning environments, where the level of usability can be used to diagnose the availability of instructional design factors and which instructional design factors need to be enhanced (Jena, 2020; Zaharias & Poylymenakou, 2009). Decision-makers also benefit, especially when deciding whether to choose, purchase, or develop systems and platforms for managing and delivering e-learning (Ali et al., 2018). The interest in improving the usability of e-learning systems and environments is one of the main supporting factors for educational institutions to ensure the continuity of providing educational services to beneficiaries (Yeo et al., 2020).

Research Problem and Objectives

In the light of the accelerating trends in recent years towards the adoption of e-learning and its delivery platforms, e-learning has become a strategic solution to face many challenges, especially those imposed by the coronavirus pandemic (COVID-19) . A number of studies found that the effectiveness of e-learning in reducing the negative effects of COVID-19 (Hasan & Bao, 2020; Favale et al., 2020; Yeo et al., 2020; Owusu-Fordjour et al., 2020; Adeoye et al., 2020; Jena, 2020; Subedi et al., 2020). However, those studies linked their findings to the need for more research on the factors that enhance the effectiveness of e-learning, especially with regard to educational design quality, attractiveness, availability, and usability factors. This is what the current research seeks to investigate.

Several studies revealed a strong correlation between the level of availability of usability factors, user satisfaction with e-learning, their engagement in learning and the quality of educational outcomes (Cheok & Wong, 2015; Mtebe & Raphael, 2018; Gunesekera et al., 2019; Lee et al., 2019; ; Perez-Perez et al., 2020; Yunusa & Umar, 2021). This reinforces the objective of the current research in an attempt to unveil the predictive factors of e-learning usability to enhance learners' engagement and continuity in learning. In the light of the accelerating trends in recent years towards the adoption of e-learning and its delivery platforms, e-learning has become a strategic solution to face many challenges, especially those imposed by the coronavirus pandemic (COVID-19). Some studies found that the effectiveness of e-learning in reducing the negative effects of COVID-19 (Hasan & Bao, 2020; Favale et al., 2020; Yeo et al., 2020; Owusu-Fordjour et al., 2020; Adeoye et al., 2020; Jena, 2020; Subedi et al., 2020). However, those studies linked their findings to the need for more research on the factors that enhance the effectiveness of e-learning, especially concerning educational design quality, attractiveness, availability, and usability factors. This is what the current research seeks to investigate.

In a similar context, some studies have developed predictive models and conceptual frameworks for the factors and determinants that affect the effectiveness of e-learning. Also, these studies emphasized the need for further research to explore the factors affecting the usability of e-learning and the elements of availability and

accessibility (Ali et al., 2018; Al-Qahtani, 2016; Wang et al., 2019; Salloum et al., 2019; Sharma et al., 2017; Zaharias & Poylymenakou, 2009) .

In the light of the foregoing, the research problem can be defined in the main question "How can a theoretical model be established to predict the usability of e-learning platforms among Najran University students?" Hence, the following hypotheses were written.

H1: Learnability positively affects the statistical significance of student satisfaction with e-learning platforms .

H2: Efficiency positively affects the statistical significance of student's satisfaction with e-learning platforms.

H3: Effectiveness positively affects the statistical significance of student satisfaction with e-learning platforms.

H4: The instructional design of electronic content positively affects the statistical significance of student satisfaction with e-learning platforms.

This research aims to:

− develop a theoretical model on the predictive factors for the usability of e-learning platforms at Najran University in the light of the COVID-19.

− assess the relationship of the predictive factors of usability of e-learning platforms with user satisfaction.

− investigate the level of overall usability of e-learning platforms among Najran University students.

