

EDMODO-BASED FLIPPED CLASSROOM LEARNING MODEL TO IMPROVE CRITICAL THINKING AND PROBLEM SOLVING ABILITIES

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Abstract--The purpose of this study is to compare the edmodo-based blended learning typeflipped classroom model and LMS-based blended learning model to students' critical thinking and problem solving skills. The problems of the research are there any differences in the two dimensions of the learning model on students' critical thinking skills and problem solving. In this research the independent variable (X) is the edmodo-based blended learning typeflipped class learning model (X1). While the dependent variable (Y) is critical thinking (Y1) and problem solving ability (Y2). The research sample was taken from semester III students of Muhammadiyah University of Surabaya, there were 2 classes and semester III students of Muhammadiyah University of Sidoarjo there were 2 classes. The research sample was taken from students who were normally distributed, had the same characteristics (homogeneous), and had the same average value. Then two groups (classes) of students were taken as samples, namely the experimental group and the control group. The data analysis technique used to determine the differences in the blended learning typeflipped classroom learning model on students' critical thinking and problem solving skills was the statistical analysis technique of Multivariate Analysis of Variance (MANOVA). Based on Pillai's trace, Wilks' lambda, Hotelling's trace, and Roy's largest root showed 0,000. Figures 0.000 < 0.05 so that H₀ is rejected and H₁ is accepted. That is, there are differences in critical thinking skills and problem-solving abilities between edmodo-based blended learning typeflipped classroom model and the LMS-based blended learning model.

Keywords— *flipped classroom* Model; *Edmodo*; Critical thinking; problem solving

I. INTRODUCTION

The positivistic paradigm in the view of society develops in line with the advancement of the people's mindset, supported by the development of knowledge and technological progressivity. Understanding and utilizing information technology and communication are the main skills that must have society in 21st century or knowledge society. According to Trilling and Fadel in their book entitled 21st Century Skills Learning for Life in our Times, the focus of 21st century skills is critical and innovative learning skills, namely critical thinking and problem solving, communication and collaboration, creativity and innovation (Triling & Fadel, 2009).

Learning in the 21st century has several principles, one of which is that learning must be learner-centered. Students are placed as learning subjects actively in their studies. Students are not required to memorize lecture material, but build their own knowledge according to the level and capacity of developing their thinking. Students are also required to be able to solve real problems in a society (Nichols, 2019).

Students are required to be able use their abilities to try solving the problems they face independently, students also must have the ability to compose and express, analyze, and solve problems. The real condition obtained from the results of research conducted by Fadel shows that the problem-solving ability of higher education graduates is still very low (Triling & Fadel, 2009).

The low level of problem solving skills is shown by various empirical facts from several studies. (Chis et al., 2018) in his research, it shows that low student programming skills are caused by low student problem solving skills. This is rhythmically expressed by (Chang et al., 2018) that the academic achievement of students is still low. The reason is direct instruction that is emphasized excessively, causing students to become easily frustrated and not supporting problem solving skills. The learning process that lacks edutainment is a factor in the low student problem solving skills (Chis et al., 2018). A fun learning atmosphere can be obtained if the lecturer involves the use of technology in it.

One of the recommendations of the 2019 Kemenristekdikti National Working Meeting is online learning in University with reference to the Regulation of the Minister of Research, Technology and Higher Education No. 51/2018 to be held as a higher education strategy to answer the challenges of the industrial revolution. As well known, the Directorate General of Higher Education has launched an online learning program called the Indonesian Online Learning System (SPADA) which is attended by all universities throughout Indonesia. Generally, the blended learning learning model is learning based on web technology using a very open learning environment accessible via the internet, which has the aim of facilitating learning and constructing student knowledge through very meaningful interactions.

