Logistic Regression Approach in Classifying the Effectiveness of Online Education

Elif Bengi ÜNSAL ÖZBEK[1], Alper YETKİNER[2]

[1]Trakya University, Faculty of Education, Educational Sciences, Edirne, Turkey iD 0000-0003-2136-3081

[2]Kilis 7 Aralık University, Muallim Rıfat Faculty of Education, Kilis, Turkey iD 0000-0003-2136-3081

ARTICLE INFO

ABSTRACT

The developments and changes that have accompanied the Covid 19 pandemic have affected the educational world and all sectors. Educational institutions around the world have implemented emergency and online educational practises to ensure continuity of education as opposed to the planned distance education activities that were implemented for continuity of education. Due to the Covid 19 pandemic, face-to-face classes have been held in universities across the world for about a year in many disciplines through various platforms. In this process, determining the effectiveness of distance education practises in universities for students is critical for programmes to achieve their goals. This study aims to highlight the variables and effects that influence university students' decisions regarding the efficiency of online instruction. To this end, 821 university students were surveyed. Their willingness and attachment to online education, socioeconomic level, and gender were tested using logit regression analysis to build a model that predicts university students' decision about the efficiency of online education. Age, gender, high school graduation, willingness to Online Education, and attachment to Online Education are among the variables in the logit regression model that significantly predict university students' decision about whether they consider online education to be efficient or not. When analysing the result of classifying students whether they consider online education efficient or not using the logit regression model, 291 of the 409 students in the group who consider education efficient were classified correctly and 118 of them were classified inaccurately, with the rate of correct classification being 71.1%.

1. Introduction

Education is one of the most critical components in the center of the world. The developments and changes experienced affect every field as well as the education world. The Covid-19 pandemic, which the world has been grappling with for more than a year, and its impact have led to changes and new formations in education. While all the countries had to adapt to this new formation, they were also involved with their new ideas designed and put into practice. As a matter of course, the realities experienced by students, who are the most important actors in the education world, and their efforts to adapt to the process should not be denied.

Covid-19 case, which was seen in Wuhan, China, for the first time in the world in December 2019, spread from wholesale food markets in Wuhan and affected the whole world in a short time (WHO, 2020). Most educational institutions worldwide cancelled face-to-face education in March 2020 and switched to distance

learning and teaching to contain the spread of Covid-19 (Di Pietro et al., 2020). With the closure of schools worldwide, more than 1 billion students faced the risk of being deprived of education. Therefore, countries have initiated distance education programs. With the closure of schools in approximately 188 countries as of April 2020, alternative ways of providing continuing education have been sought, primarily via technologies such as the internet, television, and radio (UNICEF, 2020a). With the Covid-19 pandemic, the education system was determined to be vulnerable to potential threats, and the introduction of online emergency distance learning applications as a response to the global education crisis came into question (Bozkurt & Sharma, 2020). Due to the ineffectiveness of traditional methods in the Covid 19 process, schools and universities worldwide have adopted online courses and practices as an alternative means of continuing education (Adnan & Anwar, 2020).

Concepts of social and physical distance require individuals to stay away from each other and stay home to prevent the virus from spreading. Hence, face-to-face learning activities in schools and classrooms have been replaced by an online learning system (Girik Allo, 2020). Online learning is a type of learning that provides education in line with electronic technologies and is carried out through courses and specific programs. It is an increasingly widespread learning environment inspiring world societies. It makes education flexible and possible for everyone to participate in education with potential opportunities. In this way, it prevents time and space limitations (Salamat et al., 2018). Besides, with the Covid-19 pandemic, alternative teaching methods have started to be considered worldwide. Thus, web-based learning, e-learning, or online learning have become quite popular. The use of desktop and laptop computers or smartphones and internet access has become the essential components of online learning methods. The fact that it has mainly become prevalent among students worldwide indicates that online learning will continue to be relevant in the upcoming years (Radha et al., 2020).

In the Covid-19 period, it is also a crucial issue how ready students and society are for online learning, which has gained more place in our lives with inexperienced new applications. Readiness to online learning affects efficiency, as well. Chung, Subramaniam, and Christ Dass (2020) revealed in their research with university students in Malaysia that students were either less or moderately ready for online learning and stated that because of internet connection problems and their inability to understand the course contents led to problems. Similarly, Mohallik and Suparno Sahoo (2020) in their research with trainee teachers continuing their education at college found that trainee teachers were willing to learn via digital devices and had financial support to access online learning; however, they had problems with power supply and internet connection. They concluded that inadequate internet access has negative effects on online learning. Li and Lalani (2020) expressed in their research that students without reliable internet access or technology had difficulty participating in digital learning, and that this gap existed both between countries and between different income groups within countries. While 95% of students in Switzerland, Norway and Austria have a computer they can use for schoolwork, this rate is only 34% in Indonesia, according to the OECD (Organization for Economic Co-Operation and Development). Dikbaş Torun (2020) stated in her research that students' willingness to use applications in online learning is a crucial factor. She also stated that knowing students' readiness levels and their direct and indirect effects would provide a planning guide for decision makers and practitioners of online programs for better learning and students' success in online learning. Moreover, she emphasized that the impact of students' readiness levels for online learning on their learning progress, outcomes, and academic achievement is also very important to achieve the main goals of education and online learning.