Conceptual Modeling and Hypothesis

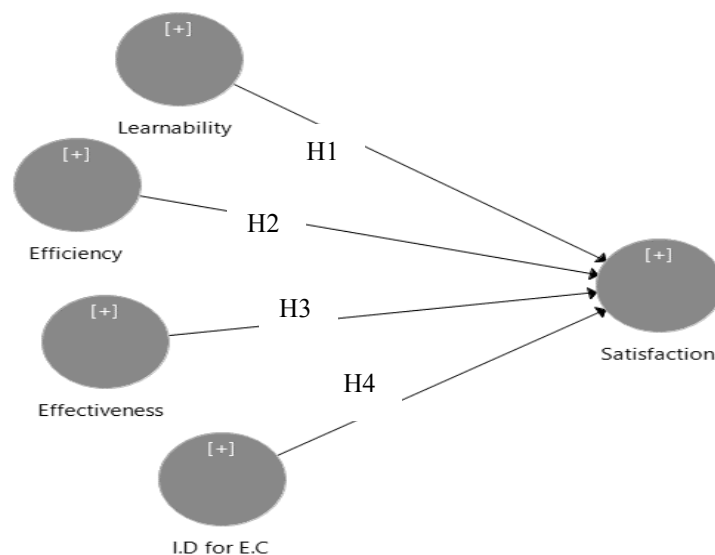In the light of the study objectives, the initial research model was formulated and shown in Figure 1.

Figure 1. Proposed Research Model

Significance of the Study

This study will attempt to answer the following questions:

1. Is there an effect of using concrete, representational, and abstract sequence on improving students' performance in calculating the perimeter of geometric shapes, solving mathematical word problems in the pre and post-tests?

2. To what extent does the performance of students with LD differ on the delayed test in calculating the perimeter of geometric shapes after three weeks of application?

Method

Population

The population of the study consisted of two groups. The first group included all students of the Faculty of Education at the undergraduate level (n=1016). The second group had all the postgraduates (master students) in the Faculty (n=185).

Participants

The sample of the study consisted of 181 male and female students of the Faculty of Education at Najran University split into two groups: 128 undergraduate male and female students and 53 postgraduate students (Master). The students were accessed through the social networking of WhatsApp as well as through the teaching staff. It was assured that all students of the study sample had studied for at least one year using an e-learning system. This indicates that they possess digital skills to deal with e-learning platforms, and thus become suitable to represent the study population. The instrument was administered to the participants after programming it using Microsoft Form and sending them the link in the first semester of the academic year 2021. The data were collected and transformed in an Excel sheet after having excluded incomplete questionnaires. Table 1 shows the demographic characteristics of the study sample.

Table 1. Demographic Characteristics of the Research Sample

Group	Experience in using Blackboard	N
Undergraduate students	more than a year	128
Postgraduate students (Master)	more than a year	53
Total		181

Instrument

In the light of the objective of the study, the usability scale for e-learning platforms and systems at Najran University was prepared through the following steps:

-Determining the objective of the scale: The usability scale has been prepared to estimate the degree of ease of use, efficiency, and satisfaction of students and faculty members at Najran University with their

use of e-learning platforms, especially Blackboard to achieve the required learning goals with the least percentage of errors.

- Determining the dimensions of the scale: The dimensions of the scale were determined by reviewing some of the previous literature (Lee et al., 2019; Wang et al., 2019; Perez-Perez et al., 2020; Derisma, 2020; Laurence & Kaburuan, 2021). Ramadhan et al., 2021; Mailicevic et al., 2021), and the in light of what the current research examines, the following dimensions were decided to be explored: learnability, efficiency, effectiveness, instructional design for e-content, and satisfaction.

-Designing levels of estimation for responses: a five-point Likert scale was chosen, where the levels of response estimation were made on the scale item with five possibilities that ranged between strongly agree and strongly disagree, taking into account positive and negative items. The assessment of the positive item begins with a response strongly agree, is estimated at five degrees, graded until strongly disagree, and assessed to one degree. The estimates of negative items were reversed. Accordingly, it was possible to prepare the initial version of the usability scale of e-learning platforms at Najran University as shown in Table 2 and Figure 2.

