DISCRIMINANT ANALYSIS IN DETERMINING THE DIFFERENTIATING FACTORS OF BLENDED LEARNING SUCCESS IN EDUCATIONAL INSTITUTIONS

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Abstract

Blended learning has become an increasingly popular approach in the educational field because it combines traditional/conventional learning with digital technology-based learning. However, the success of implementing blended learning in educational institutions can be influenced by various different factors depending on the characteristics of the educational institution. Therefore, this study aims to analyze the differentiating factors that influence the success of blended learning in educational institutions. The discriminant analysis method in this study was used to identify and determine the differentiating factors that distinguished the high success blended learning group from the low success group. Research data was collected from various educational institutions that have implemented blended learning in their curricula. The results of the analysis show that there are several significant differentiating factors between the high and low success groups in applying blended learning. Some of these factors include Implementation Standards and Guidelines, Infrastructure and Technology mastery, Learning Strategy, Human Resources, Learning Content and Learning Environment. This research makes an important contribution to the development of more effective blended learning implementation strategies in educational institutions. By understanding the differentiating factors that influence success, educational institutions can increase their efforts to create a conducive learning environment and improve the quality of student learning outcomes.

Keywords: *Blended Learning, Receiver Operating Curve (ROC), Discriminant Analysis*.

1 INTRODUCTION

Blended learning is an innovation in learning that mixes visual learning patterns with virtual learning patterns. Blended Learning refers to the desire of students in their learning activities, with the control of the students themselves. Where students can access the material they want according to the teacher's guidance and can also ask directly to the teacher during offline teaching and learning activities (Nurhidayat: 2021).

In other words, it can be concluded that Blended learning is an educational approach that combines traditional in-person classroom instruction with online learning components. This method offers students a flexible and dynamic learning experience, allowing them to access resources and engage in activities both in the physical classroom and through digital platforms.

Blended learning aims to enhance student engagement and cater to diverse learning styles by incorporating technology, multimedia, and interactive elements into traditional teaching methods. It can include a variety of formats, such as video lectures, discussion forums, and interactive assignments, providing learners with a well-rounded educational experience that can be tailored to their individual needs and preferences. Ultimately, blended learning seeks to harness the advantages of both face-to-face and online learning to optimize educational outcomes (Graham:2006).

Taylor (1995) suggests that blended learning emerged in the late 1990s as a new teaching method for distance learning through the application of technology and the internet. Blended learning aims to enhance learner learning and encourage teachers to change their educational methods, and therefore to shift learning to a more student-centered model versus a teacher-centered learning model.

When COVID-19 hit, the education sector was forced to make a breakthrough in learning patterns that began face-to-face visual education to virtual/online. Various educational institutions are experiencing a process of disruption and competing with time and circumstances to change face-to-face learning methods with internet-based online learning methods (e-learning). However, online learning, which was initially expected to replace face-to-face learning, did not live up to expectations. The results showed that students and students still have a low participation rate and they still need the presence of teachers (Teachers and Lecturers) in the classroom learning process directly or realtime.

Research with the theme of Blended Learning that already exists, some of which focus on students, for example, research conducted by Hapsari (2023) which explains the factors of student interest in learning using Blended learning. The results showed that full attention is needed in learning. In contrast to blended learning research that focuses on teachers (teachers / lecturers) as conducted by Ramadani, et al (2019).

The results of these studies leave the question of what factors are determinants or differentiators in the success of blended learning in different educational institutions in this case higher and primary-secondary education, of course with a research focus that not only focuses on the point of view of students but also teachers / lecturers as a whole. This study intends to determine the determining factors for the success of blended learning by involving different data groups, including teachers / lecturers, students, and levels of higher education and primary/middle education.

2 METHODOLOGY

2.1 Research Design and Research Approach

This research uses exploratory research methods (Cresswell: 2015), namely in the early stages using various data sources and literature to then be extracted into variables and the indicator that will be continued with a quantitative approach in this case is an analytical descriptive research design. The research process begins with looking for literature or references to previous research (literature search) to obtain previous research that is used as a source of data in obtaining research gaps. Furthermore, the results of this process are formed constructs and indicators that will be used as question material in the research questionnaire. The results of research questionnaires distributed online using *google form* to the academic community (teachers, lecturers and students) in several universities and schools that carry out blended learning. Furthermore, valdiity and reliability analysis of research instruments was carried out, then further analysis was carried out using a quantitative approach.

2.2 Population and Sample

The population in this study is educators (teachers and lecturers) in several universities as well as students and students who are willing to fill out research questionnaires, so that the population size is unlimited (undefinite population) based on the number but limited (definite population) based on the criteria and time of research.

