

Connectivism: Promising Constructs to the E-Learning Systems Success

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Abstract—The use of e-learning in teaching and learning today is very widespread. Various learning theories have been used behind the use of e-learning. However, there is still room for improvement by strengthening the connectivity aspect in the learning process. Connectivism has the potential to remove issues such as lack of interaction, inaccessibility to various ideas and resources, dissatisfaction with the systems, and failure in e-learning. Therefore, this study aims at the e-learning systems success by applying the principles of the connectivism theory. The findings of this study introduce the main connectivism determinants of interaction, autonomy, diversity, and openness which can equip the future e-learning studies with the necessary constructs and principles to propose models and frameworks for the e-learning success in not only usual but also unusual situations. This study will promote the satisfaction with the e-learning systems which leads to the e-learning success as a result.

Keywords—E-Learning, Information Systems, Systems Success, Satisfaction Theory, Success Model, Connectivism, Learning Theories, Online Learning, MOOCs, COVID-19

I. INTRODUCTION

Information and Communication Technologies (ICTs) have evolved in this fast-paced age of communication, and they now provide higher education with a plethora of new ways to present learning programs. Electronic learning (e-learning) is an example of pedagogical innovation that has changed the learning path by providing learners with a variety of options. During the COVID-19 pandemic, e-learning tools are becoming increasingly important. Learning providers should use e-learning systems to organize, plan, deliver, and track their learning and teaching processes. They also aim to assist universities, schools, and instructors in facilitating student learning during school and university closures.

Despite their benefits, e-learning courses have been observed to face challenges, indicating that the success of e-learning is limited by a number of factors that must be addressed. Nonetheless, both learners and teachers are encountering issues in e-learning programs as a result of the COVID-19, which has been in effect since the beginning of 2020. These problems can be solved by applying the principles of the most recent theory of learning, connectivism. This research highlights the connectivism principles and explains how they empower the e-learning systems to be successful. The motivation behind this study,

the gaps in the prior e-learning studies and models, the theoretical foundation of the study, the main determinants for the successful e-learning systems and the conclusion of this research are discussed.

Issues that obstruct e-learning may jeopardize its achievement. Regardless of the unsolved problems, e-learning success can be ensured by using models that are properly formed based on the e-learning theory as a solution. Therefore, this study examines the previous e-learning success studies in order to find their gaps with the help of the connectivism learning theory. Unknown issues at the heart of the e-learning program, such as a lack of interaction, collaboration, openness to a variety of ideas and sources, autonomy, and many others, can endanger the learning process. The considerable research amount in e-learning has helped us understand the key factors of success for e-learning: information quality, system quality, service quality, satisfaction, and usefulness. The most critical and general measure of information system success is user satisfaction [1]. Accordingly, applying the factors of the e-learning theory of connectivism in user satisfaction can pave the way for the success within the e-learning systems.

In previous e-learning experiments, the effects of some constructs on others were considerably reduced when there were more constructs present. For example, despite the fact that autonomy is frequently praised for leading to higher satisfaction level and work engagement, the effects that autonomy has on satisfaction were greatly reduced when shared leadership was present [2]. In the field of e-learning, substantial growth and development have existed; but, according to the e-learning theory, there is still a need for a related e-learning study. E-learning projects, likewise, are not based on the e-learning theory [3]. Despite their tremendous contribution, Behaviorism, Cognitivism, and Constructivism theories have not provided satisfactory results in e-learning studies. This is due to the fact that e-learning is a combination of "e" and "learning," suggesting that something unique exists about e-learning that distinguishes it from traditional learning. As a result, applying traditional learning theories to e-learning would fail because e-learning and traditional learning vary in a number of ways [4], [5].