Table 2. Usability Scale Variables (Initial Version)

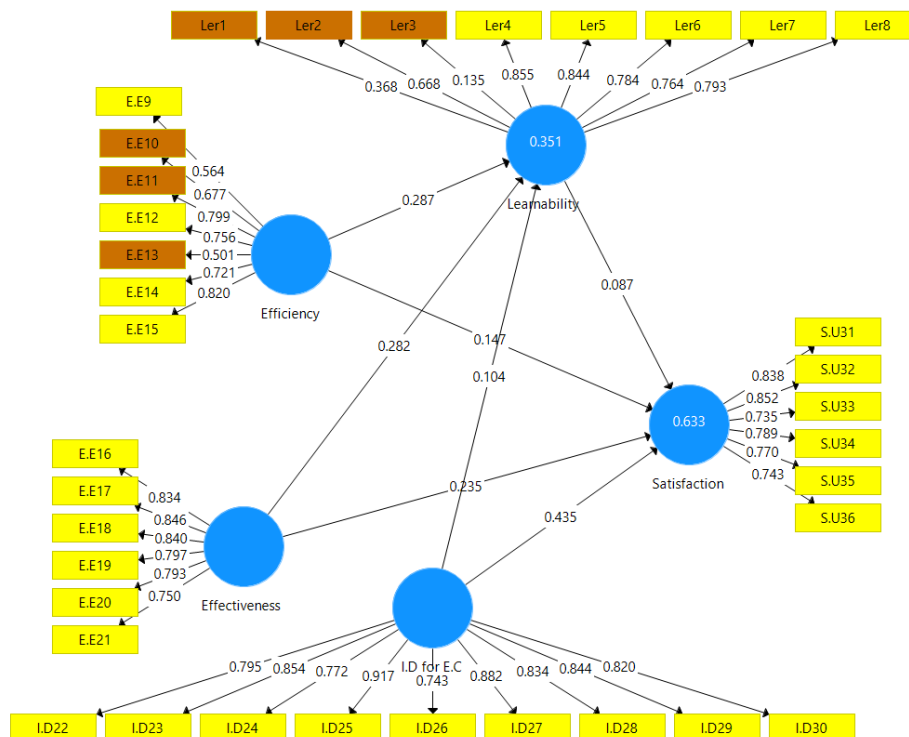| Scale dimensions	Positive items	Negative items	Total
Learnability	5	3	8
Efficiency	4	3	7
Effectiveness	2	4	6
Instructional design of e-content	5	4	9
Satisfaction	4	2	6

Figure.2 Assessment of the Initial Scale (Instrument)

Data Collection

A survey research design was used to collect data related to the phenomenon by creating a set of questions that describe the opinions, perceptions, and behaviors of users in a population about a phenomenon. The scale was distributed to 240 male and female students from the Faculty of Education at Najran University at the undergraduate and postgraduate levels. Then, the data were transformed into an Excel sheet, saved in CSV format, and prepared for statistical treatment using SMART PLS 3.0 program.

To test the proposed hypotheses, structural equation modeling (SEM) was used. SEM is a statistical method based on the structured modeling technique. It was used for its ability to test hypotheses. PLS-SEM concentrates on prediction and estimation. Structured modeling is one of the second-generation statistical methods. The measurement model was designed in the light of determining the error rate in the data and then excluding missing data before the data analysis (Hair et al., 2017). SMARTPLS 3.0 was used to run confirmatory factor analysis (CFA) and to verify the internal consistency, reliability, and validity of the theoretical model. The structural model was estimated, and the proposed hypotheses were confirmed.

Results

Measurement Model

The objective of the development of a measurement model is to examine how well the predictive items act as a measurement tool for the variables. To verify this, validity and reliability were calculated. Two assessment criteria have been used: Convergent validity (individual item reliability or factor loading, composite reliability (CR), and average variance extracted (AVE). Table 3 displays the Convergent validity results. Table 3 shows that convergent validity is satisfactory (factor loading, composite reliability, and average variance extracted (AVE)) were statistically significant and acceptable, except for some items (Lern1, 2, 3 and E.f 2, 3, 5). Therefore, the items were removed from the final model, as shown in Figure 3.

