A Model for e-Learning Systems Success: Systems, Determinants, and Performance

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Abstract—E-learning is used by higher education institutions and corporate training institutes as a means of solving performance problems, and the accessibility to educational technology which considered as vital for acquisition and dissemination of knowledge to students, as well as interaction between instructors and students. To determine technological solutions for those institutions, an analysis to the literature, and related theories have been conducted depending on the context impact to e-learning system, as well as the interrelationship between e-learning system components and its impact on learner performance. The main findings show that e-learning system is composed of four components, mainly; the instructor, learner, course, and information and communication technologies (ICT), in addition to the context determinants of e-learning system success. The current study, proposed a model for e-learning success, which incorporates eight factors, mainly; e-learning context that include individual, institutional, and environmental determinants to e-learning success. In addition to e-learning components which include instructor, learner, course, and ICT. As well as the learner performance, that aims to measure e-learning success. The proposed model was designed to integrate prior research in the area of e-learning, where it adds set of determinants to e-learning systems success, and find out the best fit of e-learning system components. Moreover, educational institutions can use this proposed model.

Keywords—Information Systems, E-Learning, Learning Management System, Knowledge Management Systems, E-Learning Success.

1 Introduction

The market of e-learning can be classified as a growing market. In their report about e-learning trends, as stated in [1] the worldwide market for self-paced e-learning reached $35.6 billion in 2011, in addition, the report show that the five-year compound annual growth rate is estimated to 7.6% so revenues can reach $51.5 billion by 2016. Furthermore, Ref. [1] showed that e-learning is influenced by sales trends related to smart connected devices and the internet megatrend. In addition, Ref. [1] show that the number of PC's will fall from 28.7% in 2013 to 13% in 2017, and tablets will increase from 11.8% in 2013 to 16.5% by 2017, and smartphones will increase from 59.5% to 70.5%.

As stated in Ref. [2], many institutions of higher education and corporate training institutes use e-learning to solve authentic learning and performance problems, while others do not want to be left behind. Therefore, Ref. [3] identified accessibility to educational technology as vital for acquisition and dissemination of knowledge to students, and interaction between lecturers and students.

In order to achieve the anticipated benefits from e-learning, comprehensive evaluations must be conducted. Meanwhile, Ref. [4] showed that existing models for evaluating the complex interaction between e-learning factors influencing e-learning effectiveness have not yet been widely tested and developed. In addition, learners' criteria for evaluating the success of e-learning are generally not well understood.

Ref. [5] recommended for the development of better measures of system and user attributes within the e-learning context. Where, Ref. [6] recommends that; there is a need to develop a causal structural equation model by generating causal relationships among factors, and to check the validity of the causal research model. In addition to the recommendation in Ref. [7] for a future study that will incorporate factors such as tutor competency, learner characteristics and other factors influencing e-learning effectiveness.

The main objective of the current study is to create a model that incorporates e-learning success factors. To pursue this objective, a review to prior researches and theories will be conducted, in order to find out a model that incorporate the most important factors that effects the success of e-learning systems, and then evaluating this model depending on set of theories and prior researches in the area of e-learning.

2 Theoretical Framework

2.1 The General Model

The general theoretical model is presented (Fig. 1) to identify the main research propositions, and the relationship between learner performance as a dependent variable, and the independent variables; which include the e-learning system, and institutional context.

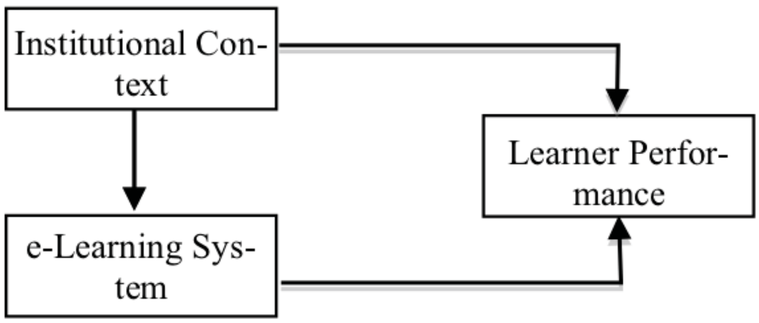

Fig. 1. The General Model

The detailed theoretical model is developed depending on prior research on e-learning success, information systems success, pedagogical theories, and learning theories. These theories include; situational theory of publics – STP [8], technology acceptance model – TAM [9], information system success model - D&M [10, 11, 12], multilayer model of user activity [13, 14, 15], action theory [16], situated action theory [17], and GOMS model [14].