The blended learning model that can be applied to teach students is the flipped classroom. The flipped classroom learning model is active learning that combines the involvement of students, a combination of various learning designs and the distribution of study materials on a prodcast basis (video, sound, images and documents in the form of pdf, doc, etc.). *The "flipped classroom" instructional model was developed by Jonathan Bergman dan Aaron Sams in 2007 to provide instruction to secondary students who were missing class and therefore missing instruction* (Bergmann & Sams, 2012). One of the main pillars of the flipped classroom learning model is a learner-centered learning model, so that students are more actively involved in forming their knowledge. The flipped classroom model is simply divided into 5 stages, namely before class, beginning of class, during class, after class, and officials hour. When outside the classroom students learn through a predetermined learning management system, while in the classroom students learn actively through real activities in the classroom.

Flipped classroom is a pedagogical approach which in its implementation departs from individual learning that can be done outside the classroom, and then the learning outcomes are discussed in the classroom (Chis et al., 2018). The main purpose of the flipped classroom is online instruction before the class, which will give students free time to prepare more questions. The feedback given by lecturers to students is to straighten and clarify misconceptions experienced by students (Chis et al., 2018). Learning activities will be meaningful if students learn with their own learning styles.

In the flipped classroom learning model, the role of the lecturer is only as a facilitator. Through the learning model flipped classroom is able to train students' learning independence, because students can look for other learning resources besides videos and materials provided by students (Chang et al., 2018).

There are several advantages that are the reasons for using the blended learning typeflipped classroom learning model, namely: 1) students are more independent in the learning process, 2) students can learn in comfortable conditions and atmosphere, 3) are able to facilitate student learning speed, 4) every student can get full attention from lecturers when having difficulty understanding concepts and assignments, 5) students can learn from various types of learning content.

The use of Edmodo as a medium in the flipped classroom model is an alternative learning to improve students' problem solving abilities (Kustandi, 2017). Using Edmodo facilitates and enhances effective learning communication and can save time (Wahyuni et al., 2019).

Flipped classroom learning is carried out by providing the required reading materials and assignments to students. In class students hold discussions and finishing the exercise solving problems. The class becomes more alive where students actively communicate between friends and lecturers when completing the exercises given. In line with the research results (Elmaadaway, 2018) that through the flipped classroom approach, first students learn the material at home, so that in class they participate in relevant activities, ask questions and involved in problem solving. (Bergfjord & Heggernes, 2016) stated that in a flipped classroom, students prepare themselves better for learning in class, feel satisfied and achieve better learning outcomes. So, this learning has a positive effect on the knowledge, skills, and involvement of students (Murillo-Zamorano et al., 2019). In addition, (Chiang, 2017) also supports the results of this study that project-based flipped classroom learning is effective in learning.

The purpose of this study was to compare learning with the edmodo-based blended learning type flipped classroom model and the LMS-based blended learning model through students' critical thinking and problem solving skills.

II. Theory

2.1 Flipped Classroom learning Model

Flipped classroom is a learning model that presents the latest learning process by providing material online outside of the classroom and doing assignments in the classroom. Students are given learning videos and online presentations that can be accessed through the edmodo application. Learning videos are used as the main learning media of the flipped classroom learning model by posting videos to an online portal that are used as media by lecturers.

According to (Bergmann & Sams, 2012), the flipped classroom learning model is an active learning model that combines student activities, integrates various learning methods, and distributes learning resources on a procast basis (video, sound, images, and documents in the form of pdf, doc, etc.).

The flipped classroom learning model, delivering learning material, usually online outside of the classroom and turning learning activities that are usually done as homework, into learning activities in class. In the flipped classroom learning model, students watch the instructional videos or read ebooks sent through the Edmodo application at home to find their own concept of subject matter according to their respective speeds. When in class, students already have a concept about the material to be learned so that students are more ready to receive lessons and have more time to work on assignments, practice questions, projects, or discussions related to the material that has been delivered by the lecturer through the learning video or ebook.