Table 3. Result of Convergent Validity

Variable	Item	Loading	CR	AVE
Learnability	Lern 1	0.368	0.922	0.703
	Lern 2	0.668		
	Lern 3	0.135		
	Lern 4	0.855		
	Lern 5	0.844		
	Lern 6	0.784		
	Lern 7	0.764		
	Lern 8	0.793		
Efficiency	E.f 1	0.703	0.868	0.624
	E.f 2	0.564		
	E.f 3	0.677		
	E.f 4	0.765		
	E.f 5	0.501		
	E.f 6	0.721		

	E.f 7	0.820		
Effectiveness	E.E 8	0.834	0.920	0.658
	E.E 9	0.846		
	E.E 10	0.840		
	E.E 11	0.797		
	E.E 12	0.793		
	E.E 13	0.750		
Instructional design for e-content	I.D 1	0.795	0.952	0.690
	I.D 2	0.854		
	I.D 3	0.772		
	I.D 4	0.917		
	I.D 5	0.743		
	I.D 6	0.882		
	I.D 7	0.834		
	I.D 8	0.844		
	I.D 9	0.820		
Satisfaction	S.U 1	0.838	0.908	0.622
	S.U 2	0.852		
	S.U 3	0.735		
	S.U 4	0.789		
	S.U 5	0.770		
	S.U 6	0.743		

* Convergent validity is satisfactory when the AVE is greater than 0.50. CR and factor loading are greater than 0.70 (Hair et al., 2017).
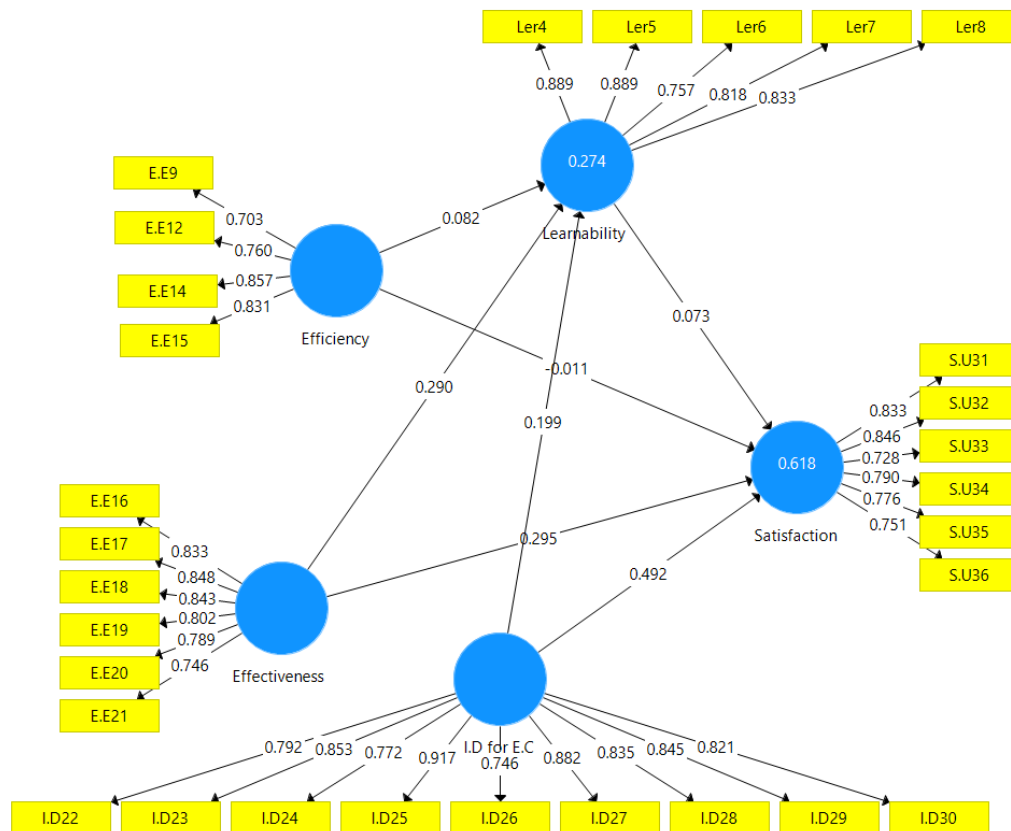

Figure 3. Theoretical Model

To assess discriminant validity, cross loading was used. Table 4 displays the value of cross loading.