With Covid-19, students' getting used to using computers and the internet also demonstrates that they have adopted online learning compared to traditional face-to-face learning. Starting as a necessity, the online learning model has spread worldwide, and countries have started to include online learning methods in their programs. Students' engagement in online learning varies in line with the time they spend in online learning environments. Junco (2011) expresses learning engagement as students' time and effort in creating learning outcomes. Ergün and Koçak Usluel (2015) stated that it was necessary to ensure student engagement in online learning environments so students not to get bored with the environment, participate effectively in the environment, and achieve the desired learning outcomes. Brownlee (2020) stated that at the beginning of the pandemic in the United States of America (the USA), some institutions had the necessary technological infrastructure to provide online courses to students, making participation in the course easier.

However, he underlined the importance of developing steady program strategies as the same conditions were not valid in all institutions. Fleming (2021) drew attention to the digital divide in online learning. He stated that parents' lack of skills or time to help students use online platforms and troubleshoot when necessary also significantly affected them. He pointed out that problems experienced by students studying in disadvantaged regions while using online platforms caused students to participate less in lessons.

Individuals' readiness and connectedness to online learning have gained more place in our lives, especially with the pandemic. Together with this, it is also necessary to examine the effect of online learning on educational efficiency. Singh, Rylander, and Mims (2012) mentioned the impact of online learning on educational efficiency in their research and stated that online learning was more effective than offline learning in terms of academic efficiency. Nguyen (2015) emphasized in his study that students' individual characteristics, teaching style, material use, assessment approaches, learning styles, and learning skills were influential on the effectiveness of online education. Margolis and Fisher (2002) stated in their research that online learning environments were gender-neutral, and everyone had equal access rights. Gunn et al., (2003) expressed that despite women's predispositions and their success in using technology, online learning could have the same asymmetric gender and power dynamics as traditional face-to-face learning environments, and male students could exhibit dominant behaviors. Rivera (2016) underlined that socioeconomic status and family income positively or negatively impacted learning, whether in a face-to-face or online environment. UNICEF (2020b) data also demonstrate inequalities in access to quality and qualified education between the rich and poor and students in urban and rural areas, based on their ability to access Internet and T.V. platforms. Aucejo et al., (2020) stated in their research during the pandemic process that children of low-income families faced more excellent health and economic shocks than their wealthier peers.

The covid-19 pandemic, which entered our lives in December 2019 and affected many fields, including education, paved the way for new ideas and formations to occur. Educational practices, carried out face to face in classrooms, have been conducted on different platforms worldwide for about a year. The concept of online learning has become the talk of the town and is accepted by all. Not only students but also families have gained new experiences in the process. Technological equipment, internet infrastructure services and ownership of technological devices are the critical factors for online learning process. It is quite apparent that the economic implications of the pandemic cannot be ignored. The importance of online learning has increased with Covid-19, which changes every individual's learning style from pre-school to higher education.

Along with online learning, the concepts of readiness and connectedness in online learning are also fundamental. Economic conditions, family and social structure characteristics are among the factors affecting the readiness of learners. Besides today's educational understanding, where high-level thinking skills are tried to be sharpened, the inclusion of the pandemic in our lives has affected our capacity of education and, in particular, the capacity of online education. In the last year, it has been seen in more detail that readiness, which's present impact on even face-to-face education is great, has even a greater impact on online education. Regardless of the level of learning, it is clear that readiness affects learning and the efficiency received from education. In the online learning process, which entered our lives more with the pandemic, students' connectedness to online learning also greatly affected the efficiency of education. Students' enthusiasm for online learning, attendance status, and connectedness to the online education process have become integral components of online education. Technological infrastructure support, having the necessary environment and opportunities, and the attitude developed towards the process of getting involved in online learning are very effective in the progress of the process.

For this reason, the concepts of online readiness and online connectedness have become important concepts that take place in distance education practices carried out together with the pandemic. Along with the social structure, the socio-economic status of families and their having the necessary equipment play a significant role in the effectiveness of online learning. Since the research conducted varies based on gender and students' grade, at the point of efficiency obtained from online education, it was regarded necessary to study different variables with this research. In particular, the perspectives and experiences of university students who are in the last stage of pre-profession and about to complete their education regarding online learning are crucial.