According to (Bergmann & Sams, 2012), the steps as follows:

- a. The lecturer prepares and provides learning videos that will be watched and ebooks that students will study at home.
- b. Students watch videos and read ebooks and learn the instructions given by the lecturers through the videos and ebooks so that they are familiar with the concepts and materials that will be given at the next meeting.
- c. Lecturers and students have a brief discussion about the videos and ebooks that have been studied.
- d. Lecturers provide class assignments, discussions, or tests as is usually done in the traditional model.
- e. Lecturers act as tutors so that effective interactive communication is established.

2.2 Edmodo

The use of technology is an important feature of the blended learning typeflipped classroom learning model, the application used is Edmodo. The delivery of edmodo material can be *synchronous* or *asynchronous*.

Edmodo is a social network school based environment developed by Nicolas Borg and Jeff O'Hara, with features that support the teaching and learning process. Edmodo can be accessed freely at www.edmodo.com by lecturers, students, and parents.

According to (Basori, 2013), edmodo is one of free open source that tries to keep pace with the development of Facebook. It's just the difference that edmodo is more used in the world of education. So that the existing features support integrated learning management.

In the *edmodo* application, both students and lecturers are required to register and have a login account to make it easier to check the identity of using the application. In general, users who want to enter the system must have a login account first by entering their username and password.

For lecturer level users, first must create an account by visiting www.edmodo.com and then selecting the "I'm a Teacher" button to create a new account as a teacher. After that, create a class with the Group feature that can only be accessed via a certain Group Code. Group Code is unique and generated automatically by edmodo. Group Code is like a password to participate in class. The lecturer manually informs the Group Code to students before attending class.

According to (Basori, 2013), edmodo features are adjusted according to learning needs. Edmodo classifies its features based on users, namely lecturers and students. Below are the features available in edmodo:

1. *Assignment*

Assignments are used by lecturers to provide assignments to students online. This feature is equipped with a deadline time and an attach file feature so that students can send assignments in the form of files directly to the lecturer. In addition, there is also a "Turn in" button for the assignment which indicates that the student has completed the assignment.

2. *File and Links*

In this feature, lecturers and students can send messages by attaching files and links to class groups, students or other lecturers. The attached file applies to all types of extensions such as doc, pdf, ppt, xls, etc.

3. *Quiz*

Quizzes are used to provide online evaluations in the form of multiple choice, short entries, and description questions. Quiz can only be made by lecturers, while students only do it. This feature is equipped with a processing time limit, information about the quiz to be made, the title of the quiz, and the display of the quiz.

4. *Polling*

Polls can only be made by lecturers to be distributed to students. Usually lecturers use polls to find out student responses regarding certain matters relating to the lesson.

5. *Gradebook*

The gradebook feature is used to record student grades. Grading can be done by the lecturer and can be filled in manually or automatically. Automatic value filling can only be done based on the score assignment and quiz results. The gradebook can be exported as csv file.

6. *Library*

This feature is used as a storage area for various learning resources with various contents. With the library feature, lecturers can upload teaching materials, materials, presentations, reference sources, images, video, audio, and other digital content. Links and files contained in the library can be shared with both students and groups. Students can also add content shared by lecturers to the library.

7. *Award Badges*

This feature is used to give an award to both students and groups. The award can be determined by the lecturer himself so that it does not hinder the creativity of the lecturer in giving awards.

2.3 Critical Thinking

Thinking is the ability to analyze, criticize, and reach conclusions based on inference and good judgment. According to (Mazano, 2005), the importance of learning framework to think for someone, namely: 1) thinking is needed to develop attitudes and perceptions that support the creation of positive classroom conditions, 2) thinking is necessary to acquire and integrate knowledge, 3) it is necessary to broaden knowledge insights , 4) it is necessary to actualize the meaningfulness of knowledge, 5) it is necessary to develop beneficial thinking behavior.

Critical thinking is skillfull and active interpretation and evaluation of observation and communication, information and argumentation (Fisher, 2014). Critical thinking is defined as an evaluation because it is the process of determining the benefit, quality, price or value of something and critical thinking generally deals with evaluating the truth, probability or reliability of claims.

