Implementation of Blended Learning Model to Improve Critical Thinking Ability of Audio Visual Engineering Students

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Abstract. The goal of this study is to find out how students' critical thinking skills improve when e-learning-based blended learning is implemented. Using a pretest-posttest control group design, the research was conducted. After the experimental class went through the blended learning process, the post-test average was 96.64, while in the control class using face-to-face learning, the post-test average was 88.52. The sig value of 0.00 was obtained based on the results of the Mann-Whitney test. The average value of N gain in critical thinking skills in the experimental class is 0.93 in the high category, while the average in the control class is 0.78 in the medium category. The follow-up test based on the effect size test to determine the effect of applying blended learning on critical thinking skills has an effect size (d) value of 1.37 with a larger category. Respondents to a survey on blended learning stated that 82% of students chose to agree with learning in the blended learning process and stated that it was very helpful in understanding simulation and digital communication material, but further research was needed on the limitations of the internet network in blended learning. Based on these findings, blended learning has the potential to enhance students' critical thinking abilities. The average student is satisfied with blended learning, but researchers need to pay attention to internet connections so they can support online learning.

Keywords: Blended Learning · Critical Thinking Ability · Audio Visual Engineering

1 Introduction

The World Health Organization reports that the earth is infected with the 2019 Coronavirus. Due to its rapid spread in many countries, the covid-19 virus is very deadly, so the application of *social distancing* can effectively stop the spread of the virus from one person to another [1, 2]. As a result, many countries allow the majority of their citizens to work from home and manage their education. As a result, educational institutions

instructed that the learning process be carried out online. During the Covid-19 period, the learning process can be done online and gives students the knowledge and skills they need to support established policies.

Gqokonqana et al. [3] stated that compared to conventional courses, students in tertiary institutions tended to be less satisfied with online courses. Consequently, meeting educational needs and solving educational problems may be more effective when traditional and online learning environments are combined [4]. Teachers must be more creative in their approach to teaching in the 21st century, models or learning methods that are more interesting and effective to implement during a pandemic or the next period in order to increase students' critical thinking levels [5]. Learning that combines in-person and online learning is known as blended learning.

Blended learning based on e-learning gives students more individual access to additional theory outside school hours, eliminates face-to-face meetings in favour of practicums to teach students theoretical material [6]. Students' capacity for critical thinking can rise as a result of blended learning, motivation and student independence, because this model is able to create motivation for students to be more competitive in learning [7]. The Blended Learning model consists of 70% online instruction and 30% face-to-face instruction [8, 9].

Digital Simulation and Communication is a required subject that must be mastered by vocational high school (SMK) of Audio Video Engineering major. In this subject, students must understand the concept of logic and algorithms, understand various algorithmic communication methods, design logic with good flowcharts. So, the abilities gained after completing education, and SMK graduates can be absorbed by the industry [10]. According to the observations, students still struggle to comprehend the material during the learning process, the limited availability of teaching materials makes it difficult for students to find reading references to support the learning process. As well as the online learning that was possible during the Covid-19 pandemic, students felt bored to participate in learning. According to Tayebinik & Puteh [11] online learning still cannot replace face-to-face learning, students still need direct direction and explanation of the material taught by educators. Accordingly it is important to consolidate the internet educational experience with the face to face growing experience. The existence of the Covid-19 pandemic has changed and limited face-to-face meetings. However, the learning process can take place virtually through the E-learning model.

The rapid development of information technology today strongly supports the perspective of the shift from student-centred to teacher-centred. E-learning is a way of using the internet for learning that has been implemented along with existing technological developments. Through the various advantages of each technology, the benefits of e-learning can provide flexibility, interactivity, speed and visualization.

E-learning has a number of major weaknesses, including the inability to socialize with other students and the low frequency of meetings between teachers and students. As a result, implementing face-to-face learning is also important. However, teachers must also be able to use technology to encourage students to participate in the learning process and learn these subjects due to the technology development.

By using electronic devices (online) as supporting media, e-learning has developed as an innovation that contributes to the growth of online learning. E-learning can be

combined with face-to-face teaching by teachers. Blended learning is the name given to this type of learning. Communication becomes easier through Blended learning, students have more control over how they access material, teachers and students can discuss with each other anytime and anywhere [12]. The Blended Learning model is an innovation that is able to make students to be centre of learning (student center) [13].

The guided inquiry model, which includes orientation stages, formulation of the problem, formulation of the hypothesis, data collection, and data analysis or testing of hypotheses, and conclusion drawing, is one learning model that supports the use of blended learning [14]. Learning using guided inquiry with Blended learning is more effective than just inquiry without online learning [15, 16]. Guided inquiry is highly recommended to implement. Learning based on scientific methods can develop critical thinking skills [17].

It is hoped that this research will be able to decide whether the guided inquiry model and the blended learning model are effective in encouraging critical reasoning abilities in recreation and advanced correspondence guidance. Knowing the development of determinant reasoning can be seen from the student's response when working on questions, remembering the determinant reasoning assessment instructions using the learning model, namely blended learning. This study can also be a reference for educators, the level of guidance provided by the blended learning model.