Table 4. Discriminant validity- Fornnell-Larcker Criterion

Scale dimensions	Learnability	Efficiency	Effectiveness	Instructional design of E-content	Satisfaction
Learnability	0.839				
Efficiency	0.380	0.790			
Effectiveness	0.502	0.588	0.821		
Instructional design of E-content	0.489	0.635	0.817	0.831	
Satisfaction	0.457	0.503	0.728	0.726	0.789

According to Hair et al. (2017), discriminant validity means that the values of the correlation coefficients for a specific variable with itself are greater than their correlation coefficients with the rest of the variables in the model. The values of the discrimination coefficients shown in Table 4 indicate all the variables in the model have a high discriminatory ability. To calculate the discriminant validity of the items, cross-loading was used as shown in Table 5.

Table 5. Discriminant Validity – Cross Loading

variable	items	Learnability	Efficiency	Effectiveness	I.D for E.C	Satisfaction
	Lern 1	remove				
	Lern 2	remove				
	Lern 3	remove				
Learnability	Lern 4	0.889	0.318	0.415	0.379	0.390
	Lern 5	0.889	0.271	0.427	0.423	0.404
	Lern 6	0.757	0.368	0.438	0.368	0.387
	Lern 7	0.818	0.342	0.476	0.504	0.387
	Lern 8	0.833	0.283	0.323	0.377	0.338
	E.f 1	0.402	0.703	0.457	0.466	0.409
	E.f 2		remove			
	E.f 3		remove			
Efficiency	E.f 4	0.217	0.760	0.491	0.468	0.366
	E.f 5		remove			
	E.f 6	0.356	0.857	0.432	0.515	0.331
	E.f 7	0.188	0.831	0.471	0.547	0.465
	E.E 1	0.273	0.386	0.833	0.604	0.611
Effectiveness	E.E 2	0.406	0.470	0.848	0.616	0.512
	E.E 3	0.411	0.439	0.843	0.599	0.484

	E.E 4	0.475	0.392	0.802	0.598	0.594
	E.E 5	0.438	0.542	0.789	0.772	0.684
	E.E 6	0.409	0.603	0.746	0.409	0.610
	I.D 1	0.442	0.564	0.786	0.792	0.762
	I.D 2	0.466	0.465	0.694	0.853	0.726
	I.D 3	0.454	0.535	0.685	0.772	0.525
Instruction design for E-content	I.D 4	0.469	0.600	0.759	0.917	0.664
	I.D 5	0.374	0.527	0.540	0.746	0.442
	I.D 6	0.469	0.627	0.768	0.882	0.628
	I.D 7	0.420	0.523	0.616	0.835	0.650
	I.D 8	0.326	0.457	0.610	0.845	0.650
	I.D 9	0.198	0.435	0.583	0.821	0.598
	S.U 1	0.244	0.491	0.565	0.633	0.833
	S.U 2	0.313	0.456	0.582	0.594	0.846
Satisfaction	S.U 3	0.384	0.390	0.397	0.407	0.728
	S.U 4	0.384	0.452	0.687	0.704	0.790
	S.U 5	0.405	0.287	0.586	0.608	0.776
	S.U 6	0.440	0.301	0.560	0.592	0.751

The values of the discrimination coefficients in Table 5 show that all the items in each variable have a high discriminatory ability.

Assessment of Structural Model (Test of Hypotheses)

To assess the structural model, variance inflation factor (VIF) was used to examine Multi-linearity between variables. The path coefficient was calculated to examine the relationship between variables. The Coefficient of determination (R^2) was applied to examine the percentage of variance in the dependent variable that can be predicted by the independent variable. Effect size (f^2) was used to calculate the effect size of the variable. Goodness of fit of the model (GoF) was applied to determine the model's predictive ability as shown in Table 5 . Path coefficient was used to examine the relationship between variables as shown in Table 6.