The definition of critical thinking was put forward by Edward Glaser (Fisher, 2014), one of the writer of the Watson-Glaser Critical Thinking Appraisal (the test of critical thinking skills most widely used in the world). Glaser defines critical thinking as follows: 1) An attitude of wanting to think deeply about problems and things that are within the reach of one's experience. 2) Knowledge of logical methods of examination and reasoning. 3) A skill to apply these methods. Critical thinking requires striving to examine each belief or assumptive knowledge based on the supporting evidence and the following conclusions that result.

Table 1.Critical Thinking Ability Indicator

Variable	Indicator	Descriptor
Critical Thinking	1. Interpretation	<ul style="list-style-type: none"> • Classifying facts or conclusions or logical statements. • Become meaningful. • Clear meaning.
	2. Analysis	<ul style="list-style-type: none"> • Test idea. • Recognize arguments. • Identify reasons and statements.
	3. Evaluation	<ul style="list-style-type: none"> • Distinguish between strong arguments and relevant. • Assess the quality of arguments made on inductive and deductive consideration.
	4. Inference	<ul style="list-style-type: none"> • Assess the quality of the question. • Draw a conclusion.
	5. Explanation	<ul style="list-style-type: none"> • Declare the result. • Support the procedure. • Present arguments.
	6. Self-Regulation	<ul style="list-style-type: none"> • Self – monitoring. • Self improvement.

(Adaptation from Facione, 2013)

2.4 Problem Based Learning

According to (Oemar, 2014) problem solving ability is a thought process as an effort to find problems and solve these problems based on information that has been collected from various sources, so that the right conclusions can be drawn.

According to (Polya, 2014) problem-solving ability is an attempt to find a way out of all difficulties in order to achieve a goal of all difficulties that it can be achieved as soon as possible. With the ability to solve the problem, students will be able to manage real life situations.

Problem solving ability is the ability to find answers in solving problems to achieve goals to be achieved. Students' problem solving abilities need to be trained a lot in order to solve the problems they are facing. Problem solving ability is a cognitive understanding of analyzing and explaining all ideas, information with the thought processes that a person has when solving a problem.

According to (Polya, 2014) explains in How to Solve It, in outline, four main steps in problem solving, namely: Understanding the problem, Devising a plan, Carrying out the plan, and Looking back.

Table 2. Problem Solving Ability Indicators

Variable	Indicators	Descriptor
Problem Solving	1. Understand the problem	Students are able to write down or mention the information provided from the questions asked.
	2. Planning the solving	Students have a problem-solving plan by choosing a method or a strategy to solve problem that given.
	3. Doing solving plan	Students are able to solve problems with the strategies used with the correct results.
	4. Check back solving	Students are able to check the correctness of the results or answers.

Source: Polya (1973)

III. Literature Review

Table 3. Literature Review

No	Title	Variable	Methods	Results
1	<i>A brainstorming flipped classroom approach for improving students' learning performance, motivation, teacher-student interaction and creativity in a civics education class, (Tsai et al., 2020)</i>	Brainstorming flipped classroom, direct teaching instruction, learning achievement, learning motivation, attitude participation, C-RAT, teacher-student interaction, interaction between peers	ANCOVA	Learning achievement (not sig.), learning motivation (sig.), attitude participation (sig.), C-RAT (sig), teacher-student interaction (sig.), interaction between peers (sig.)
2	<i>Investigating cognitive holding power and equity in the flipped classroom, (Ahmed & Indurkhya, 2020)</i>	Flipped classroom, student cognitive, enhancing equity	t-test	Student cognitive (sig.), enhancing equity (sig)
3	<i>Effects of digital flipped classroom teaching method integrated cooperative learning model on learning motivation and outcome, (Jian, 2019)</i>	Flipped classroom, cooperative learning, learning motivation, learning outcome	MANOVA	Flipped classroom (sig.), cooperative learning (sig.), learning motivation (sig), learning outcome (sig.)
4	<i>Undergraduate nursing</i>	Flipped classroom,	Paired sample	Teaching presence

