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Studying The Variables That Impact E-learning as an Educational Alternative During COVID-19

Dr. Diaa Obaed Mahmood, Middle Technical University -Institute of Technical Anbar ,drdhiaaobaid@gmail.com
Dr. Obaid Mahmmood Alzawbaee, Cihan University Sulaimanya – Camp, obed.muhsin@sulcihan.edu.krd

Abstract- As a result of the world's exposure to the Corona pandemic, which led to the suspension ofinstitutions of higher education and for maintaining scientific communication with the students,a decision has been made earlierto provide lectures to the students and cooperate with them through electronic media according to the E-learningsystem. In this research, the logistic regression technique is adopted to identify the variables that have aconsiderable impact on E-learning. The variables are divided into eight independent categories. These variables arearranged according to their importance of its impact.The researchis conducted on 325 students of the Technical Institute of Al-Anbar.It is clear that the independent variables, which have a significant effect, are four variables. The correct classification rate for the built model is (80%), and its quality was tested through two tests and its quality was proven.

Keywords: E-learning, COVID-19, logistic regression.

I. INTRODUCTION:

As a result of the world's exposure in general, and Iraq in particular, to the Corona pandemic, which led to the suspension ofinstitutions of higher education and within the initiatives of the Ministry of Higher Education and its various institutions for the purpose of maintaining scientific communication with the students at different university levels,a decision was made earlierto provide lectures to the students and cooperate with them through electronic multimedia, according to a system called E-learning[16],[13].

In [3], [16] they tried to determine the factors that have significant influence on decision-making for university students by using the logistic regression technique. The study came out to build a model by which the decision can be predicted. As well as, identifying the substantial independent variables according to their importance.

The study (3) aimed to build a logistical regression model to identify the variables that have a significant impact on the adequacy of household income. Through a questionnaire conducted on a sample of families in the Iraqi Kirkuk governorate. Meanwhile, the study concluded in addition to building a model for determining the significant influencing factors and arranging them according to their importance.

On the other hand, [20], [1] have studied the diagnose the effect of using a problem-solving strategy in teaching the subject of national education in developing decision-making skills among a group of students. Thus, the study found the experimental group's superiority in developing decision-making skills, male superiority over females, and the absence of significant differences between academic levels.

Studies by [12], [17] have dealt with the identification of the relationship between mental ability and personality characters and the level of ambition on a sample of university and secondary students. The study founda positive significant correlation between mental and achievement ability and some of personality characters and the level of ambition.

According to [11], his study aimed to analyze the relationship between problems in decision-making and job satisfaction among teachers. The study was conducted on a sample of secondary school teachers in Korea. The study result has been concluded that there are significant differences between teachers' participation in decision-making and job satisfaction due to gender, experience, school size and the topics taught by the teacher. In addition,itturns out that the actual levels of participation have a positive impact.

In this research, the logistic regression techniqueis used to identify the most important variables that have a significant impact on E-learning. In addition, these variables are arranged according to their importance in influencing the adopted variable that represents E-learning.The study is conducted on 325 studentsrepresented the three major specializations in the Technical Institute of Al-Anbar [1].Eight qualitative independent variables arenamed, besides the dependent variable (Y), which is also qualitative

variable[5], [22].A model is built that includes significant variables, and the correct classification rate of the proposed model is (80%),which has tested its quality.The value of the researchcomes from the fact that it provides an effective tool that can be adopted in planning, taking immediate and corrective decisions and drawing thePolicy. Additionally, the study focuses on the use of logistic regression technique by building an efficient model both in terms of independent variables with significant influence and determining the importance of each variableor using the model in predicting. Moreover, the study isbased on the hypothesis that all parameters are significant (B_1, B_2, ..., B_8) for all the independent variables.The research problem is to study the variables that have an impact on E-learning, and arrange these variables according to its importance.Furthermore, the objective of this research is to identifying the factors (variables) that have significant impact onE-learning by building alogistic regression model that can be adopted in predicting. Finally, this research adopts the deductive analytical method by applying the basics of the statistical theory of logistic regression analysis[10][13].