This research aims to reveal the variables affecting university students' decisions about the efficiency of online education. In line with this purpose, an answer to the following question will be sought: "Do university students' readiness to online education, their connectedness in online education, socio-economic levels, grades, and gender predict their decisions of finding online education efficient or not?"

2. Methodology

2.1.Research Model

The study is correlational research because the research aims to reveal the variables affecting university students' decisions about the efficiency of online education. Correlational research involves measuring two or more variables and examining their correlation without any variable manipulation. (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz, & Demirel, 2008).

2.2. Research Sample

The study group of the research consists of 821 university students. The students' average age is 21, and 619 of them are females while 202 are males. These students participated in the study from 12 different universities in Turkey. One hundred fifteen participants are freshman, 279 sophomores, 268 junior, and 159 senior students. Data were collected voluntarily within the framework of the criterion of the participants being university students.

2.3. Data Collection Tools and Procedure

In the study, Online Learning Readiness Scale, Online Student Connectedness Survey, and demographic information form were used, and the students were asked whether they found the online education conducted by their universities efficient or not. The independent variables in this study are as follows: university students' readiness to online education, their connectedness in online education, socio-economic levels, grades, and gender. The dependent (predicted, criteria) variable is the efficiency of online education.

The Online Learning Readiness Scale was developed by Hung et al. (2010) and adapted to Turkish by Yurdugül and Sırakaya (2013). The scale, including the sub-dimensions of computer/internet self-efficacy, self-directed learning, learner control, motivation for learning, and online communication self-efficacy, comprises a total of 18 items. It is a 5-point Likert type scale, responded as "1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree." The internal consistency coefficient of the Turkish form of the scale was found to be 0.85. When examining the Cronbach's alpha values of the sub-dimensions of the scale, computer/internet self-efficacy is 0.92, self-directed learning is 0.84, learner control is 0.85, motivation for learning is 0.80, and online communication self-efficacy is 0.91. Also, confirmatory factor analysis of the scale was conducted. As a result of the confirmatory factor analysis, there is no item with factor load values below 0.30. Hence, no item was excluded from the scale. Accordingly, when the confirmatory factor analysis results are taken into account, the fit values of the scale are as follows: RMSEA=0,085; CMIN/DF (X2/sd)=3,850; GFI=,935; CFI=,947; NFI=,915, and in the light of this result, it was observed that the fit values of the model were at acceptable levels.

Online Student Connectedness Survey, prepared by Bolliger and İnan (2012), was used to measure the online student connectedness levels of students studying online. It is a 5-point Likert type scale, responded as "1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree." The scale, which the researchers organized as 25 items in its final form, consists of four factors regarding the level of student connectedness. These are "Comfort", "Community", "Facilitation" and "Interaction and Collaboration". Five items in the "Interaction and Collaboration" factor were created by making small changes on the factor items developed by Walker and Fraser (2005) (as cited in Bolliger & İnan, 2012). High scores to be obtained from scale factors indicate that relevant factor level is observed at a high level in students. Cronbach's alpha values of the sub-dimensions of the scale are as follows: 0.97 for comfort, 0.96 for the community, 0.94 for facilitation, and 0.97 for interaction and collaboration. The total internal consistency coefficient of the scale was found to be 0.98.

In the demographic information form prepared by the researchers, there are questions regarding the student's grade, university and department, gender, socio-economic status, and whether they find online education efficient.

2.4. Data Analysis

Demographic information form, The Online Learning Readiness Scale, and Online Student Connectedness Survey were uploaded online and delivered to university students via social media. University students were asked to respond voluntarily to the scale forms, which were structured and shared through online Forms.

"Binary Logistic Regression Analysis" was used to determine whether university students' readiness to online education, their connectedness in online education, socio-economic levels, and gender predict their decisions to find online education efficient or not. Binary variables are referred to as "Bernoulli variables" (Tabachnick & Fidel, 1996) with only two possible responses, such as "yes/no, dead/alive, true/false, negative/positive." The dependent variable in logistic regression is binary; it has a value of "1(θ) in the likelihood of success" and a value of "0(1- θ) in the likelihood of failure."

"The binary logistic regression model" is given by:

$$P(Y_j = 1) = \frac{e^{\beta_0 + \beta_1 X_{j1} + \ldots + \beta_k X_{jk}}}{1 + e^{\beta_0 + \beta_1 X_{j1} + \ldots + \beta_k X_{jk}}}$$

"P (Yj =1) j." refers to the probability of the unit being in or selecting the first category. Before beginning the logit regression analysis, the mentioned assumptions were tested: absence of multicollinearity, linearity, predictive variables standard errors, VIF values, tolerance, error independence, the number of participants in multivariate statistical outliers and categories. Following that, using logit regression analysis in SPSS® statistical software, the regression model developed to estimate whether or not university students find online education efficient was analyzed.

