Predicting critical success factors among students of e-learning in a pandemic situation

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***Abstract*—E-learning, one of the tools emerged from information technology, has been integrated in many university programs and its vitality was highlighted especially during prevalent situations such as COVID-19 pandemic. The objective of this study is to identify and predict critical success factors (CSF) of e-learning during pandemic situation. The published e-learning critical success factors were surveyed and grouped into 4 categories namely, student, instructor, technology, and resource characteristics. Data collection was proceeded by sharing a structured questionnaire among university undergraduates of Sri Lanka and 81 responses were recorded. Statistical approach with hypothesis development conducted confirmed that level of impact and criticality of each CSF and amplified that student characteristic cause the most impact to the critical success of e-Learning at a pandemic situation while resource characteristic has no significance relation to critical success of e-learning.**

Keywords—e-learning, critical success factors, pandemic

I. INTRODUCTION

Information technology in teaching and learning has created a need to transform how university students learn by using more modern, efficient, and effective alternative such as e-learning. E-learning concept has been around for decades and is one of the most remarkable recent developments in the information systems industry. During the critical pandemic situations such as COVID-19, educational institutions were shut down all over the world and it caused a massive disruption of the education system. This paved the way to boost the use of e-learning by educational bodies in delivering their service to students. As a best practice many entities determine the most valuable critical success factors (CSF) that should be achieved in order to boost a project mission. Similarly, in this context it is vital to determine and predict CSFs for e-learning in a pandemic or destructive situation among university students.

In aligning to the aforementioned objective under three main steps: (1) CSFs of e-learning were surveyed and classified to well defined categories via a critical review of literature, (2) questionnaire development and circulation targeting Sri Lankan university undergraduates, and (3) confirmatory analysis of collected data while performing a methodical statistical approach in deriving most impactful CSFs of e-learning during pandemic and their significance of the relation.

Review of published literature on CSFs of e-learning, questionnaire design and data collection, hypothesis development, and analysis followed by results generated are the sequential steps of methodology presented in this paper. Furthermore, the in detailed methodology followed in this study, compare and contrast of results of the statistical analysis discussed in the next chapters.

II. LITERATURE REVIEW

E-education, distance-learning, and online learning are all different terminologies of e-learning. The authors in [1] defined E-learning as “the wide set of applications and processes which use available electronic media and tools to deliver vocational education and training”. Researchers [2] stated that E-learning is "the use of various technological tools that are web-based, web distributed, or web capable for education". E-learning has been growing year after year as there are many advantages, such as flexibility, internet accessibility, and cost-effectiveness [3]. These advantages could transform education into a lifelong learning process. According to [4], having access to lectures anytime, as many times as needed, allows students to better recall the information that is required for traditional education.

The critical success factors are referred to as ”characteristics, conditions, or variables that, when properly sustained, maintained, or managed, can have a significant impact on the success of a firm competing in a particular industry” [5]. By finding the CSFs, stakeholders can boost these factors for better outcomes. The critical success factors that were evaluated in this paper are identified and defined below.

A. Student Characteristic

This factor focuses on the student’s environment while learning. It includes the student’s pace of learning, commitment, attitude, motivation, knowledge of computer systems, and demographics [6],[7],[8].

B. Technology Characteristic

This factor focuses on the information technology system to deliver learning materials and objectives. It includes ease of use, reliability, efficiency, privacy, and information [6],[7].

C. Instructor Characteristic

This factor focuses on the instructor’s environments while teaching. It includes the instructor’s attitude, flexibility, knowledge of learning technology, teaching style, and efficacy in student motivation [6],[7],[8].

D. Resource Characteristic

This factor focuses on supporting both the instructors and students to enhance their experience. It includes communication tools, help disk availability, and training. Furthermore, it focuses on the management knowledge within the educational institution. It includes the management team, managing delivery and maintenance, time management, thinking strategies, and implementation expertise [6], [7],[8].

III. MATERIALS AND METHODOLOGY

The methodology of this study conducted mainly via the questionnaire-based survey.

A. Questionnaire Design

As the basis of constructing a structured questionnaire, the CSFs determined and identified from the published literature in the previous chapter was used. Each and every characteristic categorized namely, student, technology, instructor and resource were partitioned into instruments or sub elements, and each instrument was elaborated via a question in the questionnaire. Table 1 indicates the discussed partitioning as below.

