



Review on E-Learning Effectiveness Models

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Abstract: *E-learning systems are gaining momentum in the field of education and training. Corporations have recognized the importance of this new way of training to reduce costs and to ameliorate trainees' competitiveness. Educational institutions are also introducing innovative e-learning programs to expand the scope of their curriculum. India is also witnessing an increase Government initiatives to promote e-learning. This scenario necessitates justification of the huge investments in e-learning systems. Hence, there is a pressing need to evaluate the effectiveness of an e-learning system. As research in the area of e-learning evaluation is burgeoning, an attempt is made to review diverse perspectives on e-learning effectiveness. Models formulated for measuring e-learning effectiveness based on DeLone and McLean IS success model, Technology acceptance theory, Social cognitive theory and Media richness theory have been reviewed in this paper to gain an understanding of the measures of e-learning effectiveness and its antecedents. An insight into this area would facilitate e-learning companies and academicians to design and develop a successful e-learning environment.*

Keywords: *E-Learning, effectiveness, DeLone and McLean IS success model, Technology acceptance theory, Social cognitive theory, Media richness theory.*

I. Introduction

Developed countries are financially competent to provide grants and special institutional facilities to support all levels of education. But in developing countries, not only there is a lack of such facilities, but there is a strict compulsion for youngsters to extend financial backing for their family. Hence the situation learn while you earn which is substantiated by the increasing enrollments in distance education. This paves way to an opportunity for education supported by internet. E-learning refers to any type of learning situation in which instructional context is delivered through the use of computer networked technology, primarily over an intranet, or through the Internet, where and when required" (Bondarouk & Ruël, 2010). E-Learning is expected to expand the scope of education. Electronic Learning congregates knowledge by transcending geographical barriers and provides learners with an engaging, intuitive, collaborative and personalized learning experience.

Homing a large number of digital natives, Indian education system provides a huge room for technology based education. Corporations are increasingly adopting e-learning programmes to facilitate talent management. According to Global Industry Analysts, corporate training is a \$200-billion industry out of which eLearning represents \$56.2 billion and is expected to grow into a \$107 billion market by 2015.

Being the future of education and training, it is essential to enhance the effectiveness of an e-learning system. It is vital to understand the dimensions and drivers of elearning effectiveness. Identifying and specifying these items would define the features of an e-learning system and would imply the directions of designing and developing efficient e-learning systems. This understanding will also further utilization of novel IT tools in expanding the reach of technology based education.

II. E-Learning effectiveness

Learning effectiveness is defines as the quantity of knowledge, skills and behavior learned in a training session and their effective application by trainees on their job. Baldwin and Ford (1988)

An E-Learning environment has in it a set of stakeholders differing in their expectations regarding the outcomes of an e-learning programmed. Hence the success measures may differ for different courses seeking different objectives - ROI for the organization or institution, Level of knowledge gained for the trainers,- User satisfaction for the employees/students. Accordingly the factors leading to these success measures also vary. A number of factors like system quality, content quality, content delivery, continuous feedback have to be incorporated into the system to attain the desired results So rather than trying to come up with an exhaustive list of measures and factors, it would be better to enlist the most generalisable dimensions.

Several studies been conducted adopting different methodology and have revealed numerous dimensions and antecedents. Various Information systems (IS) theories are adopted by different researchers. As of yet a universally acceptable exhaustive model for evaluating the effectiveness of e-learning is yet to be developed. A review of relevant literature may be a precedential to develop a comprehensive framework for evaluating e-learning effectiveness.

III. DeLone and McLean IS success model approach

In order to provide a comprehensive understanding of IS success; DeLone and McLean have identified and explained six critical dimensions (systems quality, information quality, use, user satisfaction, net benefits) to evaluate the success of information systems. They developed a multidimensional model depicting the interdependencies between the success dimensions in 1992. Many scholars working in this area attempted to extend or respecify this model. Based on the feedback obtained from different researchers, the model was updated by the original authors a decade later (2003). The dimensions specified in the model measure the technical, semantic and effectiveness success of an IS.