E-Learning System

E-Learning Concept. E-learning is defined in the literature as an educational system that delivers information using the information technology resources such as the internet, intranet, satellite broadcast and multimedia applications [18] [19] [20]. In Ref. [21] e-learning refers to using electronic applications and processes to learn via the Internet, network, or standalone computer, in order to enable the transfer of skills and knowledge.

Components of E-Learning System. As stated in [22] most challenging role and responsibility of the online teacher is to provide a creative and interesting learning environment. Therefore, teachers use student-oriented learning management systems to oversee their classroom. In addition, teachers base their classroom agendas, which require the teacher to analyze the learner, determine the learning objectives, and then select the methods, media and materials to be used in the classroom, and utilize the chosen media and materials.

As stated in [18]; a wide variety of factors affect the success of e-learning; these factors include the development of courses, the way of teaching and learning, course structure, student support, instructor, technology, previous use of technology by a student, the suitability of course content, building e-learning course, and e-learning platform.

Ref. [21] show that; there are five e-learning components that are essential for all successful online courses, mainly; audience, course structure, page design, content engagement, usability. Where, audience are students –learners- whom are critical factor in the process of developing online courses, course structure refers to how a course is intended for e-learning, page design refers to the e-learning page design (navigation, appearance, balance between text and graphics, consistency, and ease of scanning), content engagement refers to how students interact with content of the course (concepts, explanations, graphics, exams), and usability refers to testing e learning content and applications in the same environment that the student will complete the course.

The previous discussion to prior researches show that e-learning system consists of recipients- (learners), a task or content to be presented to those learners (course), a presenter or instructor who is responsible of designing the task and follow up the learners' achievement, and the information & communication technology (ICT) which is used to mediate e-learning. Figure 2 depicts this traditions view of e-learning system. Where the learner depends on the available course tasks, and information and communication technologies to gain knowledge and skills.

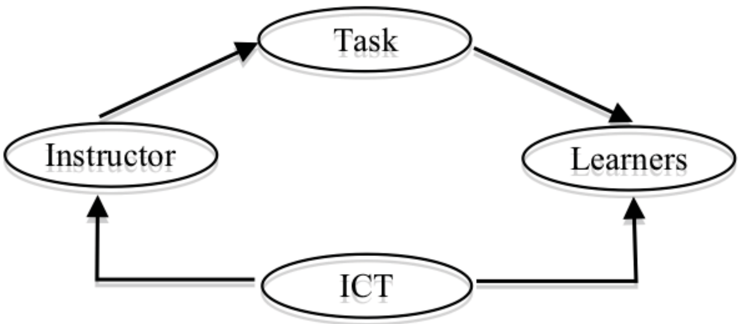

Fig. 2. Traditional e-Learning Systems

Learner Performance. As stated in [23]; performance can be defined as the result of a pattern of action carried out to satisfy an objective, according to some standards. They add that performance related goals are to improve the human ability to handle physical load or demands of the work situation. Therefore, performance can be measured by reducing errors, improving quality, reducing time required to complete task, and end user acceptance of the system [23]. Furthermore, Ref. [24] and Ref. [25] stated that; educational outcomes include satisfaction, knowledge, attendance, adherence, and self-reported change in practice.