The original version of the DeLone & McLean (D&M) Information Systems (IS) Success Model has been used in many studies to date [6], [7] to assess and measure the

effectiveness of the e-learning systems. However, the findings suggest that the studies dimensions in [7]–[10] are insufficient to find out what factors impact e-learning use, satisfaction, and success. Alraimi et al. [11] conducted a thorough and systematic study, there are certain limitations to their findings. Their research model, for example, looked at a small number of antecedents that were thought to affect the individual intention to continued e-learning use. However, placing a premium on students' continuance intention to use e-learning, probably, is not the best way to assess the e-learning success. As a result, a study that would have contributed to the improvement of e-learning and served as a foundation for subsequent research has been overlooked because most of the studies done earlier formed the IS based models to the e-learning success which can support the “e” part of the e-learning term but ignore focusing on the “learning” part of the term e-learning to equally follow both the IS theories as well as the learning theories.

On the other hand, the few models which considered the learning theories followed the traditional learning theories by applying only one or two constructs which cannot be seen as vital constructs. Furthermore, earlier research has left out a number of the IS Success Model predictors. For instance, in a model developed by [12] both system quality and service quality which are thought to be influential variables in the e-learning systems success were not included. To aim at the issues mentioned, the present study tries to answer its main research question which is “*What are the connectivism factors which can influence the e-learning systems success?*” The discussion which was addressed as the study's main issues previously is the incipient background to arrive at the main goal of this study which is to investigate the connectivism factors which can influence the e-learning systems success.

II. PRIOR LITERATUR

A series of researches have been carried out on education and e-learning e.g., modeling e-learning systems' adoption, satisfaction, and success. The adoption of the systems of e-learning is emphasized in most studies. More research is needed into the determinants of the e-learning success, particularly in identifying the e-learning main factors in association with satisfaction. [13]. Triggered by the previously defined gap and the need to better grasp the success factors, Means et al. [14], Seddon [15], and Seddon et al. [16] suggested that constructs in the D&M IS Success Model be included [6], [7], which reflected the various stakeholder groups' for their diverse interests and perceived outcomes. The D&M IS Success Model is a constructed model on information systems success theory [6], [17], [18] in which individual impact is explained by use and user satisfaction and organizational impact is explained by individual impact.

Several researches in the field of e-learning have used the IS Success Model to determine the connection between the parameters of IS quality and IS continuous use and satisfaction [19]. In a study by Cidral et al. [10] the success of e-learning was modulated in a context in Brazil. Following the previous e-learning satisfaction theory and the IS success theory, they proposed a model [8], [9], [18]. Some empirical

studies have already validated these theories and, as a result, the related models can be referred to because of their solid foundations [20].

The model which Cidral et al. [10] proposed consists of 11 theoretical constructs and collaboration quality, learner perceived interaction with others, diversity assessment, instructor attitude toward learning, and learner computer anxiety were attached to the D&M IS Success Model. In their model, collaboration quality is related to the principles of the web environment, the universal use and the digital culture of the web [9], [21], [22]. The results emphasize that the model dimensions in [8], [9], [18] are not able to extract the vital variables of satisfaction, use, and e-learning success completely. By incorporating the key principles of connectivism learning theory, our research leads to the progress of theory advancement and acts as a foundation for potential studies.

Robert & You [2] conducted a study to see if autonomy, shared leadership, individual trust could help improve satisfaction. They decided to learn more about the impact of autonomy, shared leadership, and the trust of team members on satisfaction in their research. Autonomy is widely considered because it contributes to higher involvement and satisfaction. In the presence of shared leadership, indeed, the impact of autonomy on satisfaction was considerably reduced. This might be particularly critical since individual autonomy may have a considerably higher degree of involvement than the time when teams depend on a shared leadership framework. [2].

