

PAPER

An Adaptive E-Learning Systems Success Model

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E-learning implementation is growing alongside the e-learning market's growth. As a result, competing models and approaches were proposed to improve e-learning and learner performance; one of these models is the e-learning systems success model. In order to expand this model, an analysis of the published e-learning models and frameworks in the period 2017–2022 was conducted using the aggregative review method. 37 studies that match the current study interests have been selected and analyzed. The main results support the e-learning system success model. In addition to further constructs other than those used in the model that have been used to enhance it, an adaptive e-learning success model has been proposed, which integrates the e-learning success model with the other models and frameworks proposed in the literature. This study recommends that achieving e-learning success requires an analysis of the internal and external environment and crafting an adaptation plan to determine the e-learning methods depending on the pedagogical approaches and tutors' and learners' abilities and characteristics, which in turn determine the instructional material required and assessment methods, besides the required ICT. Besides the required enhancements, such as tutor and learner training, as well as the institution's policy and e-learning management, in addition to the required adaptations to cope with environmental factors in order to embrace learners in education policies and future strategies.

KEYWORDS

e-learning, e-learning system, e-learning models, e-learning methods, pedagogical approaches

1 INTRODUCTION

E-learning is one of the fastest-growing phenomena in the digital age. It is rapidly expanding and shows no signs of slowing down. Whereas, e-learning has emerged as one of the most significant and potentially major instructional tools for improving teaching, learning, and assessment [1]. As a result of this evolution, higher education has replaced virtual universities and cross-border education with e-learning [2], in addition to shifting the function of education from custodian to facilitator and distributor [3].

Romi, I.M. (2023). An Adaptive E-Learning Systems Success Model. *International Journal of Emerging Technologies in Learning (ijET)*, 18(18), pp. 177–191. <https://doi.org/10.3991/ijet.v18i18.42929>

Article submitted 2023-06-08. Revision uploaded 2023-07-23. Final acceptance 2023-07-29.

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It's reported that the worldwide e-learning market is projected to be worth \$325 billion in 2025, and the learning management systems (LMS) market is expected to grow by 14.2% between 2022 and 2029 [4]. Furthermore, the global industry has grown by 900% since its birth. In addition, this market will experience a 200% increase between 2020 and 2025. Meanwhile, 28% of companies conduct their compliance training through online training [5].

On the other side, e-learning implementation is growing along with the e-learning market's growth. Where students retain 25%–60% more through online courses, since 2020, 98% of universities have moved classes online; 80% of schools have purchased or are purchasing additional technology for students. 79% of teachers found technology makes learning more interesting, and 90% of students think online learning is the same or better than the traditional classroom experience. 90% of companies offer employees some form of digital learning; companies with training programs have 218% higher revenue per employee; and companies that use e-learning see an 18% boost in employee engagement [6].

Researchers are attempting to bridge the gap that has emerged due to transition from face-to-face learning to various forms of e-learning and distance learning. As a result, numerous approaches were proposed to improve e-learning and learner performance. The majority of these approaches seek instruments for measuring e-learning achievement in order to comprehend the worth and efficacy of e-learning management and investments. A taxonomy and an interactive model for conceptualizing and operationalizing e-learning success were suggested in an attempt to raise awareness of the e-learning concept [7]. The goal of this study is to evaluate the literature in order to strengthen and reformulate the proposed model, as well as to provide a method for measuring the success of e-learning.

2 BACKGROUND AND LITERATURE REVIEW

2.1 A model for e-learning systems success

Figure 1 illustrates a model for success of e-learning systems (ELS), which was developed based on previous research and a set of models and theories. These include, notably, the situational theory of publics (STP), a multilayer model of user activity, action theory, situated action theory, the GOMS model, and the Information System Success Model (D&M) [7]. This model was derived in an attempt to improve the fit among the e-learning system components [7]. To achieve the required fit, the model is composed of three main dimensions: context, e-learning system, and learner performance.