Ref. [22] stated the advantages of e-learning, where the learner gains more freedom in e-learning process, learners can acquire and transfer knowledge, enhanced communication among the learners , the ability to conduct an open discussion, each learner gets more of an equal standing, responses can be made around the clock with no restrictions, a higher motivation and involvement in the process on the part of the learners, the study is based on various sources of information; including online data banks and net experts located by the student, the student learns "how" and less "what". Ref. [20] adds that in e-learning, the content can be easier and faster to modify and update. In addition, Ref. [26] stated that online learning produces collaborative learners who can learn in groups.

Physical engineering seeks to improve system performance by improving the fit between the human and the computer. Where, fit is the match between the computer design and the user and task; so as to minimize the user's human resources needed to accomplish the task. Therefore, reducing efforts required by the user, using suitable objects and colors, training the user, and task analysis will lead to best fit, and hence improves performance [23]. As stated in Ref. [27], designing an interface must help users to achieve set of goals. They show that the goals include matching user interface to the task, making the user interface efficient, providing appropriate feedback, generating helpful queries, and improving the productivity of computer users.

The previous discussion shows that; the learner performance is affected by the interrelationships between all e-learning system elements. Figure 3 depicts this relationship; where the task design has an impact on the other three elements in the e-learning system. This type of relationship will be the same for all other element.

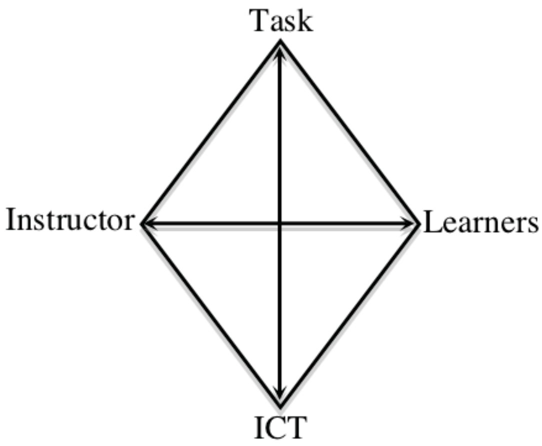

Fig. 3. The Interrelationships Between e-Learning

Achieving Fit among E-Learning System Components. Prior researches examine the impact of one, or more e-learning system constructs on learner performance. Table (1) provides a summary for these constructs, and the requirements that enables achieving positive impact, and hence, enhancing the fit between e-learning system components.

Components' Fit and Learner Performance. As it noted earlier in the previous section, physical engineering seeks to improve system performance by improving fit between the human and the computer. In order to determine the best fit between e-learning components, the current study will depend on prior researches and theories, mainly; situational theory of publics – STP [8], multilayer model of user activity ([13, 14, 15], action theory [16], situated action theory [17], GOMS model [14], and Information System Success Model-D&M [10, 11, 12].

1. Situational Theory of Publics (STP)

As stated in [8], publics can be identified and classified in the context to which they are aware of the problem and what they do about the problem. This theory explains when people communicate and when communications aimed at people are most likely to be effective. The main variables of this theory are problem recognition, constraint recognition, and level of involvement. Where, problem recognition is referred to how individuals recognize a problem facing them. Meanwhile, constraint recognition is referred to how individuals see their behavior as limited by factors beyond their own control. In addition, level of involvement is a measure of how personally and emotionally relevant problem can be for an individual. Information seeking is looking for information and understands it. Information processing is processing information that comes to individuals.

The situational theory of publics was adapted in Ref. [29] and applied to predict online learning success. They define the theory as the states that individuals can be classified into different groupings based on their awareness about a particular topic and what they do about that topic; such as seeking further information, or removing barriers that preventing them from becoming more involved.