3. Findings

Basic logistic information, including all variables predicting whether or not to find online education efficient such as university students' readiness to online education, their connectedness in online education, socio-economic levels, grades, and genders, are presented in Table 1.

Table 1. *Case Processing Summary*

Unweighted Cases		N	%
	Included in Analysis	821	100,0
Selected Cases	Missing Cases	0	,0
	Total	821	100,0
Unselected Cases		0	,0
Total		821	100,0

Table 1 shows, there are no missing data concerning cases to be analysed in the developed regression model to estimate whether university students find online education effective or not. "Omnibus Tests of Model Coefficients" based on the "traditional chi-square method" were used to test the coefficients' significance in the logit regression model developed (Table 2).

Table 2. *Omnibus Tests of Model Coefficients*

		Chi-square	df	Sig.
	Step	245,936	9	,000
Step 1	Block	245,936	9	,000
	Model	245,936	9	,000

Table 2 shows that the logit regression model coefficients used to predict whether university students find online education efficient or not are significantly meaningful for a significance level of 0,01. Additionally, the model was created using the "enter method," which is a procedure in which all variables are entered in a single step and the x^2 values of "step," "block," and "model" are all equal.

Furthermore, to determine the coefficients' statistical significance, the "Hosmer and Lemeshow Test" was used to ensure that the regression model was compatible with the data. The H0 hypothesis, in this test, is the statement: "The developed model accurately represents the data." H1 hypothesis, on the contrary, is the statement: "The developed model does not accurately represent the data."

Table 3. *Hosmer and Lemeshow Test*

Step	Chi-square	df	Sig.
1	12,408	8	,134

When Table 3 is examined, the logit regression model developed at the significance level of 0,01 accurately represents the data. Otherwise, "at the level of significance of 0,01, there is no difference between the values estimated by the model and the values observed." Finally, Table 4 provides summary information about the model.

Table 4. *Model Summary*

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	892,200	,259	,345

The value of "-2 Log-Likelihood" in Table 4 indicates how strong the model's decisions can be. This value is as close to zero as possible, indicating that the model is a better fit. The "Cox & Snell R^2" value is interpreted in the same way that "R^2" is in Linear Regression statistics. According to "Cox & Snell R^2" value (see Table 4), the predictor variables explained 25.9% variation by model in the decision of whether students find online education effective or not. The "Cox & Snell R^2" value never takes the value "1," making interpretation difficult. The "Nagelkerke R^2" statistic was designed to take values between "0" and "1" for the "Cox & Snell R^2" statistic. According to the "Nagelkerke R^2" value in Table 4, the predictor variables explained 34.5% variation by model in the decision of whether students find online education effective or not.

Table 5 presents the analysis results on the estimation of their decisions of whether students found online education effective or not, using the binary logit regression model, the properties of which were reported in the preceding paragraphs.

Tablo 5. *Classification Table*

	Observed	Predicted		
		Online Education is Efficient	Online Education is not Efficient	Percentage Correct
Step 1	Online Education is Efficient	291	118	71,1
	Online Education is not Efficient	114	298	72,3
	Overall Percentage			71,7

Examining Table 5, the logistic regression model developed accurately predicts whether students found online education effective or not, with an accuracy rate of 71,7%. Furthermore, the binary logistic regression model classified correctly 71,1% of those who found online education efficient. The classification accuracy of students who did not find online education efficient is relatively higher than the prediction accuracy of those who did find it efficient. The binary logistic regression model classified correctly 72,3% of the students who did not find online education efficient.

With respect to the binary logit regression model developed to estimate university students' decisions about whether or not they find online education efficient, Table 6 shows the coefficients of the independent

variables in the regression model, the standard errors of the coefficients, "Wald Statistics," the significance values, and the exponentiated coefficients ((Exp (B)), Odds Rates) to reveal their statistical significance in terms of the amount of variance affecting the dependent (response) variable.

Table 6. *Variables in the Equation*

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	SES(0=High SES)			3.530	2	.171	
	SES(1=Low SES	-.191	.301	.400	1	.527	.826
	SES(2=Moderate SES)	-.486	.321	2.293	1	.130	.615
	Age	-.131	.036	12.859	1	.000	.877
	Gender (0=Male, 1=Female)	-.427	.194	4.869	1	.027	.652
	OLRStotal	-.031	.010	10.227	1	.001	.969
	OSCStotal	-.055	.006	78.595	1	.000	.947
	Grade (0=4.Grade)			17.587	3	.001	
	Grade(1=1.Grade)	-.574	.305	3.542	1	.060	.563
	Grade(2=2.Grade)	-1.019	.246	17.156	1	.000	.361
	Grade(3=3.Grade)	-.533	.238	5.038	1	.025	.587
	Constant	9.844	1.120	77.288	1	.000	18842.019