	<i>students' experience of learning respiratory system assessment using flipped classroom: A mixed methods study, (Choi et al., 2020)</i>	teaching presence, social presence, cognitive presence	t-test	(sig.), social presence (sig.), cognitive presence (sig.)
5	<i>Flipping the Managerial Accounting Principles Course: Effects on Student Performance, Evaluation, and Attendance, (Downen & Hyde, 2016)</i>	Flipped classroom, traditional classrom, higher grade performance, rate the course and the instructor, class attendance	Regression	Higher grade performance (sig.), rate the course and the instructor (sig.), class attendance (sig.)
6	<i>Use of a flipped classroom in ophthalmology courses fornursing, dental and medical students: A quasi-experimental study using amixed-methods approach, (Zhu et al., 2020)</i>	Flipped classroom and traditional learning classroom, Self-rated learning ability, skill exam	Independent sample T-test	Self-rated learning ability (sig.), skill exam (sig.)
7	<i>Impacts of a flipped classroom with a smart learning diagnosis system on students' learning performance, perception, and problem solving ability in a software engineering course, (Lin, 2019)</i>	Flipped classroom and traditional learning classroom, student's learning achievement, learning motivation, learning attitude	t-test, ANCOVA, MANCOVA	Flipped classroom (sig.) > student's learning achievement, learning motivation, learning attitude
8	<i>The Effect of Using Flipped Classroom Strategy on the Academic Achievement of Fourth Grade Students in Jordan, (Elian & Hamaidi, 2018)</i>	Teaching strategy, educational achievement, gender	ANCOVA	Teaching strategy (sig.) on educational achievement, educational achievement (not sig.) on gender
9	<i>How the flipped classroom affects knowledge, skills, and engagement in higher education: Effects on students' satisfaction, (Murillo-Zamorano et al., 2019)</i>	Flipped classroom, knowledge, skills, engagement, satisfaction	Partial least squares	Knowledge (sig.), skills (sig.), engagement (not. Sig.), satisfaction (sig.)
10	<i>Comparing the effects of individual versus group face-to-face class activities in flipped classroom on student's test performances, (Rawas et al., 2020)</i>	Individual flipped classroom, group face to face flipped classroom, foundation knowledge (sig), application (not. Sig.), integration (sig.), human dimension (sig), E:caring (sig.), learning to learn (not. sig)	Independent sample t-test, ANOVA	foundation knowledge (sig), application (not. Sig.), integration (sig.), human dimension (sig), E:caring (sig.), learning to learn (not. sig)
11	<i>The Impact Of Flipped-Classroom In Mba's Evaluation, (Scafuto et al., 2017)</i>	Classroom activities, prior exposure, evaluation of the service, quality of the service	Regression	evaluation of the service (sig.), quality of the service (sig.)
12	<i>A comparison between flipped</i>	Flipped, lecture based	t-test	There was no

	<i>and lecture-based instruction in the calculus classroom,</i> (Scott et al., 2016)	instruction, attended, spent, watched, read, agreed, class increased interest		statistically significant
13	<i>The flipped classroom: A meta-analysis of effects on student performance across disciplines and education levels,</i> (Strelan et al., 2020)	Flipped classroom, student performance across disciplines, education levels	Meta-analysis	Flipped classroom (sig.) > student performance across disciplines, education levels
14	<i>Using cluster analysis to explore the engagement with a flipped classroom of native and non-native English-speaking management students,</i> (Walsh & Rísquez, 2020)	Flipped classroom, access the flipped materials, native and non-native english speakers, gender and language profile	Analisis cluster	Flipped materials (sig.), native and non-native english speakers (sig.), gender and language profile (sig.)
15	<i>On the relationships between behaviors and achievement in technology-mediated flipped classrooms: A two-phase online behavioral PLS-SEM model,</i> (Wang, 2019)	Problem solving class, achievement, behavioral engagement, self assessment	PLS SEM Model	Problem solving class (sig.), achievement (sig.), behavioral engagement (sig), self assessment (sig.),

IV. METHOD

This research uses a quantitative approach and based on its classification this type of research is included in the type of experimental research. This research uses experimental research with a quasi experiment research type. In a quasi experiment type research, by dividing the research group in non-random. According to (Sugiyono, 2009), This type of quasi experiment research has a control group but it cannot fully function to control external variables that affect the implementation of the experiment.