Firstly, context can be categorized into three main constructs: individual, institutional, and environmental determinants. Secondly, an e-learning system consists of an instructor, learners, a course, and information and communication technology (ICT). Classifying learners into different groups based on their level of awareness about the task and the extent to which they do the task will enhance the fit between the learner and the task. On the other hand, the learner must have the technical skills and knowledge to navigate online learning in order to achieve a fit between the learner and technology. Furthermore, achieving fit between the human (instructor and learner), the computer (ITC), and the task occurs through four levels of interaction. Each level provides the context for the level below it, starting from the task level until reaching the lexical level, which is closest to the resources that are needed to physically implement this task. Thirdly, achieving high performance requires a good fit among e-learning system components, and the higher the fit between e-learning

system components, the higher the learners' performance. This implies that each component of e-learning systems must possess a set of characteristics in order to strengthen the fit.

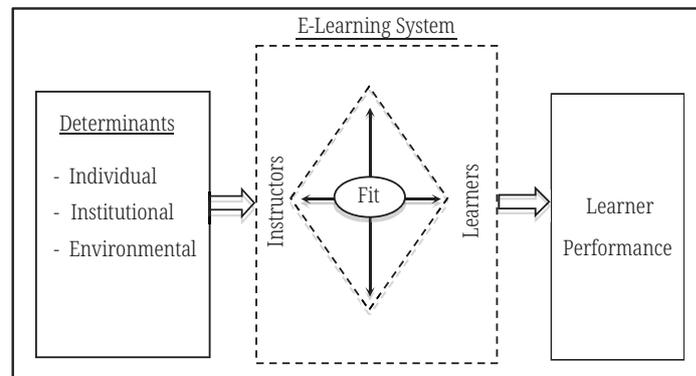


Fig. 1. E-learning systems model

Source: [7].

2.2 E-learning systems success model in the literature

An analysis of prior research that has used the proposed e-learning systems success model (ELS) since it was published in 2017 shows that part of this research used the model's accompanied factors and dimensions to extend new models [8–14]. The other part of these researches used some aspects of the model to compare it with other models [15–17]. The rest of the researches used the results and implications of the models to accumulate the determinants and results of e-learning success [18–23]. These results imply that a comprehensive model is needed for e-learning success in both academic institutions and business organizations.

2.3 E-learning models and frameworks' review and analysis

A lot of models and frameworks have been developed since the ELS was proposed in 2017. To review these models and frameworks, an aggregative review method will be used; which is an approach for reviewing a large body of research evidence to aggregate, evaluate, and synthesize all empirical evidence that meets a specified criterion of interest [24].

The interest of the current study is to find out the components of the e-learning systems used in prior research, which was published during the period 2017–2022, and the determinants that impact these e-learning systems. Therefore, eligible prior studies are all studies with one or more of the predefined interests, which include components and/or determinants of e-learning systems. As a result of searching Google Scholar, 54 studies were reached, and 37 studies that match the current study interests have been selected.

The outcomes of the aggregation review are summarized in Table 1. This table presents the selected studies and the various constructs extracted from the models of e-learning systems. Notably, these constructs encompass the components of e-learning system, the determinants that impact these systems, and the characteristics inherent to e-learning systems. The forthcoming analysis of these findings aims to enrich the existing e-learning systems model.