Table 6. Evaluation of Structural Model- Path Coefficient

Hypothesis	Relationship	Std. Beta	Std. Error	t value	P value
H1	Learnability -> Satisfaction	0.073	0.069	1.053	0.293
H2	Efficiency -> Satisfaction	0.005	0.003	0.083	0.934
H3	Effectiveness -> Satisfaction	0.316	0.077	4.119	0.000**
H4	Instructional design for E-content -> Satisfaction	0.507	0.075	6.779	0.000**

* P value must be <0.05 to be statistically sufficient (Hair et al., 2017).

In order to examine the significance level, t-value and p-value for all paths were calculated using SMARTPLS 3.0. Two out of four relationships were found to have significance. The significant path coefficient shows that the instructional design for e-content and effectiveness had the most important influence on student satisfaction. Therefore, H3 and H4 hypotheses were accepted. The result also indicates that no significant influence on efficiency and learnability on student satisfaction. Therefore, H1 and H2 hypotheses were rejected **.**

To estimate the underlying relationship amongst variables, the structural equation modeling (SEM) was applied in this study to analyze the data. The results of the model fit statistics are presented in Table 7.

Table 7. Results of Assessment of Structural Model and Hypotheses Testing

Hypothesis	Relationship	VIF	R^2	f^2	Q^2
H1	Learnability -> Satisfaction	1.378	0.618	0.010	0.347
H2	Efficiency -> Satisfaction	1.728	medium	0.000	medium
H3	Effectiveness -> Satisfaction	3.199		0.07	
H4	Instruction design for E-content -> Satisfaction	3.435		0.185	

According to Chin (1998), if R^2 < 0.19 and < 0.33, (weak), =0.33 or =/> 0.67 (medium), greater than 0.67 (large).

According to Cohen (1988), f^2 < 0.02 (no effect), 0.02 to 0.15 (weak), 0.15 to 0.35 (medium), greater than 0.35 (large)

According to Wetzels (2009), Q^2 < 0.1 (no fit), 0.1 to 0.25 (small), 0.25 to 0.36 (medium), greater than 0.36 (large)

The results in Table 7 indicate that the coefficient of determination R 2 had a medium value (0.618). This result indicates that the independent variables (Learnability, Efficiency, Effectiveness, and Instructional design for E-content) explained 62% of the variance in the dependent variable (student's satisfaction). Also, the results of value calculation of the effect size f 2 indicate that there was a medium effect size of the instructional design for e-content on student's satisfaction. The efficiency variable had a weak effect size on student satisfaction. In addition, the results indicate that there was no significant effect size for effectiveness and learnability on student satisfaction**.**

The predictive relevance, Q2 value for the student's satisfaction was 0.347. It was clearly above zero and was above the medium threshold. This indicates that independent variables (learnability, Efficiency, Effectiveness, and instructional design for e-content) had medium predictive relevance for student satisfaction.

Discussion

The study aimed to determine the factors that predict the usability of e-learning platforms among Najran University students.

The results of the study found that there was no statistically significant effect of learnability on students' satisfaction with using e-learning platforms, so H1 was rejected. This result differs from the findings of studies by McSweeney (2020), Subedi et al. (2020), and Auda et al. (2021). This result can be discussed in the light of

characteristics related to students and the system because the factors related to the learnability were not factors that affected the students' satisfaction with use. This can be attributed to the fact that all students study using e-learning for more than a year for all courses. Therefore, e-learning became easy for students, and they did not care about it as a factor that could affect their satisfaction. The availability of training courses, guides, and various technical support sources resulted in students not facing any problems with using e-learning platforms. Also, the interest of the Deanship of E-learning in managing the Blackboard system interface made the students feel comfortable and have no difficulties. Therefore, the students did not consider the factors related to learnability as influencing their satisfaction with use, and hence, usability.