Table I: IS success dimensions

Dimensions	Definition
System quality	The desired characteristics of the system such as usability, reliability, adaptability and response time
Information quality	The content in terms of completeness, relevancy, understandability and security
Service quality	The overall support as provided by the IS department like assurance and responsiveness
Usage	The nature of use, navigation patterns, number of site visits and transactions
User satisfaction	The users experience in using the system
Net Benefits	The positive and negative impact on the stakeholders such as cost savings, expanded markets, time savings, etc

Since an e-learning system is a special information system, the D&M IS success model has been widely adopted for evaluating the e-learning effectiveness.

A. ELSS Model(2007)

The model was conceptualized by Wang, Wang, et al was based on the widely cited DeLone and McLean (2003) IS success model with six dimensions. A multidimensional model has been developed and validated for evaluating the success of an e-learning system. The e-learning systems success construct was empirically measured from the perspective of the e-learner. The items underlying the dimensions were obtained through a detailed review of literature.

Table 1: Dimensions and items in the ELSS model

Dimensions	Items
System quality	System availability, Ease of use, User-friendliness, Interaction, Personalized information presentation, Attractive features to appeal the users, Fast information access
Information quality	Right information, Responsiveness, Relevancy, Adequacy, Understandability, Up-to-Date
Service Quality	Online assistance, Interaction, Availability, Responsiveness, Support
Use	Frequent usage, Voluntary usage, Dependency
User satisfaction	Attitude, Perceived utility, System satisfaction
Net Benefits	Improved job performance (individual), Enhanced competitiveness, Quick response to change, Better products or services to customers, Cost savings, Shortened product cycles, increased return on investment, goal achievement (organization)

The above items were measured on a 7 point Likert scale in the ELSS instrument. The responses were collected from employees of eight organizations in Taiwan that had implemented e-learning systems. The empirical analysis showed that the instrument had a high reliability and consistent factor structure. The result also emphasize that the six dimensions of success are interrelated as suggested by DeLone and McLean and hence equal importance has to be given to improve the system along all the six dimensions.

It is suggested that the validated instrument could be used for making an overall assessment as well as for comparing different e-learning systems. In spite of its applicability across various e-learning systems, the authors suggest future research to test the causal relationship between the dimensions.

B. Structural model depicting e-learning success dimensions and its determinants (2009):

With insights gained from previous literature on e-learning systems success, a multidimensional measure of e-learning success is presented in this paper. Adapting the DeLone and McLean IS success model, a structural model depicting the main determinants of e-learning success has been proposed.

Table 2: Dimensions measuring e-learning success

Dimensions	Definition
System use by learners	The extent to which the e-learning system is used by the instructor to instruct and motivate his students
Learner satisfaction	The extent to which the learners are contented with the system based on their experience in using the system
Learning effectiveness	An evaluative measure of student learning reflected by their performance
Continuance intention	The intention of the learners to use e-learning components in the future courses they take up

The structural model incorporated Content quality, System quality, Service quality and Perceived task value as the determinants of the success measures.

Table 3: Determinants of e-learning success

Determinants	Definition
Content quality	Value of the e-learning content
System Quality	Ease of use, Reliability and Responsiveness of the technology
Service quality	Amount of Instructor and Technical support
Perceived Task Value	The learners perception of the significance of being successful in the course

The model posits that system quality, content quality and service quality influences system use and learner satisfaction which in turn has an impact on learning and continuance intention. The learner perception about success is said to affect satisfaction and intention to continue relying on online courses.

C. E-Learning success model: (2009)

Lee post reports the knowledge acquired while developing an online course for business undergraduates. The focus is to integrate and formulate a holistic model for evaluating e-learning. Based on the experience of designing and delivering the online course, the author has proposed and a model empirically validated an e-learning success model. The model has been developed by adapting the DeLone and McLean Model (2003) with system quality, Information quality, Service quality, Use, Net benefits and User satisfaction as the dimensions of success. The study follows a process approach and hence hypothesizes that the overall e-learning systems success depends on the success achieved at every stage of system development – design, delivery and outcome analysis. Therefore the success dimensions have been categorized as follows:

Design stage – System quality, information quality and service quality

Delivery stage – Use

Outcome stage – User satisfaction and Net benefits

System quality corresponds to the ease of use, user friendliness, stability, security, speed and responsiveness of the e-learning environment. The quality features of the course content such as organization, presentation, clarity, usefulness etc are measured in the information quality dimension. The communication between the instructor and student is evaluated in terms of promptness, responsiveness, fairness, knowledge and availability in the service quality dimension. The Use dimension assesses the degree to which the course elements like case studies, PowerPoint slides, excel tutorials, practice problems etc are being actually utilized by the learners. The outcomes of the e-learning systems are measured in terms of net benefits and user satisfaction. The Net benefits represent both the positive aspects (improved learning, time savings, and academic achievements) and negative aspects (isolation, technological dependence). The user satisfaction is determined by the learners overall contentment and success facilitated by the e-learning system.