The variables in this research consist of independent variables and dependent variables. The explanation for each variable is as follows:

1. Independent Variable

According to (Sugiyono, 2009), independent variables are variables that affect or cause changes or the emergence of the dependent variable. The independent variable is a state of treatment or a controlled variable (Turmudi & Hartini, 2008). The independent variable in this study is the edmodo-based blended learning typeflipped class learning model.

2. Dependent Variable

The dependent variable is the variable that is affected or that is the result of the independent variable (Sugiyono, 2009). While according to Janah (2016:34), the dependent variable is a variable that is measured in an experiment to see if there is a change after the independent variable is given. The dependent variable in this study is the ability to think critically and solve problems.

The conceptual relationship between variables in this research is shown in the following figure:

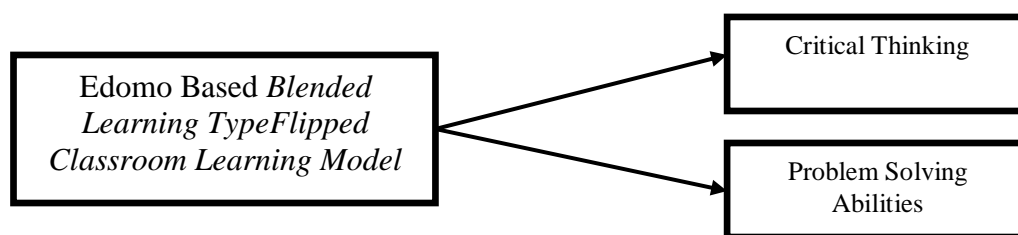


Figure1. Relationship between Variables in Research

In this research, the independent variable (X) is the edmodo-based blended learning type flipped class learning model (X1). While the dependent variable (Y) is critical thinking (Y1) and problem solving ability (Y2). The following is the operational definition of each variable:

1. The edmodo-based blended learning type learning model (X1) is a learning model that presents the latest learning process by providing material online outside of the classroom and doing assignments in the classroom. In the flipped classroom learning model, students watch instructional videos or read ebooks sent through the Edmodo application at home to find their own concept of subject matter according to their respective speeds. When in class, students already have a concept about the material to be studied so that students are more ready to receive lessons and have more time to work on assignments, practice questions, projects, or discussions related to material that has been delivered by the lecturer through the learning video or ebook. The learning model for flipped classroom is simply divided into 5 (five) stages, namely before class, beginning of class, during class, after class, and official hour.
2. Critical thinking (Y1), is an intellectual ability to conceptualize, apply, analyze, synthesize, and evaluate what is obtained from the results of observation, experience, reflection, where the results of this process then decide and implement it can be defined that critical thinking has two steps, namely: 1) do reasoning, 2) make decisions or problem solving quickly.
3. Problem solving ability (Y2), is the ability to find answers in solving problems to achieve the goals to be achieved. Students' problem solving abilities need to be trained a lot in order to solve the problems they are facing. Problem solving ability is a cognitive understanding of analyzing and explaining all ideas, information with the thought processes that a person has when solving a problem.

The research sample was taken from students of Islamic Education (PAI) semester III Muhammadiyah University of Surabaya, there are 2 classes and semester III students of Muhammadiyah University of Sidoarjo there are 2 classes. The research sample was taken from students who were normally distributed, had the same characteristics (homogeneous), and had the same average value. Then two groups (classes) of students were taken as samples, namely the experimental group and the control group. The details of the sample in this study are as follows.