Table 1. E-Learning Components' Fit and Success in Prior Researches

Prior Researches	Fit Components and Items	
[6]	Instructor	Enthusiastic, style of presentation, friendly towards learners, has a genuine interest in students, encourages learners interaction, handles the e-learning units effectively, explains how to use the e-learning components, keen on using the e-learning units, learners were invited to ask questions/receive answers, encourage learners to participate in class, encourages and motivates me to use e-learning, active in teaching the course subjects via e-learning.
	Learner	Searching for facts, participating actively in discussions, using the PC and applications, not intimidated by using the e-learning based courses, Learning by absorption, Learning by construction
	Course	clear instructions, sufficient course content, the structure of e-learning components, navigate through the Blackboard/course web, e-learning components were available all the time, the course materials were placed on-line in a timely manner, good design of the e-learning components.
	ICT	Easy on-campus access to the Internet, satisfying speed, easy to use, information was well structured/presented, pleasant, Interaction, easily contact the instructor, can use any PC at the university, can use the computer labs, reliable, can use banner, efficient information technology infrastructure.
[28]	Learner	Accessing diverse student population, interactive ways of communication.
[29]	Instructor	Instructor support, lecturers need to be cautious when including e-learning as part of their assessment
	Learner	All students have to participate in the discussions, students have to interact with each other both within and outside the online space.
[30]	Instructor	The presence of a personal tutor considered unimportant by students
	Learner	Flexibility of time and hours, mandatory quizzes and exercises
	ICT	A user-friendly platform
[31]	Instructor	Timely response, self-efficacy, technology control, focus on interaction, attitude toward student, interaction fairness.
	Learner	Computer self-efficacy, internet self-efficacy, attitude toward e-learning.
	Course	Course quality, relevant content, course flexibility
	ICT	Internet quality, reliability, ease of use, system functionality, system interactivity, system response.
[18]	Instructor	The way of teaching and learning
	Learner	Student support
	Course	Development of courses, course structure, suitability of course content, building e learning course, suitability of e-learning course
	ICT	Previous use of technology by a student, e-learning platform
[9, 32, 34, 35, 36]	Instructor	Perceived ease of use, perceived usefulness, computer self-efficacy.
	Learner	Perceived ease of use, perceived usefulness, computer self-efficacy.
[36, 37, 48]	Instructor	Responsiveness , instructor attitude towards e-learning
	Learner	Learner attitude , learner anxiety , self-efficacy
	Course	Course flexibility , course quality
	ICT	Technology quality , Internet quality
[25]	Learner	Collaboration, interaction, learner control, age, entrance scores, experience, language, learner characteristics, learner preferences, locus control, motivation, expected workload, previous e-learning experience, training.
	Course	Active Learning, applicable to practice, balance between asynchronous and synchronous activities, cognitive load, design, instructional scaffolding, modeling, problem-based learning, practice, structure.
	ICT	Computer playfulness, technological constraints, usability.

When applying the independent variables of the Situational theory of publics to the online learning environment, the constructs can be operationalized to reflect the many dimensions of success, or lack thereof, in the online learning environment. As stated in Ref. [29]; the dimensions include the self-motivation, time-management, understanding course expectations, class assignments, and having knowledge and skills required to navigate the online learning.

This theory implies that classifying learners into different groups based on their level of awareness about the task, and the extent which they do the task will enhance the fit between the learner and the task. On the other hand, the learner must have technical skills and knowledge to navigate online learning in order to achieve fit between the learner and technology.

2. Multilayer Models of User Activity

Multilayer models report the interaction between the human and the computer. Ref [13] reported a representational framework for describing the human-computer interaction, this framework includes three types of component, mainly; the conceptual components which include the tasks and the abstract concepts, the communication components; which include command languages, and the physical components; which include the displays and keyboards.

As stated in [15] Te'eni et al adopt Moran's model [13, 14], and call it a multilayer model of user activity (TSSL model). This model presents the human-computer interaction (HCI) and the analysis of user activity as a function of human resources. The user activity encompasses the user's interaction with the computer to accomplish a task which is conceptually viewed at multiple and distinct levels of interaction.

Figure (4) shows the multilayer TSSL model, which encompasses four levels (layers) of interaction, mainly; task, semantic, syntactic, and lexical. Each layer provides the context for the layer below it, where, the uppermost layer includes the task, which is closest to the user's goals, meanwhile, the lowermost layer includes the lexical level which is closest to the resources that are needed to physically implement these goals. Therefore, the model represents the translation of goals to physical implementation (activity) at different interaction levels.