2   Research Methods

2.1   Types of Research

Grade X of Imelda Private Vocational High School, Medan will be the subject of this quasi-experimental research using a pre-test post-test control group design in the odd semester of the 2022/23 academic year.

The sampling procedure used purpose sampling technique which was carried out by selecting two classes with the same average ability as samples, and obtained Grade X of TAV 1 which consisted of 30 students as an experimental class that would apply blended learning and Grade X of TAV 2 which consisted of 28 students as a control class that applied direct learning (face to face only). The procedure for conducting the research in the experimental class included pretest - online - face to face - online - posttest, while the control class was pretest - face to face - posttest.

2.2   Data Analysis

Data analysis in this study includes validity and reliability tests that were carried out before the questions were used to the research sample. Use the Pearson test to test the validity of the instrument. The test of the validity of the critical thinking instrument resulted in a correlated item score – total correlation which showed >0.37, so that this item was considered valid. Because r-value $>$ r-table, then the data is showed to be valid when conducting a reliability test. Meanwhile, the reliability test can be seen that the Cronbach Alpha value shows the number of 0.421, so the instrument can be assumed to be quite reliable. In addition, after the critical thinking instrument was declared valid and

Table 1. Category of N-Gain Score Acquisition

score	Category
g > 0.7	Tall
0.3 < g ≤ 0.7	Currently
g ≤ 0.3	Low

reliable, both the pre-test and the post-test can be implemented as instrument. The data were then subjected to homogeneity and normality tests, and the normality test confirmed that the data were normally distributed, after the homogeneity test the data was not homogeneous, therefore non-parametric statistical tests were carried out. Conducted by the Mann Whitney U-test to determine the differences in the applied models and to test the effect size. Further research determined the impact of blended learning on Simulation and Digital Communication subjects on the critical thinking abilities of students.

To find out the impact of blended learning on Simulation and Digital Communication subjects on the critical thinking abilities of students. The following is how the average normalized gain formula was used in the analysis by [18]:

$$N - Gain = \frac{\text{Posttest score} - \text{Pretest score}}{Ideal\ Score - Pretest\ score}$$

After calculating according to the equation, the N-Gain score is then categorized based on its level. The N-Gain score categories are available in Table 1.

3   Discussion

Pre and post-test scores on critical thinking skills and e-learning-based blended learning questionnaires constitute the quantitative and qualitative components of this study.

Research Instrument Test Results
The validity of the instrument was tested using SPSS to determine the validity of the questions before being tested on students and 20 valid questions were obtained. Reliability testing to determine the level of reliability of the question produces a value of 0.421 which is quite reliable.

Stage of Implementation
There were two classes during the study's implementation phase: the experimental class and the control class. Throughout the study, the research conducted in the experimental and control classes were three times. Direct or face-to-face learning is implemented in the control class, which is comprised of 28 students from grade X of Audio Visual Technique 2. Blended learning is implemented in the experimental class. A guided inquiry model is implemented in these two classes.

The results of the pre-test and post-test tests on students' critical thinking skills are presented in Table 2.

The experimental class has higher greatest and least scores than the control class, as showed in the Table 2 of decisive ability to reason test results. In both the experimental

Table 2. Results of the student's Critical Thinking Ability Test.

Class	Critical Thinking Ability				
	test type	max value	min value	average	SD
Experiment	Pretest	68	25	44.05	12.64
	posttest	98	74	96.64	5.23
Control	pretest	55	20	40.24	13.65
	posttest	96	67	88.52	6.21

Table 3. N-gain score of Students' Critical Thinking Ability.

Score	Experiment Class	Control Class
Highest Gain	1	1
Lowest Gain	0.68	0.64
Average Gain	56.35	49.14
Average N-gain	0.93	0.78
Category	High	High

and control classes, the typical worth of the experimental class is higher than that of the control class. The impact of N-gain on students' capacity for critical thinking is depicted in Table 3.

After the pre-test and post-test, the average n-gain score of students' critical thinking skills was 0.78 for the control class and 0.93 for the experimental class. This can see how students' abilities improve after learning. Using moderate criteria, the experimental class's average gain is greater than the control class's.

After getting the N-gain data, normality and homogeneity tests were carried out. The experimental class got a normality value of 0.073 and the control class got a value of 0.187 from the calculation results for the critical thinking ability variable. These results are classified as normal based on the analysis test results obtained, because they have met the criteria for the normality test which states that the data will be normally distributed if the sig value is greater than 0.05. While the homogeneity variable of critical thinking ability gets a score of 0.000. The significance level indicates that the data do not have the same variance, indicating that they are not homogeneous because the significance value is < 0.05.