1- Logistic Regression:

Logistic regression is a special case of regression analysis and is used to know and reconcilethe relationship between the dependent variable which must be qualitative and the independent variables whether these variables are qualitative or quantitative[8], [7].

Logistic regression is based on that the dependent variable (Y) is a binary variable that takes the value of (1) byprobability of (P) and (0) by probability of (1 – P).

$E(y \mid x) = p(y = 1) = p$ ----------(1)

Where:

$$0 \leq p \leq 1$$

From the regression point of view, the model is not applicable and to solve the problem, we have to do the following:

$$0 \leq p \leq 1$$

$$0 \leq \frac{p}{1-p} \leq \infty$$

And by taking the natural logarithmshould get:

$-\infty \leq \ln\left(\frac{p}{1-p}\right) \infty \leq$ ---------- (2)

At the end, the regression model can be written as:

$\text{Ln}\left(\frac{p}{1-p}\right) = B_0 + \sum_{i=1}^{n} Bj X_{ij}$----------(3)

j = 1, 2, ... k

i = 1, 2, ... n

Equation number(3) represents the logistic regression model, and iscalledLn $\left(\frac{p}{1-p}\right)$ by logit transformation[9], [13], [15].

The logistic regression is a powerful tool because it gives an idea to the researcher about the effect of each independent variable on the dependent variable.In addition, it arrangesthe effects of independent variables according to their importance through testing the significance of the parameters. The logistic regression is less sensitive to deviations from the normal distribution and the linear relationship of the research variables[19], [21].

The logistic regression model is used to predict the probability of the occurrence of the dependent variable by matching the data in the form of a logistic curve, and depend on the logistic curve that takes the form of:

$$P = \frac{e^{a+Bx}}{1+e^{a+Bx}} = \frac{1}{1+e^{-a+Bx}} \text{ ---------- (4)}$$

Instead of a straight line equation($y = B_0 + B_1X + e$)[18].

2- Practical side:

The sample of this researchwas pulled from the students of theTechnical Institute of Al-Anbar,the number of them is 1700 and the type of sample isstratified random sample. The students are divided into three strata, technical, medical, and administrative.Equation (5) isadopted[21] [22]:

$n = \frac{N}{1+N(d)^2}$ … ---------- (5)

Where:
n: Sample size
N: Population (1700)
d: Error = 0.05
The students' number of the mentioned specializations at the Technical Institute of Al-Anbar are as following:
Medical specializationN_1 = 350
Technical specialization N_2 = 380
Administrative specialization N_3 = 970
By using the above equation, the sample sizeis:

$n = \frac{1700}{[1+(1700)(0.05)^2]}$ … ≅325

The numbers are tested according to the following equation:

n_h= n * (N_h) / N----------(6)

n_1= 325 * 350 / 1700 = 67 Medical specialization

n_2= 325 * 380 / 1700 = 73 Technical specialization

n_3= 325 * 970 / 1700 = 185 Administrative specialization

The attached questionnaire form is approved in Appendix No. (1).As for the search variables, they are as follows [15], [14]:

The first variable, which is the dependent variable (Y), Where:

Y = 1 if the student agrees with the idea of E-learning.

Y = 0 if student disagrees with the idea of E-learning.

The independent variables, which have been studied, areeight as following:

X_1: E-learning is an effective means of delivering the scientific material {the value is (1) if the answer is yes and is (0) if the answer is no}.

X_2: E-learning is an effective contribution to the success of the educational process {the value is (1) if the answer is yes and is (0) if the answer is no}.

X_3: Time flexibility in E-learning is considered a positive factor {the value is (1) if the answer is yes and is (0) if the answer is no}.

X_4: E-learning increases students' skills {the value is (1) if the answer is yes and is (0) if the answer is no}.

X_5: The available internet service negatively affects E-learning{the value is (0) if the answer is yes and is (1) if the answer is no}.