The research sample was part of the study population that filled out a research questionnaire based on a predetermined deadline of 102 respondents. The nature of the research sample is saturated sampling, meaning that all respondents who meet the research criteria in accordance with the target population are made research units.

2.3 Data Analysis Techniques

In general, this study uses an exploratory method, which starts from qualitative identification of variables based on journal articles read and then continues to be verified using surveys to students participating in blended learning.

The results of the data collected from the distribution of questionnaires are then analyzed with exploratory data analysis to determine the distribution of data, the size of centralization and distribution of data and the creation of frequency distribution tables for variable variables that affect the implementation of blended learning in educational institutions. Furthermore, ROC (Receiver Operating Curve) analysis was carried out to determine the classification of the

success of blended learning implementation based on empirical data. The second step is to conduct a discriminant analysis to determine what are the determining factors in a research model (Hair, et.all:2015) in this case is the success of the implementation of blended learning in educational institutions.

3 FINDINGS AND DISCUSSION

All indicators in the variability obtained from the first stage, namely obtaining information from literature search, then used as material in research instruments / questionnaires. This instrument is first tested for validity and reliability. This valdiity and reliability test process is calculated based on the Corrected item total correlation and alpha Cronbach values. If the corrected item total correlation value obtained is greater than 0.3 then the indicator is declared valid. For the results of the Cronbach alpha value, if the value obtained is greater than 0.75 or close to 1, it is said to be reliable. Here are the results of the valdiity and reliability tests.

Table 3.1 Validity and Reliability Result

Item	r corrected item total correlation	alpha Cronbach
item_1	0.599	0.905
item_2	0.747	
item_3	0.847	
item_4	0.718	
item_5	0.517	
item_6	0.414	
item_7	0.500	
item_8	0.857	
item_9	0.816	
item_10	0.829	

Based on the table above, it can be seen that all indicator items are valid and reliable in measuring perceptions of supporting and inhibiting variables for the success of Blended Learning in educational institutions. Note that item 11 which is an item of question on the status of respondents whether teachers (teachers or lecturers) and students (students / students) are not tested for valdiity and reliability because this indicator item is included in demographic data, as well as respondent gender data.

The respondent data obtained from data collection consisted of 56.86% men and 43.14% women with a composition of 46.1% from primary and secondary education (teachers and students) and 53.9% from higher education (PT), namely lecturers and students by 53.9%.

While the classification of the success of Blended Learning Implementation based on the factors that influence it can be seen based on the table below

Table 3.2 Comparison Measure of Blended Learning Score based on Variables

	High BL		Low BL	
	Mean (sd)	With (min - max)	Mean (sd)	With (min - max)
X1: Infrastructer and Technology mastery	7.8 (1.16)	7 (6 - 11)	6.54 (1.09)	6 (5 - 11)
X2: Study Environment	6.84 (0.74)	7 (5 - 9)	6.8 (0.98)	7 (4 - 9)
X3: Learning Content	5.14 (1.8)	6 (2 - 8)	5.34 (1.29)	5 (3 - 10)
X4: Standard and Implementation Guidelines	5.59 (1.17)	6 (3 - 8)	4.15 (0.77)	4 (2 - 6)
X5: Learning Strategies	3.09 (0.83)	3 (2 - 4)	2.66 (0.61)	3 (2 - 4)