Table 1. E-learning models and frameworks components

Literature	Constructs
[25]	individual features, interaction, assessment, infrastructure, presenter, content, and media.
[26]	intellectual capital management, e-learning practices, facilitating factors, technical infrastructure, educational infrastructure, people involved in the learning process, individual factors, technical features, education, strategic management, communications
[27]	social environment, facilitating conditions, TAM.
[28]	content, learner, adaptive model, Interface, System Implementation
[29]	system quality, service quality, information quality, user satisfaction, use.
[30]	time, content control, delivery method, interface design, institutional, resources support, pedagogical, ethical, evaluation, technical knowledge, human resources, attitude, culture, equipment and infrastructure, financial support, management support
[31]	an application that includes an interface, assessment, and communications.
[32]	course quality, education system quality, technical system quality, service quality, intention to use, e-learning actual use, instructor satisfaction, environmental factors, university readiness, trust, perceived benefits
[33]	An application that include three modules: Learner module, adaptation module, teacher model.
[34]	user model, adaptation model, assessment model.
[35]	learning management system, developer, tutors, students, education institutions, society
[36]	repository, organization model, business processes, transport layer, interface.
[37]	learner, infrastructure, support, education, ethics, law, culture, evaluation
[38]	system quality, information quality, service quality, support, learner quality, instructor quality, perceived satisfaction, perceived usefulness, system use, benefits.
[39]	learner model, content model, adaptation model.
[40]	social, facilitating factors.
[41]	course objectives, motivation, feedback, independence of learners.
[42]	IT infrastructure, system quality, multimedia instruction, service quality, ease of use, usefulness, openness, self-efficacy, user satisfaction
[43]	social media
[44]	quality of technology, content agent, learning methods, teacher agent.
[45]	e-learning service quality, e-learning system quality, e-learning instructor and course materials quality, e-learning administrative and support service quality
[46]	ease of use, user-friendliness, ease of understanding, operational stability, ease of discussion, ease of accessing shared data, up-to-date content, sufficient content, useful content, personalization
[47]	engagement time (bounce rate)
[48]	student engagement
[49]	technology knowledge management, management support, student awareness of utilizing e-learning systems
[50]	course development technologies, models of courses and their pedagogical design, availability of the course curriculum, course delivery technology, ease of access to courses and services, course navigation, availability of guidelines, availability of interaction technologies, adaptability, personalization
[51]	information quality, use, and user satisfaction
[52]	e-learning platform, individual experience, digital literacy
[53]	top management support, change management, course content quality, system quality, service quality
[54]	knowledge sharing, Social media features, motivations and uses

(Continued)

Table 1. E-learning models and frameworks components (*Continued*)

Literature	Constructs
[55]	social influence, system quality, instructor quality, learner computer anxiety
[56]	student online learning activities (reading content, working on exercises, submitting assignments, number of logins, login duration, time spent learning online).
[57]	family support
[58]	understanding of the e-Learning system as a method of study
[59]	administrative support, course content, course design, social support, technical support, instructor characteristics, learner characteristics, and e-learning quality.
[60]	performance expectancy, social influence, perceived enjoyment, self-efficacy
[61]	student autonomy, background, student-instructor dialogue, student-student dialogue.

Aggregation analysis and review. Table 2 shows the mapping of the e-learning system model components (ELS) and determinants alongside the extracted constructs from prior research's models and frameworks, which are reviewed in Table 1. This mapping is conducted by matching the extracted constructs with the main components of the ELS, namely the instructor, learner, task, and ICT. In addition to the determinants (individual, institutional, and environmental) and the e-learning systems' characteristics.

The results of this mapping, as presented in Table 2, show a set of further components, determinants, and characteristics that will be discussed in detail in the following sections in order to enhance the e-learning system success model.

Table 2. E-learning systems constructs**

Literature	ELS Components*				Further Components	Determinants		
	I	L	T	C		Individual	Institutional	Environmental
[25]	√	√	√	√	–			
[26]	√	√	√	√	e-learning practices		facilitating factors, strategic management	
[27]	√	√	√	√	–		facilitating conditions	social environment
[28]	√	√	√	√	adaptive e-learning			
[29]	√	√	√	√	–			
[30]	√	√	√	√	Pedagogy, evaluation	time, ethical, technical knowledge	financial support, management support	culture
[31]	√	√	√	√	–			
[32]	√	√	√	√	–	trust	readiness	environmental factors
[33]	√	√	√	√	–			
[34]	√	√	√	√	adaptation, assessment			
[35]	√	√	√	√	–			education institutions
[36]	√	√	√	√	Organization model, business processes.	–		
[37]	√	√	√	√	evaluation	ethics,	support,	law, culture

(Continued)

Table 2. E-learning systems constructs** (Continued)