X_6:Having a difficulty in discussing the scientific material with the teacher {the value is (0) if the answer is yes and is (1) if the answer is no}.

X_7: The student's poor skill in using the computer is one of the problems of E-learning (1) to answer yes and (0) to answer no.

X_8: The skill of the faculty member in E-learning is necessary {the value is (1) if the answer is yes and is (0) if the answer is no}.

II. RESULT:

The result and findings of the collected data are discussed in this section. The software namedStatistical Product and Service Solutions(SPSS)is used to analyze the data. The Iteration was adopted as the probability of the derivative of the greatest possibility (-2 Log likelihood) where the estimation of the model parameters was obtained as shown below.

(- 2 Log likelihood = 299.367)

Analyzeswere stopped at the fifth cyclebecause the change in parameters(B_0, B_1, …., B_8) became zero, whichrepresents the best result that can be obtained for parameters because (-2 Log likelihood) is at the minimum ends, as shown in the table (1).

Table 1. Iteration History

Iteration		-2 Log likelihood	Coefficients Constant	x1	x2	x3	x4	x5	x6	x7	x8
Step 1	1	305.372	-1.667	1.180	0.550	0.468	-0.139	-0.178	0.603	-0.090	0.213
	2	299.491	-2.141	1.293	0.691	0.708	-0.187	-0.256	0.773	-0.174	0.358
	3	299.367	-2.230	1.304	0.708	0.758	-0.193	-0.272	0.795	-0.197	0.402
	4	299.367	-2.233	1.305	0.709	0.759	-0.193	-0.273	0.796	-0.198	0.404
	5	299.367	-2.233	1.305	0.709	0.759	-0.193	-0.273	0.796	-0.198	0.404

a. Method: Enter
b. Constant is included in the model.
c. Initial -2 Log Likelihood: 375.589
d. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Table (2)clarifiesthe value of the model parameters besides the standard error (S.E) for each parameter and Wald Statistics.

Table 2.Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	x1	1.305	0.424	9.461	1	0.002	3.686	1.605	8.464
	x2	0.709	0.418	2.870	1	0.090	2.031	0.895	4.612
	x3	0.759	0.345	4.851	1	0.028	2.136	1.087	4.198
	x4	-0.193	0.416	0.216	1	0.642	0.824	0.365	1.862
	x5	-0.273	0.507	0.290	1	0.590	0.761	0.282	2.055
	x6	0.796	0.406	3.845	1	0.050	2.216	1.000	4.909
	x7	-0.198	0.407	0.237	1	0.626	0.820	0.370	1.821
	x8	0.404	0.488	0.685	1	0.408	1.498	0.575	3.899
	Constant	-2.233	0.525	18.063	1	0.000	0.107		

a. Variable(s) entered on step 1: x1, x2, x3, x4, x5, x6, x7, x8.

Themodel quality was tested by using thedistribution of(Chi-squared χ^2) since in the case of logistic regression, log likelihood ratiowas used and the Chi-square distribution wasfollowed according to the relation.

$\chi^2 = 2[\ \text{Loge}L_0 - \text{Loge}\ L_1]$---------- (7)

L_1: the value of Log likelihood function that contains (i) variable
L_0: the value of Log likelihood function that contains (i-1)variable
The value of Chi-squareis ($\chi^2 = 76.222$) and it is a significant as shown in the following Table (3).

Table 3.Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	76.222	8	0.000
	Block	76.222	8	0.000
	Model	76.222	8	0.000

Furthermore, another non-parametric test wasdone to test the model fit quality by finding the ($\chi 2$) value for the difference between expected and observed values asshown in table (4). Besides, this test was suggested by Hosmer and Lemeshow using the ($\chi 2$) distribution. From table (5), it can be noticedthat the value of H - Statistics $\chi 2$ = (1.956) and with a degree of freedom (df = 6) where the null hypothesisaccepted (H_0) and (Sig = 0.924). Thus, this confirms thefit quality of the entire model.