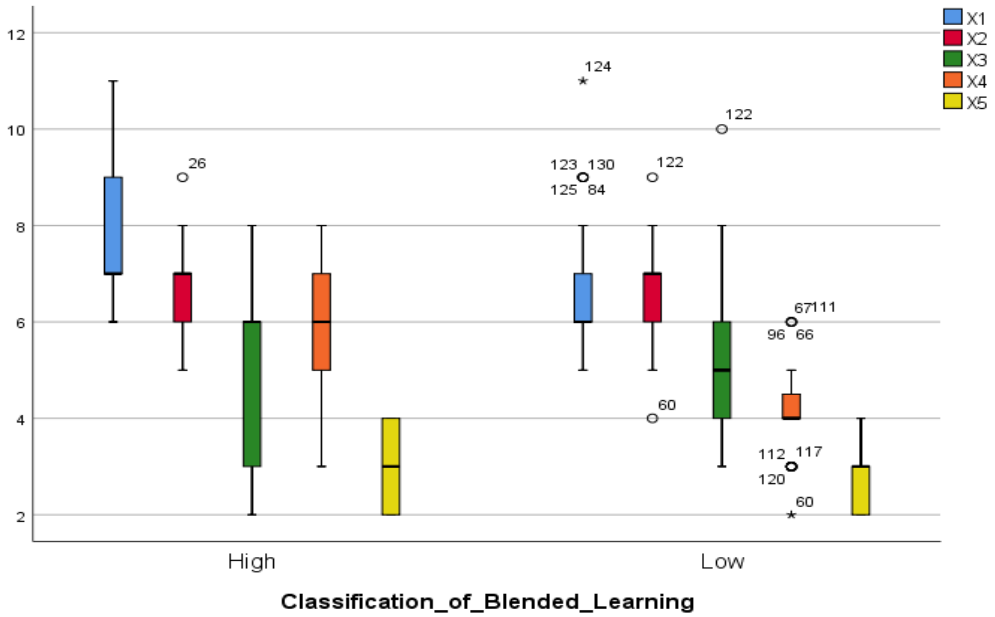

Figure 3.1. Boxplot of Blended Learning Score among Variables

From table 3.2 and figure 3.1 above, it can be seen that the distribution of the Blended Learning Score classification based on the analyzed variables, it can be seen that in general the distribution of Blended Learning High Score is wider in the data range and greater in value specifically in variables X1, X4, and X5, while X2 and X3 are more likely to have the same upper limit score even though the data range is different.

The distribution of high and low scores on the successful implementation of Blended Learning based on the analyzed variables can be seen based on the results of the ROC curve analysis.

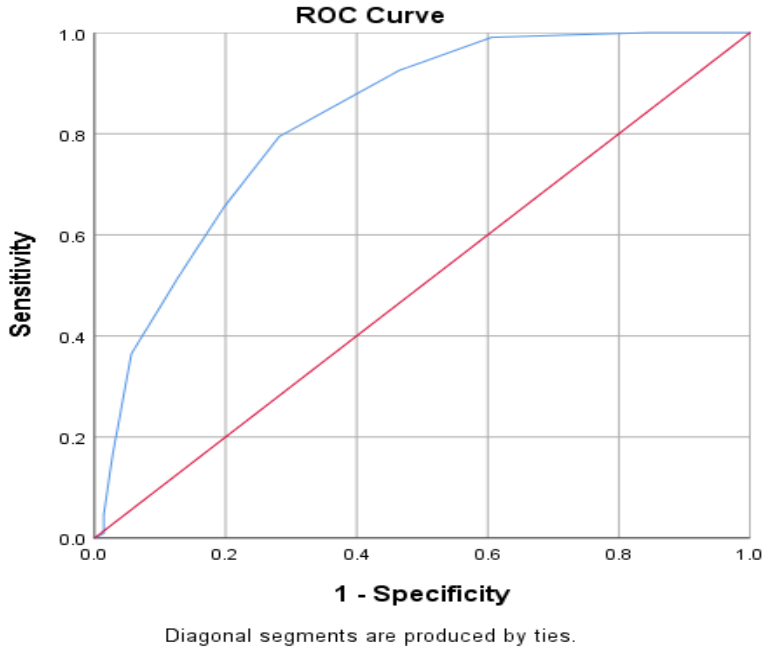

Figure 3.2. ROC Curve of Blended Learning Classification

Table 3.4 Measure of ROC

Area	Std. Errora	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval		Cut Off	Accuracy
			Lower Bound	Upper Bound		
0.828	0.032	0.000	0.765	0.891	26.5	0,756

From figure 3.2, we can see the ROC curve as a visualization of the Blended Learning classification with an area under the linear curve of 82.8%. This means that the classification results have been able to explain around 82.8% of the variance of variables that affect the implementation of Blended Learning so that the classification made is significant. Based on table 3.4 it can also be seen how much the limit value or cut off of the score of all variables analyzed, obtained the cut off value from the total of all variables is 26.5. So if the total score of all variables obtained by a respondent has a value of < 26.5, it is classified into the criteria of Low Blended Learning while if the total score of all variables obtained by a respondent ≥ 26.5, it is categorized as High Blended Learning. This cut-off value has accuracy in separating

the total score of variables that affect blended learning into high and low classifications is 75.5%.

The purpose of ROC Curve analysis is to determine the cut off that serves as validation of the Blended Learning classification strength to be used in discriminant analysis. Meanwhile, to find out which variables are the determining factors for the success of implementing blended learning in educational institutions, it can be known from the results of the discriminant analysis below.