In Table 6, the value of "Beta (B)" represents the relevant independent variable's (predictor) coefficient in the established logistic equation. For instance, a one-unit increase in "Connectedness in Online Education" will cause a decrease of "0.55" in the logarithm of the likelihood ratio, provided that other independent variables remain constant. The "Wald Statistic", which is similar to the t-test in linear regression, is used to determine the significance of coefficients. The "t values" square is equal to the "Wald Statistics," which examines the statistical significance of the term of constant and predictor variable coefficients. As shown in Table 6, the coefficients of some independent variables are not significantly meaningful at the 0.05 significance level. The "Sig" column displays the statistically significant levels of "Wald Statistics." The Beta (B) values are indicated as the original coefficients. The Beta (B) values' sign ("positive or negative") represents the relationship direction. A coefficient with a positive sign raises the estimated likelihood, whereas a coefficient with a negative sign lowers it. On the other hand, negative values indicate that the probability (odds) value is lower than 1.0 and the odds value is lower than .50. Original coefficients of logit regression are convenient for determining the relationship directions; although, they are less beneficial for deciding the size of the relationship (Allison, 2001).

Table 6 shows the Beta(B) exponential coefficients values as Exp(B). The exponentiation of the B coefficient is an odds ratio fort he predictors. These values represent the logarithm of the original coefficients. An exponential coefficient value greater than 1,00 demonstrates a "positive relationship", while a coefficient value below 1,00 represents a "negative relationship". That means the following is how Exp(B) values are commented: If Exp(B) value is above 1.00, the likelihood ratio for the event's accuring increases as the predictor variable increases.

On the contrary, if Exp(B) value is less than 1,00, the event's likelihood decreases as the predictor variable increases. The greatness of the change in the probability value is indicated by exponential coefficients, which provide a percentage representation of the variation in the response (dependent) variable "[(Exponential Coefficient-1).100]." Accordingly, as can be seen, that one (1) unit increase in the "Connectedness in Online Education" variable causes a 5.3% [(0.947-1).100] decrease in the odds of not finding education efficient; because the category coded as 1 is the category of finding inefficient. It is seen that one (1) unit increase in the "age" variable causes a 12.3% [(0.877-1).100] decrease in the odds of not finding education efficient. Alternatively, in other words, a one-unit increase in "Connectedness in Online Education," on the condition that all independent variables are constant, will cause the likelihood of not finding education efficient to decrease by "0.947". Furthermore, the "Exp(B)" values are shown in Table 6 for each level of the categorical predictor variables indicate how many times they will raise or lower the probability ratio of being in that classification. For instance, female students' likelihood of not finding their education efficient is 0.652 times less than male students.

Given the preceding explanations, it is probable to conclude that the attributes variables added in the regression model to predict university students' decisions about whether online education is efficient or not

are "Readiness to Online Education" and "Connectedness in Online Education," "Age," "Gender," and "Grade."

4. Conclusion and Discussion

When analyzing the result of classifying the students who thought the online instruction was efficient or not with the binary logit regression model, 291 of the 409 students in the group who thought the instruction was efficient were classified correctly and 118 of them were classified incorrectly, with the rate of correct classification being 71.1%. Of the 412 students who perceived the online instruction to be inefficient, 298 were classified accurately, 114 were classified inaccurately, and the accurate classification rate was 72.3%. The overall accurate classification rate for the planned model is 71.7%.When examining "students' readiness level for online education", one of the predictors of university students' decision whether to consider online education efficient or not, it is found that one (1) unit increase in the variable "readiness to Online Education" leads to a 3.1% [(0.969-1),100] decrease in the probability of not considering education efficient. Horzum, Demir Kaymak and Guengoeren (2015) in their research found that the level of students' readiness affects their motivation and thus has a positive impact on the efficiency of education. Kayaoğlu and Dağ Akbaş (2016) in their research found that students' motivation for online learning helps them to adapt to learning. Wang, Zhu, Chen, and Yan (2009) emphasised that readiness for online learning has a significant impact on students' performance. Similarly, Tuntirojanawong (2013) in her study found that students' readiness is related to the concepts of access to technology, motivation, and time and influences students' learning styles and desires.Similarly, when examining the "degree of students' connectedness to online education", which is one of the predictors of whether students perceive online education as efficient or not. It is found that one (1) unit increase in the variable "connectedness in Online Education" leads to a 5.3% [(0.947-1).100] decrease in the probability of not perceiving education as efficient. Erguen and Koçak Usluel (2015) stated that it is crucial for students to effectively engage in online learning environments without getting bored in the learning environment and to ensure students' connectedness in order to achieve the desired learning outcomes. In the studies conducted by Topal (2020) and Zareie and Navimipour (2016), it was found that connectedness and learning motivation was crucial to ensure learner satisfaction and create a meaningful impact. Cronhjort, Filipsson, and Weurlander (2017) also mentioned the effect of connectedness on learning power in their research and emphasized that choosing different practices in the learning environment would increase the success rate. Sadera, Robertson, Song, and Midon (2009) determined in their research that students' online connectedness positively affected their perceived success.