Literature	ELS Components*				Further Components	Determinants		
	I	L	T	C		Individual	Institutional	Environmental
[38]	√	√	√	√	–			
[39]	√	√	√	√	adaptation			
[40]	–	–	–	–	–		facilitating factors	social
[41]					–	motivation, learner independence		
[42]	√	√	√	√	–	openness, self-efficacy		
[43]					social media			
[44]	√	√	√	√	–			
[45]	√	√	√	√	–			administrative support
[46]	√	√	√	√	–			
[47]					–	engagement time, bounce rate		
[48]					–	student engagement		
[49]					–	technology knowledge, utilizing e-learning systems	management support,	
[50]					–	adaptability		
[51]	√	√	√	√	–			
[52]	√	√	√	√	–	individual experience, digital literacy		
[53]	√	√	√	√	–		top management support, change management	
[54]					–	motivations		Knowledge sharing
[55]					–	learner computer anxiety		social influence.
[56]					–	reading content, working on exercises, submitting assignments, logins, logins duration		
[57]					–			family support
[58]					–	understanding		
[59]					–	learner characteristics	administrative support, technical support,	social support
[60]					–	performance expectancy, enjoyment, self-efficacy		social influence
[61]					–	autonomy, background, dialogue.		

Notes: *I: Instructor, L: Learner, T: Task, C: ICT; ****Extracted characteristics include:** Interaction, course objectives, feedback, system quality, service quality, ease of use, usefulness, user satisfaction, quality of technology, learning methods, instructor and course materials quality, stability, ease of discussion, ease of accessing shared data, up-to-date content, sufficient content, useful content, personalization, pedagogical design, course delivery, ease of access, navigation, availability of guidelines, social media features, course design.

3 DISCUSSION

3.1 Components of e-learning system

The results of mapping the ELS alongside the extracted components from prior research's models and frameworks are presented in Table 2. This shows that prior research's models support the ELS model components. Furthermore, these models show some additional system components other than those used in the e-learning system success model. These components include e-learning methods, pedagogy, and assessment.

Figure 2 depicts the adapted e-learning system. This system takes into consideration the components extracted from the literature. Furthermore, prior research has used e-learning for different types of educational institutions, including public institutions as well as private corporations. In order to cope with these uses, some terms will be adapted, mainly instructional material instead of task and tutor instead of instructor.

Table 2 shows the aggregated characteristics of ELS success that have been derived from prior research. Integrating these characteristics with those of the ELS success model determined in Ref. [7] will produce a set of characteristics for all the ELS components, which include tutor, learner, instructional material, and information and communication technology.

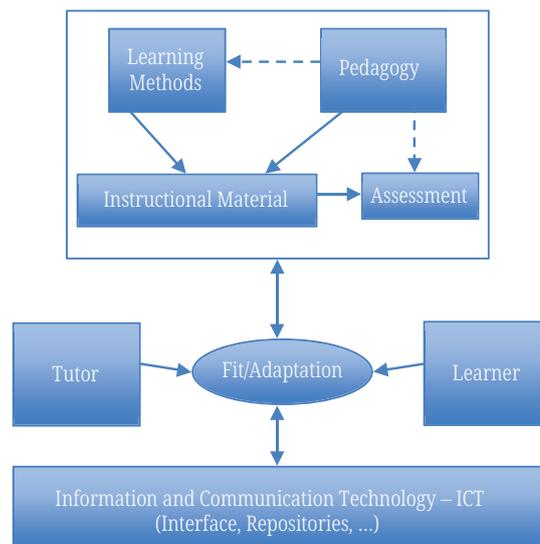


Fig. 2. The expanded e-learning system

Tutor. The tutor is the person in charge of the e-learning instructional material. The main characteristics of the tutor as described in the literature include style of teaching, ICT self-efficacy, keenness and activeness in teaching the course subjects via e-learning, enthusiasm, timely response, openness, motivation, collaboration, experience, satisfaction, and support for learners (motivates learners to use e-learning, friendliness, interest, encourages interaction, and encourages class participation).

Learner. A learner is the person who attends the ELS for the purpose of learning or training. The characteristics of learners that are extracted from the literature include digital literacy, understanding of the ELS as a method of study, awareness of utilizing the ELS, self-efficacy, learner anxiety, attitude toward e-learning, learning

by absorption and construction, flexibility of time and hours, collaboration, interaction, learner control, experience, language, preferences, locus control, motivation, enjoyment, autonomy, satisfaction, expected workload, and previous e-learning experience.

Instructional material. The content of the course may include lectures, readings, audio, video, multimedia, assignments, exams, and other resources in the course. The extracted course characteristics include the structure of e-learning components, clear objectives, pedagogical design, sufficient content, up-to-date content, clear instructions, availability all the time, content quality, flexibility, applicability to practices, the balance between asynchronous and synchronous activities, and cognitive load.