Table 4.Contingency Table for Hosmer and Lemeshow Test

		y = No		y = Yes		
		Observed	Expected	Observed	Expected	Total
Step 1	1	33	33.049	3	2.951	36
	2	9	8.108	0	0.892	9
	3	89	91.007	14	11.993	103
	4	30	28.485	4	5.515	34
	5	33	33.648	10	9.352	43
	6	22	21.546	10	10.454	32
	7	14	14.129	19	18.871	33
	8	9	9.028	26	25.972	35

Table 5.Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	1.956	6	0.924

Table (6)shows the possibility of the requested form on the classification of vocabulary. It is clear that the percentage of correct classification was (80%), which means that (260) items from the sample vocabulary were classified correctly while (65) items from the sample items were incorrectly classified.

Table 6.Classification Table[a]

			Predicted y		
	Observed		No	Yes	Percentage Correct
Step 1	y	No	217	22	90.8
		Yes	43	43	50.0
	Overall Percentage				80.0

a. The cut value is .500

From table (2), it can be noticed that column (B) contains the model parameters and thus the model is:

$$\text{Ln}\left(\frac{p}{1-p}\right) = -2.233 + 1.305x_1 + 0.709x_2 + 0.759x_3 - 0.193x_4 - 0.273x_5 + 0.796x_6 - 0.198x_7 + 0.404x_8 \quad (8)$$

By looking at the (Sig) column from the just aforementioned table,it is clearthat the independent variables that have a significant impact on E-learning are (X_1, X_6, X_3) at the indication level of (0.05) and (X_2) at the indication level of (0.10).The variables (X_4, X_5, X_7, X_8); however, are not significant, thus the variables with significant effect on the dependent variable (Y) are (X_1, X_6, X_3, X_2). Thevaluesof the parameters are:

B_0 = - 2.233 ------ EXP = 0.107

B_1 = 1.305 ------ EXP = 3.686

B_6 = 0.796 ------ EXP = 2.216

B_3 = 0.759 ------ EXP = 2.136

B_2 = 0.709 ------EXP = 2.031

X_1 variable, which represents the fact thatE-learning is an effective way to communicate scientifically, ranked first in the influence on the dependent variable (Y) and it has a significant impact parameter at (α = 0.05).

X_6 variable, which representshaving difficulty in the discussing of the academic subject with the teacher, came secondin the influence on the dependent variable (Y)with a significant impact parameter at (α = 0.05).

X_3 variable, which represents that time flexibility in E-learning is a positive factor, ranked third by influencing the dependent variable (Y) with a significant impact parameter at (α = 0.05).

X_2variable, which represents thatE-learning has an efficient contribution in the success of the educational process,was fourth in the influence on the dependent variable (Y)With a significant impact parameter at (α = 0.10).

As for the independent variables (X_4, X_5, X_7, X_8),they have no significant impact on the dependent variable (Y).

III. CONCLUSIONS AND RECOMMENDATIONS

The most important findings and recommendations of the research are below:

1- Building a statistical model to predict the effectiveness of E-learning from the students' point of view by using logistic regression technique was possible and reliable.
2- Some of the hypotheses areachieved where the parameters (B_0, B_1, B_2, B_3, B_6) are significant, while some hypotheses arenot fulfilled as (B4, B5, B7, B8) are not significant.
3- The independent variables with significant influence on the dependent variable are:

X_1: E-learning is an effective way to deliver scientific material.

X_6: Discussing the scientific material with the teaching staff is difficult.

X_3: Time flexibility in E-learning is a positive factor.

X_2: E-learning plays a positive factor in the educational process.

4- By several tests, the adopted model was shown that it is significantwhere the value of ($\chi 2$) calculated from the log likelihood ratioreached (76,222) with a degree of freedom (8).
5- The quality of the model has been approved by Hosmer and Lemeshowtests.
6- The percentage of the correct classification rate for the proposed model is (80%), which shows the strength of the model to distinguish between those who are with or against E-learning.
7- As an effective tool, the expansion is required using the technique of logistic regression to find out the respondents' opinions.

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