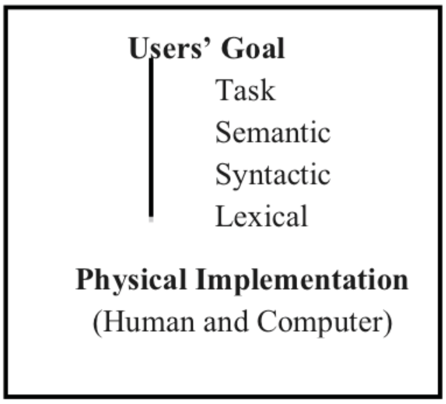

Fig. 4. The Multilayer TSSL Model [15]

As stated in [13, 14] and [15]; the task level is related the user's goals, and pertains to the information requirements that have to be met. The semantic level is related to the user's interpretation and the computer logical structure, and pertains to the set of objects and operations through which the computer becomes meaningful to the user. The syntactic level is related to the rules of combining the semantic objects and operations into instructions. Meanwhile, the lexical level describes the way that a specific computer device is used to implement the syntactic level.

The Multilayer Models of User Activity implies that achieving fit between the human (instructor and learner), the computer (ITC), and the task occurs through four levels of interaction. Where, 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.

3. Action Theory

As stated in [16], Norman and Draper provide a model (figure 5) that discuss the user behavior while using the system, and provides suggestions for bridging the gap between human and computer using a sequence of user activities. Figure (5) depicts accomplishing a task by breaking it down into set of activities, mainly; establishing a goal that needs to be accomplished, formulating the intentions that will accomplish the goal, specifying the action sequence to implement the intentions, executing the action, perceiving the state of system resulting from the action, interpreting the system state, and evaluating the interpretation against the expectation based on the specified intentions.

The action theory provides suggestions for bridging the gap between human and computer using a sequence of user activities. This implies that the theory can be considered as a base for achieving fit between the human and the computer (ICT).

4. GOMS model

As presented in [14] GOMS model provides an explanation to the user cognitive skills related to computer tasks. The model shows that the cognitive structure includes four main activities; mainly, setting goals, setting operators, setting methods, and the selection rules. Goals reflect the user need and intentions for his achievements; therefore, goals serve as the basis for control to evaluate whether it has been accomplished correctly. Operators are the required physical activities that describe the human-computer interaction at the physical level. Methods are programs and interfaces that contain the operators required to accomplish goals. Selection rules required for choosing a method from the competing methods. This model used to predict the required time for completing a task, and identifying the effects of errors on the performance.

GOMS model enables predicting the required time for completing the task, and urges to use the best interface, which achieves the best performance to the user.

5. Information System Success Model (D&M)

Delone and Mclean [10, 11, 12] presented the information systems success model (D&M) (Figure 6), which can be used to measure information systems success. This model was tested as stated in [38], and the results show that; the model shows good explanations to information systems success factors and enables the applied theories in the area of information systems measurement to take place [39]. Furthermore, the model takes in to consideration the perspectives of all information systems recipients.

E-learning studies that applied the information systems success model [40, 41, 42, 43, 44, 45] were reviewed in Ref. [31]. The main findings stated in [31] show that these studies adapted the model to be applicable in the e-learning area. Where, system quality and information quality significantly influence learner satisfaction, performance expectation and perceived usefulness.

The previous theories show that, achieving high performance, requires a good fit among e-learning system components. Figure (7) depicts the impact of e-learning system components on learner performance, taking onto consideration the fit between these components. Learner performance is affected by all e-learning systems components, where, the higher the fit between these components will lead to a higher learner performance.