The user's intention may be assessed by the user's ‘continuance intention’ [23]. The intention of a person to utilize an e-learning system repeatedly for professional growth is known as continuous intention [24], [25]. Various studies such as [25] and the D&M IS Success Model [7], [18] have illustrated that an information system use is closely related to the continuance intention. In a study, Alraimi et al. [11] tried to find the factors which increase a person's intention to continue taking MOOCs. The results from a large-scale survey were used to verify a proposed research model derived from the information systems continuance expectation-confirmation model. According to the research model, perceived openness, perceived and user satisfaction, perceived reputation, and perceived usefulness play a role in the intention to continue use of MOOCs. The key predictors were perceived openness and perceived reputation which had never been studied before in the MOOCs context. Since a university cannot afford to recruit a specialist in any area, openness is correlated with free access to instructional material [26], as well as the exchange of rare resources. Despite the fact that Alraimi et al. [11] performed comprehensive and thorough research, there are a few drawbacks to the study. The research model looked at a small number of antecedents that were thought to affect an individual's intention to continue MOOCs using. Learners' continued intention to use e-learning could not be the optimal criterion for assessing the e-learning success. Exploring alternative dependent variables like connectivism principles may also offer value for the e-learning success.

In a study done by Hermita et al. [12] an effective Blended Learning administration model was examined. Six variables were used to construct the model: system usage, information quality, internet self-efficacy, faculty-student interaction, user satisfaction, and e-learning success. Like some other studies, this study excluded few of the IS Success Model predictors. For instance, both service quality and system quality which are thought to be influential variables in the e-learning systems success were not included. To sum up briefly, table 1 presents the main theories and models from which the principal determinants of the e-learning system success are derived in this study.

Table 1. The Main Applied Theories and Models

Theories and Models	Sources
Connectivism Learning Theory	[27]–[29]
D&M IS Success Model	[18]
Employee Portal Success Model	[9]
A Survey Instrument to Measure Student Satisfaction in Distance Learning	[30]
Information Systems Continuance Expectation-Confirmation Model	[11]
A Multilevel Model of Satisfaction	[2]
An Integrated Model to E-Learners' Satisfaction	[8]
Standardized Structural Model	[12]
E-Learning Success Model	[10]

Satisfaction is characterized as the degree of satisfaction students have with blended learning [31]. The perceived level of agreeability against the whole system is known as user satisfaction. Appropriateness and effectiveness are used to assess user satisfaction [10]. According to what has been discussed so far and according to the D&M IS Success Model [6], the perceived influence of the systems of e-learning is triggered by satisfaction and actual use of the e-learning systems [32], [33]. Seddon et al. [16] suggested a series of different ways for assessing the efficacy of IS which involved the stakeholders in the programs as well. The D&M model is the foundation of our work since the primary aim is to evaluate the variables that influence the success of the e-learning systems; but, because other studies indicate that certain principles are required to improve the explanation's reliability, we will focus on autonomy, diversity, openness, and interactivity in connectivist pedagogies which highlights learning as a sort of interaction hinged upon students' development and networked knowledge making [34], [35].

III. THEORITICAL FOUNDATION

The term "connected knowledge" was first developed as a means to understand and investigate networked learning in a digital era by a new network-based pedagogy called "connectivism" [27], [29], [28]. E-learning and interactive

technologies have developed from the use of email-delivered print content to constructivist learning and then, in recent years, to connectivist learning. In distance education, interaction is highly valued. Learning, according to connectivist pedagogies, is a type of interaction focused on the development and growth of networked knowledge [34], [35]. For making connections and formulation of networks, interaction with other people as well as with network resources is crucial. Siemens [35, p. 157] noticed that "social interactions are vital to how participants made sense of course content and how they orient themselves spatially".

Siemens [27] states that the fact that behaviorism, cognitivism, and constructivism were developed in an era when technology was not evolved and dominant in education makes them incomplete. The connectivism learning process occurs as the students nurture their knowledge by linking them to collective community knowledge [36]. Learning, according to connectivists, is not simply the delivery of information from an instructor to a pupil and it does not occur in only one environment.; rather, interactions between people suggest and transform information, particularly in a web-based system [37]. According to connectivism, each individual is responsible for his/her own education. Through nodes and connections, they create their own personal learning network [38].

Connectivism is defined as a learning network theory based on connective knowledge epistemology [39]. Downes [28], [34] believes that in the field of networks, connective knowledge is the third form of knowledge, apart from the other two kinds of knowledge that have traditionally been accepted: qualitative and quantitative knowledge. Interactions with people who are connected to different networks produce connective knowledge, which is then disseminated across a web of individuals. Siemens [27, p. 8] observes in a similar vein that "The starting point of connectivism is the individual. Personal knowledge is comprised of a network which feeds into organizations and institutions, which in turn feeds back into the network and then continues to provide learning to the individual".