Table 4. Research Sample

University Name	Amount
Students of PAI Unmuh Sby Class III/A	32 students
Students of PAI Unmuh Sby Class III/B	28 students
Students of PAI Umsida Class III/A	30 students
Students of PAI Umsida Class III/B	30 students

The data analysis technique used to determine the effect of the blended learning type flipped classroom learning model on students' critical thinking and problem solving skills is the Multivariate

Analysis of Variance (MANOVA) statistical analysis technique which includes the multivariate test, test of between subjects effects, and graphs of the interaction between independent and dependent variables. Multivariate Analysis of Variance (MANOVA) is used when the number of dependent variables is more than one (Ghozali, 2013). This statistical analysis technique is also used to explain the interaction between variables. MANOVA is a statistical technique that can be used simultaneously to explore the relationship between several categories of independent variables (usually treatment) and two or more dependent variables. MANOVA is used when designing experimental situations (manipulation of multiple nonmetric treatment variables) t-test hypothesis regarding variance in the response of two groups or more dependent variables (Sofyan & Heri, 2009). Meanwhile, according to (Dencik et al., 2019), if there are two groups of independent variables and two or more dependent variables, the multivariate analysis tool used is *Hotelling's T²* and in conditions there are two or more, both independent and dependent variables used is manova. The criteria for decision making are there and the absence of influence between the independent variable and the dependent variable is based on a significance level of 5% or $\alpha = 0.05$.

V. RESULTS AND DISCUSSION

5.1. Results

Based on the results of statistical tests, the results will be explained in the following sub-chapters.

1) Varian Homogeneity Test

The variance homogeneity test can be seen from the Levene test results, are shown as follow.

Levene's Test of Equality of Error Variances^a

	F	df1	df2	Sig.
Critical thinking (Y1)	.038	1	58	.846
Problem solving (Y2)	.012	1	58	.912

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Model_Learning_X

The results of the Levene test show that the significance value of the calculation of the dependent variable "Critical thinking (Y1)" indicates that 0.846 is greater than 0.05, while the number for the dependent variable "Problem solving (Y2)" 0.912 is also greater than 0.05. Thus H0 is rejected and H1 is accepted. That is, both Y1 and Y2 have homogeneous variants.

2) Homogeneity Test of Variance / Covariance

MANOVA requires that the variance / covariance matrix of the dependent variable is the same. The variance / covariance matrix homogeneity test is seen from the box test results.

Box's Test of Equality of Covariance

Matrices^a

Box's M	.434
F	.139
df1	3
df2	605520.000
Sig.	.937

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + Model_Learning_X

Based on the table above, the significance value of the calculation results shows that $0.937 > 0.05$ so that H_0 is accepted. That is, the variance / covariance matrix of the dependent variable is the same, so that the MANOVA analysis can be continued.

3) Manova Test

After the two hypothesis requirements were met, it was continued with the MANOVA hypothesis test. The MANOVA test was used to test whether there were differences in several dependent variables between different groups. In this research, there is a distinction between critical thinking skills and problem-solving abilities for students who are taught using the Edmodo –based blended learning type flipped classroom learning model and the LMS-based blended learning model. The MANOVA test results are as follows.

Multivariate Tests^a

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.997	11074.025 ^b	2.000	57.000	.000
	Wilks' Lambda	.003	11074.025 ^b	2.000	57.000	.000
	Hotelling's Trace	388.562	11074.025 ^b	2.000	57.000	.000
	Roy's Largest Root	388.562	11074.025 ^b	2.000	57.000	.000
Model_Learning_X	Pillai's Trace	.503	28.885 ^b	2.000	57.000	.000
	Wilks' Lambda	.497	28.885 ^b	2.000	57.000	.000
	Hotelling's Trace	1.014	28.885 ^b	2.000	57.000	.000
	Roy's Largest Root	1.014	28.885 ^b	2.000	57.000	.000

a. Design: Intercept + Model_Learning_X

b. Exact statistic

If we look at the line where there is a “learning model” independent variable, the significance figures for the test results based on Pillai's trace, Wilks' lambda, Hotelling's trace, and Roy's largest root show 0,000. Figures $0.000 < 0.05$ so that H_0 is rejected and H_1 is accepted. That is, there are differences in critical thinking skills and problem-solving abilities between the blended learning model type flipped classroom based on education and the LMS-based blended learning model. Furthermore, the test of between-subjects effects, namely the MANOVA analysis of differences individually or for each variable depending on “critical thinking skills” and “problem solving abilities”.