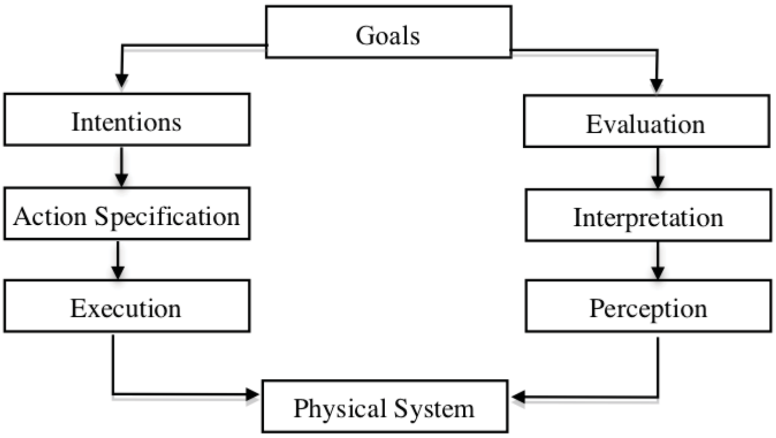

Fig. 5. Norman's User Activity Model [16]

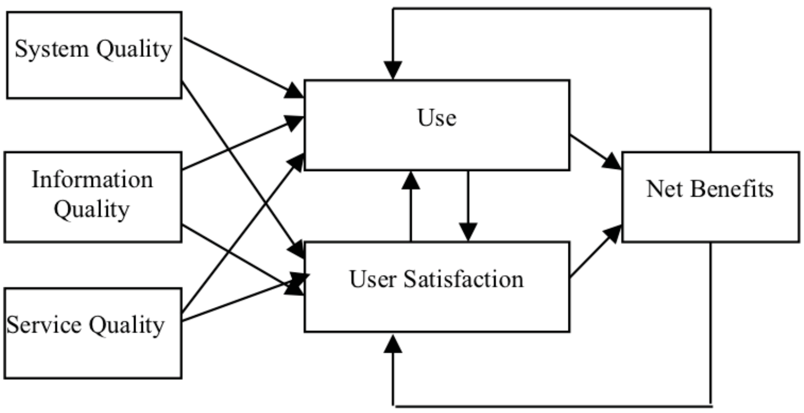

Fig. 6. D&M model [11]

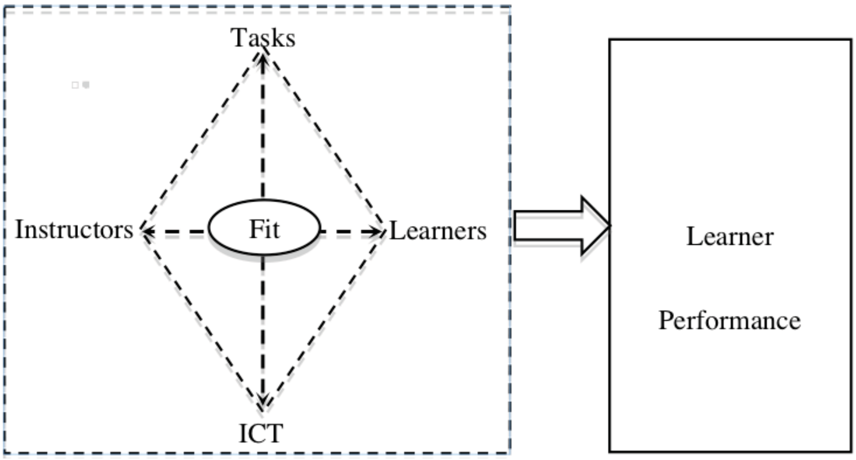

Fig. 7. Components Fit and Learner Performance

E-Learning Context and Mechanisms. Laudon and Laudon [46] classified learning management systems as enterprise-wide knowledge management systems. These systems provide tools for management, delivery, tracking, and assessment of various types of learning and training.

Becerra-Fernandez and Sabherwal [47] discussed the requirements for knowledge management (KM) systems, and define KM foundations as broad organizational aspects that support KM in the short- and long-term. These foundations include KM infrastructure, KM mechanisms, and KM technologies.