The course feedback survey result reported that the students believed that e-learning provided them with greater control over study materials and reduced the time to learn. The findings of the pilot study states that the student’s indifferent attitude towards e-learning would be a barrier to successful development of e-learning initiatives. Thus Online readiness of the students is found to be critical to the success of e-learning.

The overall success of an e-learning system depends upon the success of the three development stages. The success of system outcome stage depends upon success in the delivery stage which in turn relies on the success of the design stage.

Realizing that the incorporation of instructor and institutional perspectives in the proposed model would add on value, the model was extended. Institutional support for instructors in terms of sound infrastructure, workshops, technical and pedagogical aids were included in the extended system. The impact of incorporating adopting these were evaluated in terms of cost saving, increased enrollment for the institution etc. Consequently institutional outcome is added as the seventh success dimension along with the six dimensions as proposed by DeLone and McLean IS success model.

This research has contributed an e-learning model that would guide the design, development, and delivery of successful e-learning initiatives.

IV. Kolb Learning Style Approach:

David Kolb proposed the learning styles model based on the Experiential learning Theory. According to Kolb's model, the ideal learning process happens through a four stage learning cycle – Concrete experience-Reflective Observation-Abstract conceptualization – active experimentation. Effective learning is seen when a person progresses through a cycle of four stages: of (1) having a concrete experience followed by (2) observation of and reflection on that experience which leads to (3) the formation of abstract concepts (analysis) and generalizations (conclusions) which are then (4) used to test hypothesis in future situations, resulting in new experiences. Kolb views learning as an integrated process with each stage supporting and impacting the following stage. Based on this learning cycle Kolb defines four learning distinct styles – Diverging (feeling and

watching – Concrete experience + Reflective Observation), Assimilating (watching and thinking - Abstract conceptualization + Reflective Observation, Converging (doing and thinking - Abstract conceptualization + active experimentation) and Accommodating (doing and feeling - Concrete experience + active experimentation). Kolb explains that different people follow different learning style based on their basic cognitive structure, educational experiences and social environment.

Kolb’s model implies that learning opportunities should be designed and developed in such a way as to facilitate the learners to adapt their preferred learning style through the learning cycle.

Hu, Paul, et al (2005) conducted a longitudinal quasi field experiment to compare the learning effectiveness and outcomes produced by e-learning with that of conventional face-to-face learning. Adapting the Learning style model by Kolb this study analyses the impact of learning style of an individual on the outcome improvements of e-learning. The study evaluates the comprehensive outcome measurements – learning effectiveness, satisfaction, personalized learning support, learning community support, overall course learnability and course content assessments.

Table 4: Outcome measures

Dimensions	Definition
Learning effectiveness	The learners perception about their learning achievement
Learning satisfaction	The learners feeling (good and positive) about taking up a e-learning course
Personalized Learning support	The amount of control the learner has over the method of learning and selection of contents and the feedback provided about their learning progress
Learning community support	The amount of course related interaction the learner has with the instructor and the amount of sharing (of knowledge) with the other students in the course
Overall course learnability	The learner’s perception about the course delivery in terms of ease of understanding, consistency and clarity
Course content assessment	The validity of the course content with respect to relevancy, usefulness, adequacy and updation

The analysis of the above mentioned measures suggests that e-learning resulted in higher learning effectiveness compared to the conventional face-to-face learning. Through increased Personalized learning support, e-learning improves both objective learning achievement and perceived learning effectiveness and results in favorable course content assessments. While weak learning community support reduces course learnability and hence results in lesser satisfaction compared to conventional learning. The analysis also statistically proved that the difference in the learning outcomes was attributed to by the learning style of individuals. Hence it is suggested that learning environments and materials to be customized based on the individual’s particular learning style. And future research is recommended to investigate the effects of learning style and incorporate it in an e-learning system to enhance its benefits.