Figure 2 shows that developing the instructional material will be determined by pedagogies and e-learning methods. Pedagogy refers to the combination of teaching methods, learning activities, and learning assessments. The main pedagogical approaches are constructivist, collaborative, reflective, integrative, and inquiry-based [62]. Meanwhile, e-learning methods refer to the style and format of designing and delivering instructional material through digital resources. These methods include synchronous, asynchronous, blended, interactive, collaborative learning, and any other method [63–65]. Assessment refers to evaluating learners' progress and knowledge within an online environment. Assessment may be conducted using one or more of the assessment approaches and tools, mainly quizzes, exams, presentations, essay questions, dialogue simulations, game-type activities, and peer evaluation [66].

Therefore, achieving the instructional material characteristics requires matching the selected e-learning method with the pedagogical approach, as well as developing suitable assessment methods depending on both the e-learning method and the pedagogical approach.

Information and communication technology. Information and communication technology refers to computer and communication technologies. Computer technologies include a set of components such as computer hardware and software, applications, and repositories. Meanwhile, communication technologies include technologies such as local area networks, wide area networks, the Internet, intranet, extranet, and wireless networks. Furthermore, using ICT as an e-learning mediator requires a diverse set of ICT tools to communicate, create, disseminate, store, and manage the instructional material; such as interface applications, repositories, and other media applications and services.

The extracted ICT characteristics include efficient information technology infrastructure, a user-friendly platform, ease to use, usability, reliability, functionality, interactivity, stability, responsiveness, system quality, service quality, convenience of navigation, availability of guidelines and interaction technologies, ease of accessing shared data, the capability of controlling learning progress, recording learning performance-based, adaptability, and personalization.

E-Learning system components' fit and adaptation. The e-learning system components fit can be defined as the alignment among the ICT, the user (tutor, learner), and the instructional material [7]. Achieving the best fit requires an analysis of the e-learning system components' characteristics and mapping these characteristics in order to achieve alignment among the components. As a result of this analysis and mapping, enhancements can be made to any component in order to fit with the other components. For example, training the tutor and learner to raise their abilities, enhancing the ICT to match the user's abilities, designing the instructional material to fit the learner's abilities and the available ICT, and so forth. Furthermore, the

instructional material must be developed taking into consideration the pedagogical approaches (constructivist, collaborative, reflective, integrative, and inquiry-based) and e-learning methods (synchronous, asynchronous, blended, interactive, collaborative learning, and any other method).

3.2 Determinants of e-learning system

Table 2 shows the aggregated determinants of the e-learning system's success extracted from prior research. These determinants include individual, institutional, and environmental constructs.

The individual construct. This construct includes both the tutor and the learner. These constructs are considered part of the e-learning system components; therefore, they will be excluded from the determinants.

The institutional construct. The support provided by the interested institutions to the e-learning systems' components. Table 2 shows the institutional determinant items extracted from the literature. Integrating these items with those of the ELS success model determined [7] will produce a set of items including institutional policy, clear vision, institutional learning culture, recognition of work, rewards systems, library, strategic management, top management support, change management, financial support, readiness, learning strategies and policies, learning environment, information availability, training, technical assistance and troubleshooting, and information security policy.

The environmental construct. Refers to the factors that have an impact on the e-learning system from outside of the institution. Table 2 shows the environmental determinant items extracted from the literature. Integrating these items with those of the ELS success model determined in Ref. [7] will produce a set of items including social environment, subjective norms, interactions with others, culture, education institutions, law, knowledge sharing, family support, and social support.

3.3 Learner performance

Performance can be defined as the outcome of a pattern of actions used to achieve a purpose according to certain standards, whereas performance-related objectives include enhancing a person's capacity to manage the physical demands or load of a work environment [67].

Learners' performance can be measured by acceptance of the e-learning system, reducing errors and time to complete the task, understanding, adherence, and satisfaction [68] [69]. As well, each learner can gain more equal standing, responses can be made around the clock, and there is higher motivation and involvement in collaborative learning. [7] [70].