One (1) unit increase in the "age variable," which is one of the predictors of the decision of university students to find online education efficient or not, leads to a 12.3% [(0.877-1).100] decrease in the odds of not finding education efficient. Chyung (2007) determined that older students found education more efficient than younger students and participated more in discussions during the lesson. In their research, Gaumer Erickson and Noonan (2010) determined that adults over a certain age increasingly preferred online education methods. Li and Lalani (2020) stated that a structured framework was needed to increase online learning effectiveness so that significantly younger children could fully benefit from online learning.

When examining gender, one of the categorical predictors' variables of university students' decisions to find online education efficient or not, the probability ratio of female students not finding online education efficient is 0.652 times less than that of male students. Tsay, Kofinasb, and Luo (2018) found out in their research that female students participated in online learning activities more than male ones. In the research of Wilson and Allen (2011), the results indicated that female students participated in online education more than male students. In the research of Wagner, Garippo, and Lovaas (2011), it was revealed that males did not perform as effectively as female students in online lessons.

When grade levels are taken into account, the likelihood of not finding online education efficient is 0.361 times fewer for sophomores and 0.587 times fewer for junior students than senior students. At this point, the fact that students completing most of their education face to face till the senior year go through with the last year of their university life away from their social environment can be interpreted as influential on their decisions about the efficiency of online education.

Finally, the variable of socio-economic level, which is one of the categorical predictors of university students' decisions about whether they find online education efficient or not, was not found to significantly affect

students' decisions about online efficiency. Although it has been underlined that socio-economic status has a positive or negative effect on face-to-face or online learning (Rivera, 2016), it does not significantly affect decisions about the efficiency of education. In interpreting this situation, it should be taken into account that the students who participated in the research belonged to the group that continued with online education regardless of their socioeconomic status; in other words, they belonged to the group that did not stay away from online education because of their socioeconomic status. In terms of future research, it is considered important to reach students who have limited or no access to online education due to the low socioeconomic level of their families.When the results of the study were examined as a whole, it was concluded that among the variables included in the binary logistic regression model that accounts for university students' decisions about whether or not to consider online instruction effective, age, gender, grade, readiness for online instruction, and connectedness to online instruction significantly predicted students' decisions. Considering these variables, it is found that, especially in order of importance, connectedness with Online Education and willingness to Online Education have a significant impact on students' decision whether they find online education efficient or not. Therefore, practises to increase students' sense of community in areas such as "comfort", "community", "facilitation", and "interaction and collaboration", which are sub-dimensions of online connectedness, as well as encouraging interaction among students by instructors, providing regular feedback, and increasing interaction and collaboration will help change students' decisions regarding the effectiveness of education.Determining the skills required for distance learning at the university to increase student readiness, conducting special studies for students who consider themselves incompetent in the use of the Internet and computers so that they can improve in subjects in which they consider themselves deficient, and using incentive methods to increase participation in these studies will, in turn, help change students' decisions about the effectiveness of education. Future research is considered useful to examine the reciprocal effects in relation to instructors and students by examining instructors' willingness to learn online and their attachment to online education.

5. References

Adnan, M. & Anwar, K. (2020). Online learning amid the COVID-19 pandemic: Students 'perspectives. *Journal of Pedagogical Sociology and Psychology, 2*(1), 45-51. https://doi.org/10.33902/jpsp.2020261309

Allison, P. D. (2001). *Logistic regression using the SAS system: Theory and Application*. SAS Institute Inc.

Aujeco, E. M., French, J. F., Ugalde Araya, M. P. & Zafar, B. (2020). *The impact of Covid-19 on student experiences and expectations: Evidence from a survey.* Retrieved February 7, 2021, from https://doi.org/10.3386/w27392

Bolliger, D. U., & Inan, F. A. (2012). Development and validation of the Online Student Connectedness Survey (OSCS). *The International Review of Research in Open and Distributed Learning, 13(3)*, 41-65.

Bozkurt, A. & Sharma, R. C. (2020). Emergency remote teaching in a time of global crisis due to Corona Virus pandemic. *Asian Journal of Distance Education, 15*(1), I-VI. https://doi.org/10.5281/zenodo.3778083

Brownlee, M. I. (2020). Online student engagement: Bridging gaps in the midst of COVID-19. Retrieved January 01, 2021, from https://www.naspa.org/blog/online-student-engagement-bridging-gaps-in-the-midst-of-covid-19

Büyüköztürk, S., Kılıç-Çakmak E., Akgün, O. E., Karadeniz, S. ve Demirel, F. (2008). *Bilimsel araştirma yöntemleri* (2. baskı). Pegem.