Table 3.5 Groups Descriptives and Test Equality Groups of Mean

Independen Variables	Dependen Variables Group Means		Test of Equality Groups of Mean		
	Low Score BL (n= 71)	High Score BL (n=107)	Wilk Lambda	F value	Sign
Status	1.4648	1.5888	0.985	2.65	0.105
X1	6.5352	7.8037	0.767	53.36	0.000
X2	6.8028	6.8411	1.000	0.09	0.767
X3	5.3380	5.1402	0.996	0.64	0.425
X4	4.1549	5.5888	0.679	83.39	0.000
X5	2.6620	3.0935	0.926	14.13	0.000

As a first step of discriminant analysis is to test whether each variable to be analyzed in the discriminant analysis has an average difference between the two classifications of Blended Learning scores. It can be seen from the results of table 3.5 above that only the respondent Status variables, X2 and X3 do not have different averages between the two classifications of Blended Learning. While the variables X1, X4 and X5 have an average difference between High scores and Low scores in Blended Learning scores. This means that in other words, the status of respondents, whether students or students with teachers, whether teachers or lecturers, does not provide a difference in the implementation of Blended Learning. However, this explanation is univariate per variable only, not made simultaneously in a model or in the form of a linear combination of variable variability against the classification of Blended Learning scores.

In table 3.6 below can be seen the results of the Discriminant analysis consisting of both unstandardized and standardized Discriminant Functions, Group Classification Functions, and Matrix Structures of Discriminant Functions.

Table 3.6 Summary of Discriminant Analysis for two groups

Independent Variables	Discriminant Functions		Classification Function		Structure Matrix	
	Unstandardized*	Standardized	Low BL (centroid =-1.105)	High BL (centroid = 0,733)	Function	
Status	-0.429	-0.213	2.289	1.501	X4	0.760
X1	0.572	0.649	4.863	5.914	X1	0.608
X2	-0.191	-0.161	9.073	8.722	X5	0.313
X3	0.027	0.044	8.465	8.516	Status	0.136
X4	0.701	0.719	0.213	1.503	X3	-0.067
X5	0.402	0.301	12.716	13.455	X2	0.025
(Constanta)	-7.044		-89.082	-101.690		

*significant function based on Chsiquare Test of Wilk Lambda with sig <0,01

From table 3.6 above, it can be seen that the discriminant function formed is

$$D = -0.429 * Status + 0{,}572X1 - 0{,}191X2 + 0{,}027X3 + 0{,}701X4 + 0{,}402X5$$

This discriminant function is a function used to predict the respondent's blended Learning score group when all variables are known for their values, if the values of these variables vary in different units of measurement, then standard values (standard values) are used and use standardized discriminant functions. From this standardized function, the Cuttof value of a discriminant score can be determined using the formula

$$Z_{CO} = \frac{N_A Z_B + N_B Z_A}{N_A + N_B} = \frac{(71 \times 0{,}733) + (107 \times -1.105)}{71 + 107} = -0{,}3179$$

So if a respondent who has a standardized discriminant function value <-0.3179 is included in the low score group of Blended Learning, if ≥-0.3179 then it is included in the high score group. And to find out the factors or variaables that determine (discriminant) the implementation of Blended Learning can be seen from the matrix structure. The matrix structure displays a sequence of variables based on their determining power. From the table can be seen sequentially are X4, X1, X5, Status, X3 and X2. The predictive ability of the discriminant model formed can be seen from the table below

Table 3.7 Classification Result for Two Groups Discriminant Analysis

			Predicted Group for Analysis 1		
			High	Low	Total
Classification_of_Blended_Learning	High	Count	85	22	107
		% of Total	47.8%	12.4%	60.1%
	Low	Count	10	61	71
		% of Total	5.6%	34.3%	39.9%
Total		Count	95	83	178
		% of Total	53.4%	46.6%	100.0%

From table 3.7 above, it can be seen that the performance results of the discriminant function produced by accuracy can be calculated (85 + 61) / 178 = 82.02%. So it can be concluded that the ability to predict the discriminant function formed is 82.02%. It can also specify a standard Cut off value of -0.3179. The accuracy of this discriminant function is almost the same as the accuracy of the ROC kura analysis described earlier.

4 CONCLUSION

Discriminant analysis used as an analytical tool has been able to assess the success of the implementation of Blended Learning in educational institutions at different levels in this case education and higher education, as well as with different groups of respondents in a research model. Although the results of the discriminant analysis stated that there was no significant difference from the variability in respondent status, whether from education or higher education and whether students and students. This means that the perception of each respondent states the same thing that online learning is still very necessary for the role of teachers / lecturers or lecturers in the learning process in the classroom.

In addition to the problem, different data groups in this study succeeded in identifying variables obtained from the literature search process to be analyzed using discriminant analysis. Some things that become determining factors in the success of implementing Blended Learning as an output of discriminant analysis sequentially are X_4 = Implementation Standards and Guidelines, X_1 = Infrastructure and Technology mastery, X_5 = Learning Strategy, Status, X_3 = Learning Content and X_2 = Learning Environment.

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