TABLE I. E-LEARNING CSF ELEMENTS

Characteristic	***Id***	***Description***
Student	S1	Student's willingness to participate in e-Learning
	S2	Student's experience and knowledge about using computer systems
	S3	Student's understanding on the purpose of different parts of the e-Learning system
	S4	e-Learning environment motivation on student's learning attitude
	S5	Student's learning style affecting the use of e-Learning
Technology	T1	Internet network stability
	T2	Ease and convenience in accessing and browsing of course materials
	T3	Visibility promotion or transparency of evaluation of online assessments
	T4	e-Learning environment support on communication interaction with peers and lecturer than traditional setup
Instructor	I1	The clarity of lecturer's explanation of the eLearning system components
	I2	Lecturer's style of teaching using e-Learning technologies on the productivity of the session
	I3	The lecturer's ability to motivate the students to use the eLearning system
	I4	Lecturer's energy and positive attitude while using eLearning tools
Resource	R1	The learning material available in eLearning system (Learning Management System – LMS) is up-to-date
	R2	Online quizzes or tests are sufficiently included in e-Learning system
	R3	The ability to communicate with the lecturer or instructor via the eLearning system
	R4	Recorded lectures should be uploaded to the Learning Management System – LMS after the online session for reference purpose
	R5	Use of eLearning collaborative tool options such as breakout rooms
	R6	Language support and availability of online help desk on eLearning system with guidelines

B. Data Collection

Designed questionnaire was circulated among university undergraduates covering both private and state-owned universities in Sri Lanka. The questionnaire was subjected for a validated via a pilot run and its discipline was smoothen based on the comments obtained. 81 responds were collected. Table 2 summarizes the demographic data of undergraduates in terms of gender, university type, advanced level stream of study, academic year and e-learning tool used.

TABLE II. DEMOGRAPHIC DATA

Variable	***Elements***	***Percent***
Gender	Male	49%
	Female	51%
University Type	State-owned	75%
	Private	25%
A/L Stream	Physical science	51%
	Biological science	28%
	Commerce	7%
	Technology	6%
	Arts	8%
Academic Year	First year	33%
	Second year	25%
	Third year	16%
	Fourth year	26%
E-Learning Tool	Zoom	84%
	Teams	9%
	Big Blue Button	6%
	LMS	1%

Apart from the demographic datapoints as discussed above, the variable data were collected in means of Likert rating scale ranging from 1-5. The numbered scale reflects the magnitude of the contest provided by the respondent to each and every atomic e-learning CSF element.

The descriptive statistics of non-demographic data are represented as follows (Table 3) in terms of mean value and standard deviation value indicating the spread of the distribution.

TABLE III. DESCRIPTIVE STATISTICS

Characteristic	*Id*	*Mean*	*Std Dev*
Student	S1	2.98	1.15
	S2	3.93	0.89
	S3	3.56	0.91
	S4	2.82	1.07
	S5	3.28	1.04
Technology	T1	3.34	1.01
	T2	3.77	0.98
	T3	3.29	0.99
	T4	2.65	1.09
Instructor	I1	3.74	0.78
	I2	3.93	0.82
	I3	3.71	0.99
	I4	3.94	1.00
Resource	R1	3.95	0.81
	R2	3.81	0.83
	R3	3.94	0.79
	R4	4.33	0.90
	R5	3.75	1.00
	R6	3.75	0.85

C. Hypothesis Development

A statistical approach was considered in identifying the validity and impactful magnitude of CSFs of e-learning in pandemic. Individual hypothesis was developed for and every distinct characteristic normed with the collected data from the participants representing the university undergraduates of Sri Lanka.

As the dependent variable; critical success of e-learning in a pandemic situation among students was assessed with respondents' responses in terms of Likert scale ratings. The defined hypotheses with individual independent variables (IV) and dependent variable (DV) are as follows;

Student Characteristic

Ho- There is no significant relationship between Student Characteristic (IV1) and Critical Success of e-learning in a pandemic situation among students (DV)

H1- There is a significant relationship between Student Characteristic (IV1) and Critical Success of e-learning in a pandemic situation among students (DV)

Technology Characteristic

Ho- There is no significant relationship between Technology Characteristic (IV2) and Critical Success of e-learning in a pandemic situation among students (DV)

H1- There is a significant relationship between Technology Characteristic (IV2) and Critical Success of e-learning in a pandemic situation among students (DV)

Instructor Characteristic

Ho- There is no significant relationship between Instructor Characteristic (IV3) and Critical Success of e-learning in a pandemic situation among students (DV)

H1- There is a significant relationship between Instructor Characteristic (IV3) and Critical Success of e-learning in a pandemic situation among students (DV)

Resource Characteristic

Ho- There is no significant relationship between Resource Characteristic (IV4) and Critical Success of e-learning in a pandemic situation among students (DV)

H1- There is a significant relationship between Resource Characteristic (IV4) and Critical Success of e-learning in a pandemic situation among students (DV)

IV. RESULTS AND EVALUATION

SPSS statistical tool is used to derive the results from the dataset collected over the survey. After obtaining the statistical results via regression model from the statistical analytical tool, the conclusions were discussed as follows separately and collectively.

A. Student Characterisitc

Ho- There is no significant relationship between Student Characteristic (IV1) and Critical Success of e-learning in a pandemic situation among students (DV)

H1- There is a significant relationship between Student Characteristic (IV1) and Critical Success of e-learning in a pandemic situation among students (DV)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.666[a]	.444	.407	.734

a. Predictors: (Constant), S5, S3, S1, S4, S2

Fig. 1. Model Summary – student characterisitc hypothesis

As shown in Figure 1, R Square value is 0.444. It means, resulted 44.4% of variation in the dependent variable (critical Success of e-learning in a pandemic situation among students) accounted by the variation on independent variable (student characteristic).