In distance education, interaction is highly valued. Learning, according to connectivist pedagogies, is a type of interaction focused on the development and growth of networked knowledge [34], [35]. For making connections and formulation of networks, interaction with other people as well as with network resources is crucial. Some studies focused more on the relationship between learning and interaction which is helpful in developing interaction theories and offering a thorough and systematic understanding of interaction. While interaction is accepted as a key element and practice in connectivism, few studies have been done to examine its function in learning from a theoretical standpoint [40].

Though some learning theories put a stronger emphasis on learners' autonomous learning, connectivism emphasizes individuals' linked and shared learning experiences. In learning communities, knowledge is perceived as a shared effort. Downes [34] describes the four main components of autonomy, diversity, openness, and interactivity (or

connectedness) as follows to build communities which are dynamic:

- **Autonomy:** Making decisions about learning objectives as well as outcomes of learning and selecting resources of learning in order to generate new knowledge on their own.
- **Diversity:** Having unique characteristics in the networked learning environment (for example, various languages, culture, viewpoints, software, resources, etc.) as well as specific sets of links in order to generate new knowledge in the community.
- **Openness:** Interacting easily with others not only within but also outside the network, as well as participating in community events in order to generate new knowledge without limitations.
- **Interactivity:** Being linked and involved in diverse communications with one another in order to generate specific knowledge.

Communication encourages human connection, offers human materials, and generates a deep learning content layer that no designer could ever expect to generate, Downes added [34]. A very similar inference can be drawn from Siemens' [35] 'model of learner-technology relationship in MOOCs, 'which indicates that in connectivist learning interaction is just as necessary as production. Interaction is therefore believed to be a central practice and a key component in connectivist learning [40]. To date, studies done in the domain of the e-learning systems success have applied none or a single key construct of connectivism clarified by Downes [34]. E-learning can be studied in various scopes, including a common space in which individuals interact through and within this space. For instance, interaction of students with each other, with their instructors, with the content, and with the technology can be investigated. Applying the other connectivism constructs of autonomy, openness, and diversity can help the success of the e-learning systems as well.

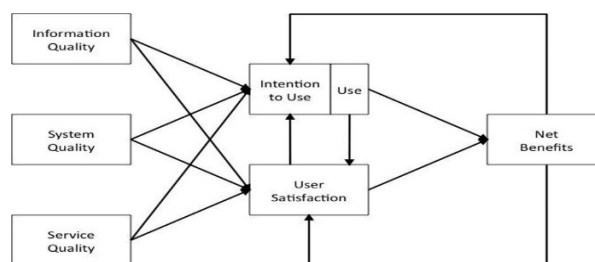
Researchers have well accepted to use the IS Success Model to assess the usefulness of the e-learning system [1]. Aparicio et al. [13] recorded a list of studies among which the D&M IS Success Model can be referred to in the context of the evaluation of e-learning systems. Though the D&M IS Success Model has been applied and verified in the contexts of the e-learning systems, it was formulated to assess IS. Aparicio et al. [13] investigated the effects of cultural and individual characteristics on the success of the e-learning systems. However, regarding the e-learning systems success, the impacts of some core constructs of the D&M IS Success Model were neglected.

Six theoretical constructs make up the D&M IS Success Model [6], [7]: information quality, system quality, user satisfaction, use, individual impact, and organizational impact. The D&M IS Success Model was revised in 2002 and theoretical proof was discovered explaining that the service quality is a success determinant in terms of beneficial influence on use and user satisfaction [18]. Three kinds of qualities are important determinants of an information system or technology [31]. A new construct, net benefits, was added

to this model as a result of combining the individual and the organizational impacts constructs.