V. Technology Acceptance Theory:

The Technology Acceptance Model (TAM) is a leading IS theory used to measure the acceptance, use and success of a technology. The model explains the factors that influence the user’s decision pertaining to the usage of a new technology. In the original TAM model proposed by Davis (1985), the actual use of a system would be determined by the user’s attitude towards the system, which in turn would be influenced by two beliefs – perceived ease of use and perceived usefulness. TAM was continuously studied and extended by researchers. TAM 3 was proposed in the context of e-commerce that includes dimensions more apt in the context of e-learning.

Table 5: Dimensions of e-learning based on TAM

Dimensions	Definition
Perceived ease of use	The degree to which an individual believes that using a particular system would be free of physical and mental effort
Perceived usefulness	The degree to which an individual believes that using the system would enhance his job performance
Computer self efficacy	The individuals belief about his ability to perform a task using the computer

Model of e-learning determinants (2013):

Zaddem, 2013 conducted a research to identify the effect of five factors namely computer self efficacy, ease of use, perceived usefulness, interaction, and social presence on e-learning effectiveness. A theoretical model has been proposed with the factors based on Technology acceptance theory, social cognitive theory and Media richness theory. The framework includes computer self efficacy, ease of use, perceived usefulness, interaction, and social presence as influential factors of e-learning achievement which in turn affects e-learning transfer.

Self efficacy denotes an individual’s belief about his/her capacity to work on the e-learning system to accomplish the learning tasks. Self efficacy is hypothesized to positively influence the learner’s perception of ease of use, perceived usefulness, interaction and learning achievement. Perceived ease of use is defined as “the

degree to which an individual believes that using a particular system would be free of physical and mental effort.” (Davis, 1989). Clarity and understandability of the learning material along with the flexibility of interaction facilitated by the learning platform allows the learner more freedom to use the online learning platform. Ease of use is assumed to have a positive impact on perceived usefulness and learning achievement. Perceived usefulness is defined as “the degree to which an individual believes that using a particular system would enhance his or her job performance” (Davis, 1989). It is the learners feeling regarding the improvement their understanding of the course and increased interaction with the instructor leading to better learning.

Interaction denotes the Instructions from the instructors to resolve problems and questions of the learners and the feedback given to the learners are the communication processes to be facilitated by an online learning environment. Learner’s achievement in an e-learning course depends upon the amount of face-to-face and e-mail interactions between learners and instructors. Social Presence is the degree to which the learners are allowed to actively, sensitively, personally and socially connect with others (learners and instructors). An environment that supports social presence improves interaction.

E-learning effectiveness is measured by the knowledge and skills acquired (e-learning achievement) by the learners during the training as well as on how effectively these are being practiced (e-learning transfer) on the job

With a detailed review of literature the authors have identified the items corresponding to the factors and have formulated twelve hypotheses to study the relationship between the factors and the measures. Employees from nine Tunisian companies participated in a semi structured interview and responded to 50 items on a 5 point Likert scale. The causal relationships were analyzed using SEM and the proposed model was found to have a good fit. The study concludes that the factors influencing trainee’s e-learning achievement are perceived usefulness, perceived ease of use, face-to-face interaction, e-mail interaction and social presence while self efficacy has an indirect influence on learning achievement. Lesser efforts by the learners due to ease of use of an online platform tends to improve perceived usefulness and thereby results in better achievement. Thus self efficacy acts as an antecedent with perceived ease of use and usefulness act as mediating factors. Increased interaction between the trainers and trainees improved learning achievement. The mutual relationship between Social presence and interaction (face to face and E-mail) was verified to be true. Greater the feeling of interactivity lesser is the feeling of isolation. With improved social presence better is the communication process in the shared e-learning environment. Colliding with many other research findings, this study also revealed that Learning achievement influences learning transfer.

The respondents of the study being employees the results cannot be generalized for other participants (students). And also the study limits the influential factors. Hence there is a scope to extend the model in light of different participants and other possible factors of e-learning effectiveness.