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	32.253	5	6.451	11.986	.000[b]
	Residual	40.364	75	.538		
	Total	72.617	80			

a. Dependent Variable: D1

b. Predictors: (Constant), S5, S3, S1, S4, S2

Fig. 2. ANOVA – student characterisitc hypothesis

The significance value is 0.000(< 0.05), this p-value is less than the significance level, this indicates that there is a statistically significant linear relationship as of Figure 2. Hence, null hypothesis Ho is rejected.

B. Technology Characterisitc

Ho- There is no significant relationship between Technology Characteristic (IV1) and Critical Success of e-learning in a pandemic situation among students (DV)

H1- There is a significant relationship between Technology Characteristic (IV1) and Critical Success of e-learning in a pandemic situation among students (DV)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.472[a]	.222	.181	.856

a. Predictors: (Constant), T4, T2, T3, T1

Fig. 3. Model Summary – technology characterisitc hypothesis

As shown in Figure 3, R Square value is 0.222 It means, resulted 22.2% of variation in the dependent variable (critical Success of e-learning in a pandemic situation among students) accounted by the variation on independent variable (technology characteristic).

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15.731	4	3.933	5.361	.001[b]
	Residual	55.019	75	.734		
	Total	70.750	79			

a. Dependent Variable: D1

b. Predictors: (Constant), T4, T2, T3, T1

Fig. 4. ANOVA – technology characterisitc hypothesis

The significance value is 0.001(< 0.05), this p-value is less than the significance level, this indicates that there is a statistically significant linear relationship as of Figure 4. Hence, null hypothesis Ho is rejected.

C. Instructor Characterisitc

Ho- There is no significant relationship between Instructor Characteristic (IV1) and Critical Success of e-learning in a pandemic situation among students (DV)

H1- There is a significant relationship between Instructor Characteristic (IV1) and Critical Success of e-learning in a pandemic situation among students (DV)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.440[a]	.194	.151	.878

a. Predictors: (Constant), I4, I1, I2, I3

Fig. 5. Model Summary – instructor characterisitc hypothesis

As shown in Figure 5, R Square value is 0.194 It means, resulted 19.4% of variation in the dependent variable (critical Success of e-learning in a pandemic situation among students) accounted by the variation on independent variable (instructor characteristic).

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	14.065	4	3.516	4.564	.002[b]
	Residual	58.553	76	.770		
	Total	72.617	80			

a. Dependent Variable: D1

b. Predictors: (Constant), I4, I1, I2, I3

Fig. 6. ANOVA – instructor characterisitc hypothesis

The significance value is 0.002(< 0.05), this p-value is less than the significance level, this indicates that there is a statistically significant linear relationship as of Figure 6. Hence, null hypothesis Ho is rejected.

D. Resource Characterisitc

Ho- There is no significant relationship between Resource Characteristic (IV1) and Critical Success of e-learning in a pandemic situation among students (DV)

H1- There is a significant relationship between Resource Characteristic (IV1) and Critical Success of e-learning in a pandemic situation among students (DV)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.342[a]	.117	.045	.931

a. Predictors: (Constant), R6, R1, R3, R2, R5, R4

Fig. 7. Model Summary – resource characterisitc hypothesis

As shown in Figure 7, R Square value is 0.117 It means, resulted 11.7% of variation in the dependent variable (critical Success of e-learning in a pandemic situation among students) accounted by the variation on independent variable (resource characteristic).

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.492	6	1.415	1.633	.150[b]
	Residual	64.125	74	.867		
	Total	72.617	80			

a. Dependent Variable: D1

b. Predictors: (Constant), R6, R1, R3, R2, R5, R4

Fig. 8. ANOVA – resource characterisitc hypothesis

The significance value is 0.150 (> 0.05), this p-value is greater than the significance level, this indicates that there is no statistically significant linear relationship. Hence, null hypothesis Ho is not rejected and in the same time null hypothesis is not accepted since it doesn't have adequate evidence.

Therefore, as discussed from coefficient of determination (R Square), the proportion of the variation in the dependent variable that is predictable from the independent variable, and from p value which determines that variables do have significance relation the CSF validity and impact were elaborated statistically.

CONCLUSION

TABLE IV. SUMMARIZED STATS

Independent variable	***R Square***	***P value***
Student characteristic	0.444	0.000
Technology characteristic	0.222	0.001
Instructor characteristic	0.194	0.002
Resource characteristic	0.117	0.150

In overall, it is possible to conclude that except for resource characteristic, other characteristics namely student, technology and instructor characteristics have significance relationship with the critical success of e-learning in pandemic. Moreover, with the value of R Square it can be conclude that Student Characteristic does have the most impact to the critical success of e-learning, and technology, instructor and resource characteristics occupies the descending impact to dependent variable sequentially as shown in the summarized table 4.

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