KM Infrastructure. As stated in [47] organizational context, KM infrastructure includes five major components, mainly; organizational culture, organizational structure, information technology infrastructure, common knowledge, and physical environment. Organizational culture reflects the norms and beliefs that guide the behavior of the organization's members. They define the attributes of an enabling organizational as an understanding of the value of knowledge management practices, management support for knowledge management at all levels, incentives for knowledge creation and sharing. Organization structure reflects the hierarchical structure of the organization. Where, organization structures can facilitate knowledge management through specific structures and roles. Information technology infrastructure consists of data processing, storage, and communication technologies and systems in an organization. Common knowledge refers to the organization's experiences in a category of knowledge and activities, and the principles that support communication and coordination in the organization. Where, common knowledge helps in enhancing the value of an expert's knowledge by integrating his knowledge with the knowledge of others. Concerning the physical environment Becerra-Fernandez and Sabherwal [47] show that it includes the design of buildings; including location, size, type of offices, and nature of meeting rooms.

KM Mechanisms. Knowledge management mechanisms was defined in Ref. [47] as organizational or structural means used to promote knowledge management. These mechanisms involve some kind of organizational arrangement or social or structural means of facilitating KM; such as learning by doing, on-the-job training, learning by observation and face-to-face meetings.

KM Technologies. As stated in [47], KM technologies are those technologies that support KM including artificial intelligence, computer-based simulations, case-based reasoning systems, decision support systems, electronic discussion groups, databases, management information systems, enterprise resource planning systems, expert systems, expertise locator systems, videoconferencing, and information.

The previous discussion shows that; the success of e-learning systems requires set of foundations, mainly; infrastructure, mechanisms, and technologies. These foundations classified by Becerra-Fernandez and Sabherwal [47] as organizational (institutional) determinants for e-learning systems success. Meanwhile, Prior researches examine individual, institutional, and environmental determinants and their impact on e-learning systems. Table (2) provides a summary for these determinants and their impact on e-learning success.

Table 2. Determinants of e-Learning Success in Prior Researches

Prior Researches	Context	Context Factors
[6]	Institutional	Technical assistance and troubleshooting, library, information availability.
[28]	Institutional	High quality support services, infrastructure, culture, recognition of work providing training, the reward systems
[28	Institutional	High quality support services and infrastructure, positive Institutional culture and norms on participation into e-learning and recognition of work, providing training for faculty, increase in payment.
[31]	Environmental	Social influence, learners' perceived interactions with others
[31]	Environmental	Social influence, learners' perceived interactions with others
	Individual	Diversity in assessment, perceived autonomy support.
[33]	Institutional	Organizational learning culture, senior management support, institutional policy, information security policy.
[29]	Institutional	Teaching and learning strategies and policies, infrastructure
[31]	Institution	Computer training, program flexibility, perceived usefulness, clear direction
[33]	Institutional	Top management support, organizational learning culture, information security policy, institutional policy
[18]	Institutional	Technical support, technological infrastructure, management support
[25]	Institutional (Context scaffolding)	Learning environment, support, technical resources available to user, time available to learn.

3 A Model for E-Learning Systems Success

The detailed model (Figure 8) is derived from prior researches, and set of theories and models. This model is composed of three main parts, mainly, context, e-learning systems, and learner performance.

3.1 Context

As a result to reviewing prior researches and theories, e-learning context and mechanisms can be divided into three main constructs, mainly, individual, institutional, and environmental determinants.