The results of the study found that there was no statistically significant effect of efficiency on students' satisfaction with using e-learning platforms, so H2 was rejected. This result differs from the findings of previous studies such as Cheok and Wong (2015), and Araujo et al. (2020). This result can be discussed in the light of a set of characteristics related to the user and the e-learning system. The student satisfaction with the use of e-learning was not affected due to the students' interest in using some applications that achieve their goals only. Also, the Deanship of E-learning has highlighted the main tools and icons most commonly used in the system homepage and provided instructions that reduce errors and alerts about the possibility of an error occurring. Students did not face any difficulties, whether in identifying or accessing applications, or the occurrence of errors. Efficacy-related factors did not have a significant effect on usability through the indicator of student satisfaction.

The results of the study found that there was a statistically significant effect of effectiveness on student satisfaction with using e-learning platforms, so H3 was accepted. This result agrees with those of Mtebe & Raphael's (2018), Wang et al.'s (2018), Eltahir et al.'s (2019), and Derisma's (2020). This result can be discussed in the light of several factors that are directly related to students, namely: students' feeling of pleasure while using the e-learning system, their learning performance, and achievement assignments quickly in less effort. Students' confidence in the e-learning system in terms of its ability to achieve their goals contributed to improving their satisfaction. Accordingly, their intentions of using and possessing the necessary digital skills contributed to increasing their confidence in the e-learning system. Also, the high perceived benefit, the multiplicity of tools available in Blackboard, and the association of each tool with a specific job contributed to the diversity of options for students to use diverse teaching and assessment methods. Therefore, the availability of these factors contributed to increasing the level of usability through the student satisfaction indicator with use.

The results of the study showed that there was a statistically significant effect of the instructional design of e-content on student satisfaction with using e-learning platforms. Therefore, H4 was accepted. This result agrees with the findings of some studies such as Lee et al. (2019), Alshehri et al. (2019), Salloum et al. (2019), Araujo et al., (2020), Perez-Perez et al. (2020), and Jena (2020). This result can be discussed in the light of some factors: clarity of objectives and procedures for accessing assignments and how to implement them, organization of the main and sub-menus of the course, clarity and stability of the icons used, availability of access to content at any time and from anywhere, multiple presentation forms of e-content. These factors contributed to reducing

distraction, ease of learning and access, and the absence of the need for a great mental effort to access any time. The diversity of methods for asking for help and asking inquiries are among the factors that contributed to reducing the cognitive load. Therefore, it can be said that the availability of the instructional design factors helped students focus on learning, instead of focusing on how to access the system. The ease of access and remembering increased motivation to learn and reduced anxiety and fear of failure.

The results of the study also found that the four factors (learnability, efficiency, effectiveness, and instructional design of e-content) together contribute to explaining 62% of the variance in the dependent variable (student satisfaction with using e-learning platforms). The results showed moderate (Medium) predictive relevance of the model to predict the behavior of the dependent variables (student satisfaction with the use of e-learning platforms), Also, high predictive relevance of the effectiveness and instructional design of e-content factors on student satisfaction with using e-learning platforms was revealed while the learnability and efficiency factors did not show any significances in predicting satisfaction with use.

Conclusion

The study has highlighted the importance of exploring the factors affecting the usability of e-learning platforms using predictive models and conceptual frameworks for the factors and determinants that affect the effectiveness of e-learning. The current research has adapted a model to reveal the level of usability through student satisfaction with the use of e-learning systems and platforms in terms of learnability, efficiency, effectiveness, and instructional design of e-content. The study found that usability can be predicted through the student satisfaction indicator with the use of e-learning systems and platforms.

The Instructional design of e-content and effectiveness showed a high relevance to predict usability through the indicator of student satisfaction with the use of e-learning platforms. Learnability and efficiency did not show a significant effect in predicting usability through the student satisfaction indicator with the use of e-learning platforms. Finally, the prediction model in this study had a moderate (medium) predictive relevance on the dependent variables (student satisfaction).

The study was limited by a number of points. This research was applied to students of the Faculty of Education, whose courses are mostly theoretical. Therefore, the results may differ for practical courses at faculties of engineering and medicine. The prediction model also addressed four independent variables (learnability, efficiency, Effectiveness, and instructional design for e-content). The fifth variable, student satisfaction, is from which usability is inferred, so further studies can be conducted to explore other factors through which usability and continuity can be predicted.

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