Based on these results, it is known that the data does not meet the Independent Sample Parametric test, which is determined by the Normality and Homogeneity test. So that a non-parametric test is used, specifically the Mann-Whitney U test to see if there is a statistically significant and significant difference between the experimental and control groups.
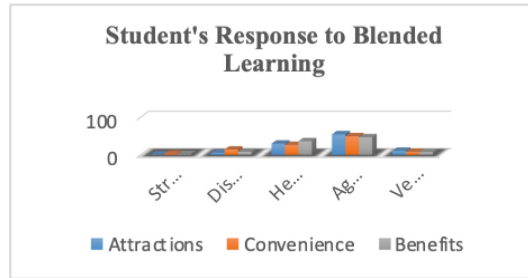
Graph 1. Student Response to Blended Learning

The Mann-Whitney U test was used to calculate the critical thinking ability variable, and the sig value was 0.00. As a result, the score shows that the experimental and control classes learn differently. According to the Mann-Whitney U Test criteria, where H0 is rejected or there is a difference between the experimental class and the control class if sig < 0.05 so that the two classes are declared to be different.

The effect size test is carried out after the n-gain results of the two data have differences. The purpose of this test is to find out how much influence the blended learning model has. In this study, the effect size value was calculated with the help of Cohen's d. Then the effect size test (d) was carried out which aims to determine the magnitude of the effect on the implementation of blended learning on critical thinking skills, the effect size value was 1.37 with a large category. Cohen (1994) categorizes the range of effect sizes into several groups, where $d > 0.8$ is included in the large effect category. Based on these data, the blended learning model has the potential to affect students' critical thinking skills.

Researchers used a questionnaire to analyze the needs of blended learning to see student responses to e-learning-based blended learning. The data is presented in Graph 1.

Based on the graph above, it is known that students' responses to the use of e-learning for blended learning are as follows: On average, students choose to agree if blended learning is implemented in schools. However, many students are also confused about whether blended learning can be implemented in schools. This is because the internet network in each student's residence is different and consumes a lot of data during the learning process, this is because the majority of students use Android to access e-learning.

Based on the experimental class's blended learning research data, the guided inquiry learning model can assist students in developing their critical thinking skills. Students can communicate more freely with teachers and other students. Based on the findings of student interviews, the ease of learning with the blended learning model is because students often play social media every day. This is in accordance with the statement of Sjukur [18] online learning is much more private and safe for the learning environment. Learning online allows students to see again the results of all group discussions, the conclusions that the teacher gives, learn more about the questions in the quiz and easily access teaching materials in each student's library. This is in accordance with Wahyunita

and Subroto [19], online learning can provide teaching materials so they are easy for students to access anytime and anywhere.

In the face-to-face test, based on the results of interviews with several students who did not complete, information was obtained that students still did not understand the material being taught. Students do not understand the material being taught because students still have difficulty in practicing Simulation and Digital Communication which is the basis of the material being taught. Meanwhile, the results of interviews with several students who completed stated that they had understood the material being taught. The results of these interviews are in accordance with the characteristics of students in grade X of TAV 1, namely in one class students have different abilities in capturing the material presented. The difference in students' abilities in capturing material causes it to take several face-to-face meetings so all students in one class can understand the material. With the combination of face-to-face and e-learning, students can ask the difficulties experienced by students in face-to-face learning. During the online discussion, some students asked about how to define Simulation and Digital Communication. This is consistent with the observation that what most students discuss is how Simulation and Digital Communication use different ways that the teacher exemplifies on the blackboard.

Based on the description, the learning outcomes of classes that implement the blended learning model have a better average concept understanding result than classes that implement active learning without the blended learning model. These results are in accordance with different findings which indicate that the mixed learning model develops more student learning outcomes [20, 21]. These outcomes are because of the mixed learning model is a model that consolidates the positive parts of eye to eye learning. The positive aspect of e-learning is that it ensures the flexibility that cannot be guaranteed in face-to-face learning (learning that is not limited by space and time) which allows teachers and students to carry out more effective learning [22], while the positive aspect of face-to-face is that it allows learning in an interactive way. Interactive so that teachers more easily control the state of the class [23].

The existence of the data above shows that students' ability to improve their critical thinking skills can be encouraged by the continuous application of the blended learning model. The existence of these data indicates that there are positive changes in students after applying the blended learning model to Simulation and Digital Communication lessons. A learning model called blended learning is well-suited for implementing in the 21st century because it can make face-to-face learning more appealing. Without having to abandon face-to-face instruction, blended learning can take into account a wide range of technological advancements in the classroom by combining e-learning with face-to-face instruction. Students can continue learning and follow the learning process with blended learning. Blended learning also assists teachers in creating a learning environment that suits students' learning styles and helps students face future challenges. The application of the blended learning model aims to support students' development throughout the learning process in accordance with their preferred learning styles.

4   Conclusion

It is possible to draw the conclusion that students' capacity for critical thinking is significantly impacted by e-learning-based blended learning. This demonstrates that the

critical thinking abilities of the experimental class are superior to those of the control class. This is demonstrated by the fact that the effect size is estimated to be 1.37 with a large category and that the experimental class's average n-gain is greater than that of the control class. Based on these findings, blended learning has the potential to enhance students' critical thinking abilities. On average, students have satisfaction with blended learning, but researchers need to pay attention to internet connections in order to support online learning.

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