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Critical Thinking (Y1)	.017 ^a	1	.017	.014	.905
	Problem Solving (Y2)	64.067 ^b	1	64.067	58.672	.000
Intercept	Critical Thinking (Y1)	7020.017	1	7020.017	6080.054	.000

	Problem Solving (Y2)	19224.600	1	19224.600	17605.686	.000
Model_Learning_X	Critical Thinking (Y1)	.017	1	.017	.014	.005
	Problem Solving (Y2)	64.067	1	64.067	58.672	.000
Error	Critical Thinking (Y1)	66.967	58	1.155		
	Problem Solving (Y2)	63.333	58	1.092		
Total	Critical Thinking (Y1)	7087.000	60			
	Problem Solving (Y2)	19352.000	60			
Corrected Total	Critical Thinking (Y1)	66.983	59			
	Pemecahan Masalah (Y2)	127.400	59			

a. R Squared = .000 (Adjusted R Squared = -.017)

b. R Squared = .503 (Adjusted R Squared = .494)

Based on the Test of Between-Subjects Effects table, it shows that:

- 1) The relationship between the Learning Model (X) with critical thinking skills (Y1) has a significance level (sig. Y1) $0.005 < 0.05$. This shows that there are differences in critical thinking skills caused by different learning models.
- 2) The relationship between the Learning Model (X) and the problem solving ability (Y2) has a significance level (sig. Y2) $0.000 < 0.05$. This shows that there are differences in problem-solving abilities caused by different learning models.

5.2. Discussion

Based on the results of hypothesis testing, there are significant differences in critical thinking skills and problem-solving abilities between the experimental classes taught using the Edmodo based blended learning type flipped classroom- learning model and the control class taught with the LMS-based blended learning model. The results of this study are in line with the research that has been conducted by (Jian, 2019), (Lin, 2019) and (Chis et al., 2018).

The flipped classroom learning model is the most widely known learning model. Flipped classroom starts with student learning that is carried out online outside of the classroom or at home with content that has been previously provided. After carrying out the online learning process outside of school students then deepen and practice solving problems at school with their teachers or peers. Thus, it can be considered that the role of traditional learning in the classroom is “reversed”. But basically this learning still maintains the traditional learning format but is carried out in a new context.

One of the type applications of online learning is web-based learning that can be accessed via the internet network. One technology-based website is edmodo. Edmodo, which is a social network that connects teachers / lecturers and institutions, and shares learning content around the world that is online (using internet access). It can even connect to student / student guardians.

Edmodo has several learning benefits, including:

- 1) Edmodo has a means of efficient communication and discussion for lecturers and students
- 2) As an appropriate tool for exams, polls, and quizzes
- 3) The teacher / lecturer can provide material in the form of questions, photos, slides, and learning videos
- 4) Students can access learning materials anywhere and anytime
- 5) Edmodo quizzes can be set to date and time, so that students pay attention to the quiz grace period

6) The assessment can be shared and can be seen by students in online distance learning activities, students will be more free or free to express their opinions or ask questions because no other student is physically observing them. Online discussion through edmodo gives students freedom of opinion. Students appear to be free in asking questions and having opinions using their everyday language.

VI. Conclusion

Based on the results of data analysis, it can be concluded:

- 1) There are differences in critical thinking skills due to differences in the learning of edmodo-based blended learning typeflipped classroom model and the control class which is taught using the LMS-based blended learning model.
- 2) There are differences in problem-solving abilities caused by differences in the edmodo-based blended learning typeflipped classroom model and the control class which is taught using the LMS-based blended learning model.

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