Chung, E., Subramaniam, G. & Christ Dass, L. (2020). Online learning readiness among university students in Malaysia Amidst Covid-19. *Asian Journal of University Education, 16*(2), 45-58. https://doi.org/10.24191/ajue.v16i2.10294

Chyung, S. Y. (2007). Age and gender differences in online behavior, self-efficacy, and academic performance. *Quarterly Review of Distance Education, 8*(3), 213-222. https://doi.org/10.2190/ET.41.3.e

Cronhjort, M., Filipsson, L. & Weurlander, M. (2018). Improved engagement and learning in flipped-classroom calculus. *Teaching Mathematics and Its Applications*, 37, 113-121. https://doi.org/10.1093/teamat/hrx007

Di Pietro, G., Biagi, F., Costa, P., Karpinski, Z. & Mazza, J. (2020). *The likely impact of COVID-19 on education: Reflections based on the existing literature and recent international datasets*, EUR 30275 EN, Publications Office of the European Union, Luxembourg. https://doi.org/10.2760/126686

Dikbaş Torun, E. (2020). Online distance learning in higher education: E-learning readiness as a predictor of academic achievement. *International Council For Open And Distance Education, 12*(2), 191-208. https://doi.org/10.5944/openpraxis.12.2.1092

Ergün, E. & Koçak Usluel, Y. (2015). Çevrimiçi öğrenme ortamlarında öğrenci bağlılık ölçeği'nin türkçeye uyarlaması: Geçerlik ve güvenirlik çalışması. *Eğitim Teknolojisi Kuram ve Uygulama, 5*(1), 20-33. https://doi.org/10.17943/etku.64661

Fleming, N. (2021). *After Covid, will digital learning be the new normal?* Retrieved January 26, 2021, from https://www.theguardian.com/education/2021/jan/23/after-covid-will-digital-learning-be-the-new-normal

Gaumer Erickson, A. S. & Noonan, P. M. (2010). Late-career adults in online education: A rewarding experience for indivudals aged 50 to 65. *Merlot Journal of Online Learning and Teaching, 6*(2), 388-397. https://jolt.merlot.org/vol6no2/erickson_0610.pdf

Girik Allo, M. D. (2020). Is the online learning good in the midst of Covid-19 Pandemic? The case of EFL learners. *Journal Sinestesia, 10*(1), 1-10. https://www.researchgate.net/profile/Markus-Girik-Allo/publication/340815846_Is_the_online_learning_good_in_the_midst_of_Covid-19_Pandemic_The_case_of_EFL_learners/links/5e9f02f1a6fdcca7892c962b/Is-the-online-learning-good-in-the-midst-of-Covid-19-Pandemic-The-case-of-EFL-learners.pdf

Gunn, C.,(2003). Dominant or different? Gender issues in computer supported learning. *Journal of Asynchronous Learning Networks, 7*(1), 13-30. http://dx.doi.org/10.24059/olj.v7i1.1860

Horzum, M. B., Demir Kaymak, Z. & Güngören, Ö. C. (2015). Structural equation modeling towards online learning readiness, academic motivations, and perceived learning. *Educational Sciences: Theory & Practice, 15*(3), 759-770. https://doi.org/10.12738/estp.2015.3.2410

Hung, M., Chou, C., Chen, C. Own, Z. (2010). Learner readiness for online learning: Scale development and student perceptions. *Computers & Education, 55*, 1080–1090. https://doi.org/10.1016/j.compedu.2010.05.004

Junco, R. (2011). The relationship between frequency of Facebook use, participation in Facebook activities, and student engagement. *Computers & Education, 58*, 162-171. https://doi.org/10.1016/j.compedu.2011.08.004

Kayaoğlu, M. N. & Dağ Akbaş, R. (2016). Online learning readiness: A case study in the field of english for medical purposes. *Participatory Educational Research (PER)*, Vol:4, 212-220. https://dergipark.org.tr/en/download/article-file/778456

Li, C. & Lalani, F. (2020). *The COVID-19 pandemic has changed education forever*. This is how. Retrieved January, 26, 2021 from https://www.weforum.org/agenda/2020/04/coronavirus-education-global-covid19-online-digital-learning/

Margolis, J. & Fisher, A. (2002). *Unlocking the clubhouse: Women in computing*. (Cambridge: MIT Press).