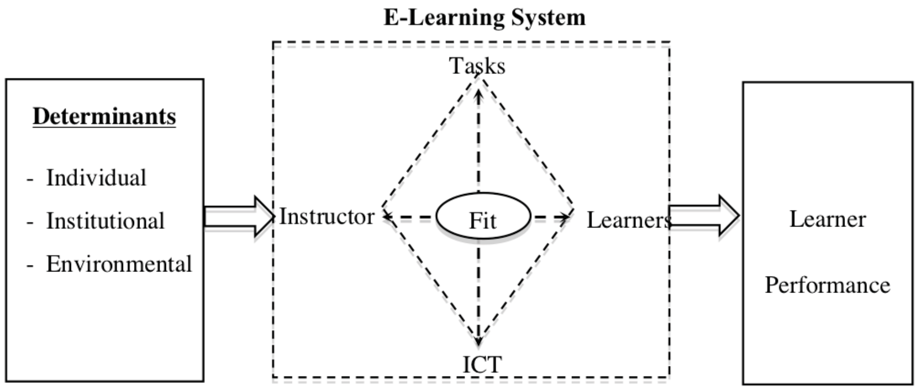

Fig. 8. A Model for e-Learning Systems Success

3.2 E-Learning Systems

Prior researches show that e-learning system consists of instructor, learners, course, and the information & communication technology (ICT). The discussed theories in the current study show that:

- Classifying learners into different groups based on their level of awareness about the task, and the extent which they do the task will enhance the fit between the learner and the task. On the other hand, the learner must have technical skills and knowledge to navigate online learning in order to achieve fit between the learner and technology (Situational Theory of Publics [8].
- Achieving fit between the human (instructor and learner), the computer (ITC), and the task occurs through four levels of interaction. Where, 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. Multilayer Models of User Activity- [13, 14].
- The action theory provides suggestions for bridging the gap between human and computer using a sequence of user activities. This implies that the theory can be considered as a base for achieving fit between the human and the computer. Action Theory- [16].
- GOMS model enables predicting the required time for completing the task, and urges to use the best interface, which achieves the best performance to the user. (GOMS model- [14].

- System and information quality significantly influence learner satisfaction, performance expectation, perceived usefulness. Information System Success Model-D&M [10, 11, 12].

These theories, and prior researches show that, achieving high performance, requires a good fit among e-learning system components, where the higher the fit between e-learning system components will lead to higher learner performance. This implies that, each component of e-learning systems must possess set of characteristics in order to strengthen the fit.

3.3 Learner Performance

Prior researches show that learner performance can be measured using set of items. These items include reducing errors, improving quality, reducing time required to complete task, end user acceptance of the system, freedom in e-learning process, adherence, attendance, satisfaction, knowledge, enhanced communication among the learners, getting more of an equal standing, responses may be made around the clock, a higher motivation and involvement, the student learns "how" and less "what", the content can be easier and faster to modify and online learning produces collaborative learners who can learn in groups.

4 Conclusion and Recommendations

The current study reviews the literature that is concerned with e-learning, and then conducted an analysis to the available determinants. This can be summarized in:

1. E-Learning system consists of learners, course content, a presenter or instructor, and the information & communication technology (ICT).
2. The learner performance is affected by the interrelationships between all e-learning system components.
3. Physical engineering seeks to improve performance by improving fit between the human and the computer. Therefore, a review was conducted to prior researches and theories to determine the best fit between e-learning components.
4. Achieving the best fit, and hence, the success of e-learning systems is determined by set of determinants, mainly individual, institutional and environmental determinants.

Examining the literature on e-learning success show that learner performance is determined by the e-learning system. This system consists of a number of factors or components, mainly; the instructor, course, learner, and ICT, where these components are interrelated and interdependent. Moreover, the literature shows that there are a number of determinants that affect e-learning systems and learner performance. These determinants include individual, institutional and environmental components.

These interactions, and interrelationships between the different factors of e-learning forms a model (figure 8). This model is composed of three main domains as follow:

1. Determinant of e-learning system which include individual, institutional and environmental determinants.
2. E-learning system components which include instructor, course, student and ICT.
3. Learner performance.

This model is designed to integrate with prior researches in the area of e-learning, where it adds set of determinants to e-learning systems success, and find out the best fit for e-learning system components. Therefore, this model provides a comprehensive view to e-learning success, show the areas where significant work has already been accomplished and point out where much work is still needed; particularly determining the best fit between e-learning components, and the impact of context determinants of e-learning success.

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