According to [18], system quality is related to the technological features, functionality, navigability, performance, system usability, and the accessibility that users perceive during the course. Information quality is related to the system's accuracy, currency in terms of the system contents, and validity. Information quality is required in terms of the reliability, applicability, comprehensiveness, and the information quality of the e learning system. Service quality is related to the technological staff's responsiveness and perceived competence. Service quality is linked to the e-learning system criteria for effective service support which are assessed in terms of trust, responsiveness, empathy, and security [9], [18]. One of the literature success indicators is use which refers to a system effective use. The perceived level of agreeability against the whole system is known as user satisfaction. Appropriateness and effectiveness are used to assess user satisfaction. The perceived individual and organizational impacts on task/job success and efficiency are known as net benefits (Figure 1).

Fig.1. The D&M Updated IS Success Model [7], [18]



IV. DERIVING DETERMINANTS

The objective behind the research model is to gain a deeper understanding of the e-learning use, satisfaction, and success. Therefore, this research aims at identifying the basic determinants of the post-adoption phase, i.e. the e-learning systems success [41]. The combination of the D&M theory of IS success with the e-learning theory of satisfaction and the learning theory of connectivism can be regarded as the key contributions of the present study. There are 15 theoretical constructs in the present study: information quality (IQ), system quality (SysQ), service quality (SerQ), collaboration quality (CQ), Learner-learner interaction (LLI), learner-instruction interaction (LII), learner-content interaction (LCI), learner-technology interaction (LTI), perceived openness (PO), autonomy (A), diversity (D), continuous intention to use (CIU), perceived satisfaction (PS), system usage (SU), and e-learning success (ELS). The constructs are depicted in table 2.

Table 2. The Identified E-Learning Success Constructs

Identified Constructs for the E-Learning Success	Sources
Information Quality System Quality Service Quality	[18]
Collaboration Quality	[9]
Learner-Learner Interaction Learner-Instruction Interaction Learner-Content Interaction Learner-Technology Interaction	[30]
Perceived Openness	[11]
Autonomy	[2]
Diversity	[8]
Continuous Intention to Use	[11]
Perceived Satisfaction	[8]
System Usage	[12]
E-Learning Success	[12]

Accordingly, some direction for the future investigations can be highlighted. Firstly, as Cidral et al. [10] noted, more research should be carried out on the success of the e-learning systems across universities and colleges in fully online format and applying a connectivist approach to the e-learning success can be a solid step in following the real meaning of e-learning which covers both the IS and the e-learning theory. Secondly, exploring alternative dependent variables like connectivism principles can offer value for the e-learning systems success in higher education during the COVID-19 pandemic because all courses have to be fully held online. Thirdly, the e-learning studies should propose models and frameworks by which the ultimate purpose of education, learning, be met in not only usual but also unusual situations. Finally, conducting quantitative studies in applying the proposed models in various educational levels specifically in higher education is highly recommended.

V. CONCLUSION

To begin with, despite crucial development in the e-learning field, e-learning studies are not based on the e-learning theory. The classical theories of learning which do not have the satisfactory potential have been used to address the e-learning studies. Moreover, although some studies have tried to expand the e-learning research by developing the related models like the D&M IS Success Model, the results prove that the studied dimensions could not clarify the constructs of the e-learning success. Besides, not only are the studies carried out on the e-learning success limited in number, but also the proposed models in these studies are restricted due to issues like the impact of a small number of antecedents on the e-learning success.

Additionally, some constructs in the e-learning success models should not be applied together since the presence of one makes the effect of the others meaningless. Furthermore, some designed models have provided general systems of measurements and ignored the necessary constructs of the e-learning systems success. Finally, UNESCO (2020) proves the fact that the provision of a successful e-learning system has emerged as the main issue for higher education due to the

COVID-19 pandemic and studying this issue, especially from students' viewpoints, is at its infancy.

To sum up, in order to overcome the problems in the mentioned studies and to fill the gaps within the e-learning research, the substantial constructs of the D&M theory of IS success with the e-learning theory of satisfaction should be equipped by the characteristics of the connectivism learning theory. The connectivism determinants introduced in this study have been either ignored or applied separately while Connectivism is the most related theory to e-learning.

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