Mohalik, R. & Suparna Sahoo, S. (2020). E-readiness and perception of student teachers 'towards online learning in the midst of Covid-19 Pandemic. *SSRN Electronic Journal.* Available at SSRN:https://ssrn.com/abstract=3666914 or http://dx.doi.org/10.2139/ssrn.366914

Nguyen, T. (2015). The Effectiveness of online learning: Beyond no significant difference and future horizons. *Merlot Journal of Online Learning and Teaching, 11*(2), 309-319. https://jolt.merlot.org/Vol11no2/Nguyen_0615.pdf

Radha, R., Mahalakshmi, K., Sathish Kumar, V., & Saravanakumar, A. R. (2020). E-Learning during lockdown of Covid-19 Pandemic: A *Global Perspective. International Journal of Control and Automation,*

13(4), 1088-1099. Retrieved February, 7, 2021 from http://sersc.org/journals/index.php/IJCA/article/view/26035

Rivera, M. (2016). *Can socioeconomic status impact online learning?* Retrieved February 7, 2021, from https://elearningindustry.com/socioeconomic-status-impact-online-learning

Sadera, W. A., Robertson, J., Song, L. & Midon, M. N. (2009). The role of community in online learning success. *Merlot Journal of Online Learning and Teaching, 5*(2), 277-284. https://jolt.merlot.org/vol5no2/sadera_0609.pdf

Salamat, L., Ahmad, G., Bakht, M. I. & Saifi, I. L. (2018). Effects of e-learning on students 'academic learning at university level. *Asian Innovative Journal of Social Sciences & Humanities, 2*(2), 1-12.

Singh, S., Rylander, D. H. & Mims, T. C. (2012). Efficiency of online vs. offline learning: A comparison of inputs and outcomes. *International Journal of Business, Humanities and Technology, 2*(1), 93-98. http://ijbhtnet.com/journals/Vol_2_No_1_January_2012/12.pdf

Tabachnick, B. G., Fidell, L. S. (1996). *Using multivariate statistics* (3rd ed.). New York, USA: HarperCollins College Publishers

Topal, M. (2020). *Oyunlaştırma ile zenginleştirilmiş çevrimiçi öğrenmenin başarı, çevrimiçi bağlılık ve öğrenme motivasyonu üzerindeki etkisi* [Yayımlanmamış doktora tezi]. Sakarya Üniversitesi, Sakarya. https://doi.org/10.14527/9786257052016.10

Tsay, C. H., Kofinas, A. & Luo, J. (2018). Enhancing student learning experiences with technology-mediated gamification: An empirical study. *Computers & Education,* 121, 1-17. https://doi.org/10.1016/j.compedu.2018.01.009

Tuntirojanawong, S. (2013). Studens 'readiness for e-learning: A case study of Sukhothai Thammathirat Open University, Thailand. *Journal of Learning in Higher Education, 9*(1), 59-66.

UNICEF. (2020a). *Education and COVID-19.* Retrieved January, 25, 2021 from https://data.unicef.org/topic/education/covid-19/

UNICEF. (2020b). *COVID-19: Socio-Economic Impact in Ghana.* Retrieved February, 7, 2021 from https://www.unicef.org/ghana/media/3071/file/COVID-19:%20Socio-conomic%20Impact%20in%20Ghana.pdf

Wagner, S. C., Garippo, S. J. & Lovaas, P. (2011). A Longitudinal comparison of online versus traditional instruction. *Merlot Journal of Online Learning and Teaching, 7*(1), 68-73. https://jolt.merlot.org/vol7no1/wagner_0311.pdf

Walker, S. L. & Fraser, B. J. (2005). Development and validation of an instrument for assessing distance education learning environments in higher education: The distance learning environments survey (DELES). *Learning Environments Research, 8*(3), 289-308. https://doi.org/10.1007/s10984-005-1568-3

Wang, Q., Zhu, Z., Chen, L. & Yan, H. (2009). E-learning in China. *Campus-Wide Information Systems, 26*, 47-61. https://doi.org/10.1108/10650740910946783

WHO. (2020). *Coronavirus disease 2019 (COVID-19) Situation Report-94.* Retrieved January, 25, 2021 from https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200423-sitrep-94-covid-19.pdf

Wilson, D. & Allen, D. (2011). Success rates of online versus traditional college students. *Research in Higher Education Journal,* Vol:22, 55-62. https://files.eric.ed.gov/fulltext/EJ1068796.pdf

Yurdugul, H. & Sırakaya, D. A. (2013). Cevrimici ogrenme hazır bulunusluluk olcegi: gecerlik ve guvenirlik calısması the scale of online learning readiness: A study of validity and reliability. *Education and Science, 38*(169), 391-406. http://egitimvebilim.ted.org.tr/index.php/EB/article/view/2420

Zareie, B. & Navimipour, N. J. (2016). The effect of electronic learning systems on the employee's commitment. *The International Journal of Management Education, 14*(2), 167-175. https://doi.org/10.1016/j.ijme.2016.04.003