VI. Learner satisfaction Dimensions and antecedents(2007):

An empirical study was carried out by Sun P.C. et al to integrate the different factors discussed by various researchers into one holistic framework. The framework was developed and validated through a survey conducted among e-learning volunteers of two Taiwan universities. It included six dimensions with thirteen variables that were measured on a seven point Likert scale.

Table 6: Learner satisfaction dimensions and variables

Dimensions	Variables	Definition
Learner Dimension	Learner attitude Learner anxiety Self Efficacy	The learners feeling about partaking in e-learning The mental pressure and fear about using computers in e-learning The learners capability to assess their internet usage skills
Instructor Dimension	Responsiveness Instructor attitude towards e-learning	The learners perception about the prompt response from the instructor to solve problems encountered in the online course The learners perception that the instructor has a positive inclination towards e-learning
Course Dimension	Course flexibility Course quality	the learners perception of the efficiency and effects of adopting e-learning in their convenient timing the amount of virtual characteristic provided by IT tools to an e-learning course
Technology Dimension	Technology quality Internet quality	the learners perception of the quality and reliability of the IT tools and techniques used in e-learning the network quality and transmission speed
Design Dimension	Perceived usefulness Perceived ease of use	the learners perception of the amount of learning affected by an e-learning system the minimal effort put by the learner in adopting an e-learning system
Environment Dimension	Diversity in assessment Learners perceived interaction with others	the varied assessment tools and methods used to evaluate the learners learning efforts the level of information exchange between the learners, instructors and the course materials

It was presumed that the above mention variables had a significant impact on learner satisfaction. Accordingly hypothesis was formulated and tested using stepwise Multiple regression analysis.

The analysis resulted in seven of the thirteen variables to have critical relationship with learner satisfaction. While learner’s computer anxiety had a negative impact on satisfaction, the remaining six variables namely

instructor attitude towards e-learning, course flexibility, course quality, perceived usefulness, perceived ease of use and diversity in assessment had a positive influence on learner satisfaction.

Although the tested framework incorporates most of the factors influencing e-learning success, the desired outcome is limited to use satisfaction alone. Hence the scope of the framework can still be widened by giving due consideration to other success measures like learning achievement, behavioral changes etc.

VII. Md. Aminul Islam(2010)

The researchers' prime focus was to investigate the factors that influence the effectiveness of e-learning. Learner's reaction and satisfaction, participation and interaction, familiarity with technology and Learning outcomes and achievement were identified as independent variables through pre survey research.

Table 7: Variables influencing e-learning effectiveness

Dimensions	Definition
Learners reaction	A measure of the students feel about their e-learning experience
Learners satisfaction	A measure of students gain from the system
Participation	the incorporation of all the concerned parties throughout from acquisition to evaluation
Interaction	the face to face contact between the students and the tutors
Familiarity with Technology	Students competency to use the internet in order to access knowledge as e-learning includes online courses, e-mail, e-book etc
Measuring learning achievement	the benefits obtained from e-learning course in terms of skills gained and the amount of cognitive learning

A survey was conducted among randomly selected students who have undertaken e-learning courses in their diploma and degree program. The selected variables were measured on a 5-point Likert scale. Multiple regression analysis was used to find out whether the independent variables have significant effect on e-learning effectiveness.

Reaction and satisfaction were found to be the major factors affecting e-learning effectiveness. The analysis revealed that e-learning resulted in enhanced Learning achievement. The learners who were more familiar with computer and internet technology seemed to use the e-learning system more effectively. But the student's participation through the online forum was not as efficient as in traditional learning, because face-to-face interaction is vital for the learning process.

VIII. Conclusion and future work:

This paper details only a few models on e-learning effectiveness. With the understanding gained from the literature, the dimensions suggested by DeLone and McLean model seems to have a better fit to e-learning effectiveness. Most of the studies have considered learning achievement and user satisfaction as the success measures of an e-learning system. System quality, Content quality, service quality and perceived usefulness are identified as the most relevant antecedents of e-learning effectiveness. Only one paper highlights learning style as an important determinant. Moving on to the items underlying these dimensions the list is endless and still needs refinement and consolidation. Therefore, the DeLone and McLean model could be used as a basis for developing an e-learning effectiveness model. The researcher intends to develop and validate a comprehensive model for e-learning effectiveness by expanding this model incorporating the identified variables.

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