4 THE ADAPTIVE E-LEARNING SYSTEMS SUCCESS MODEL

The adaptive e-learning systems success model, depicted in Figure 3, is derived from the ELS, which was proposed in [7] and expanded depending on prior e-learning systems models and frameworks. This model is composed of three main dimensions, each of which is composed of a set of constructs. Mainly, determinants include institutional and environmental factors, in addition to the ELS components,

which include the tutor, learner, instructional material, and ICT, as well as the learner’s performance.

Achieving e-learning success requires an analysis of the internal and external environment and crafting an adaptation plan. Internal factors analysis includes the tutor’s and learner’s abilities and characteristics, the pedagogical approaches as well as other institutional factors such as institutional policy, vision, management support, financial support, institutional readiness, and so forth. The external factors analysis includes advancements in information and communication technology, e-learning applications and tools, as well as subjective norms, culture, family support, social support, and so forth for the other factors.

Crafting an adaptation plan includes determining the e-learning method depending on the pedagogical approaches, and tutors’ and learners’ abilities and characteristics, which in turn determines the instructional material required and assessment methods, besides the required ICT. Furthermore, the plan will include the required enhancements, such as tutors and learner training. In addition to changes in the institution’s policy and e-learning management, the required adaptations must cope with the environmental factors in order to embrace learners in the education policies and future strategies.

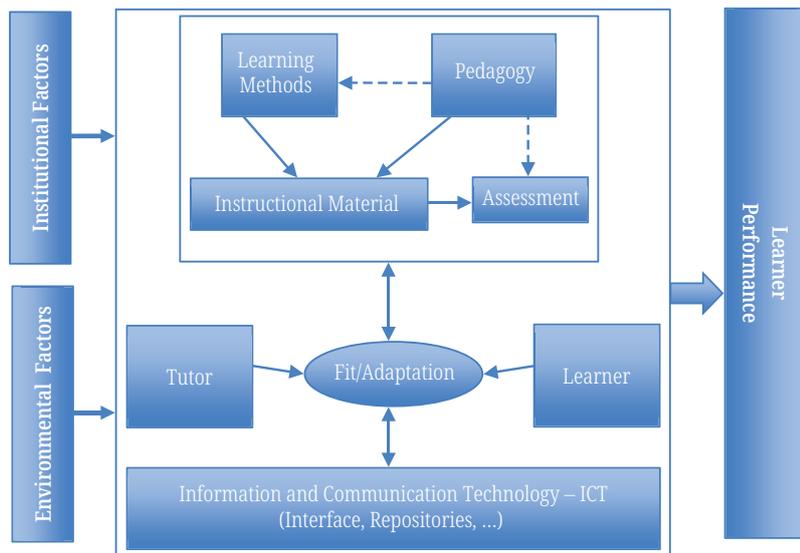


Fig. 3. An adaptive e-learning systems success model

5 CONCLUSION AND RECOMMENDATIONS

E-learning implementation is growing alongside e-learning market growth. As a result, competing models and approaches were proposed to improve e-learning and learner performance; one of these models is the ELS model. In order to expand this model, an analysis of the e-learning models and frameworks published in the period 2017–2022 was conducted using the aggregative review method.

The results of mapping the ELS model constructs alongside the extracted constructs from prior research’s models and frameworks show that prior research’s models support the ELS model’s components. Furthermore, these models show some further constructs other than those used in the ELS success model, which are used to enhance the ELS success model.

An adaptive e-learning success model, represented in Figure 3, was developed to integrate the e-learning success model with the models and frameworks developed in the literature.

This model is composed of three main dimensions, each of which is composed of a set of constructs. Mainly, determinants include institutional and environmental factors, in addition to the ELS components, which include the tutor, learner, instructional material, and ICT. As well as the learner's performance.

Achieving e-learning success requires an analysis of the internal and external environment and crafting an adaptation plan to determine the e-learning method depending on the pedagogical approaches, and tutors' and learners' abilities and characteristics, which in turn determines the instructional material required and assessment methods. Besides the required ICT, the plan will also include the required enhancements, such as tutors and learners training. In addition to changes in the institution's policy and e-learning management. Moreover, the required adaptations must cope with environmental factors in order to embrace learners in education policies and future strategies.

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